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APPLICATION NO. 09/662438	CONT/PRIOR D	CLASS 073	SUBCLASS 504.120	ART UNIT 2856	EXAMINER Kwok
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APPLICANTS

Hiram McCall
Ching-Fang Lin

TITLE

Microelectromechanical system for measuring angular rate

PTO-2040
12/99

ISSUING CLASSIFICATION									
ORIGINAL			CROSS REFERENCE(S)						
CLASS		SUBCLASS	CLASS	SUBCLASS (ONE SUBCLASS PER BLOCK)					
73		504.12	73	488					
INTERNATIONAL CLASSIFICATION			702	147					
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☒ TERMINAL DISCLAIMER	DRAWINGS Sheets Drwg. <u>6</u> Figs. Drwg. <u>7</u> Print Fig. <u>6</u>			CLAIMS ALLOWED Total Claims <u>16</u> Print Claim for O.G. <u>1</u>	
	☐ The term of this patent subsequent to _____ (date) has been disclaimed.			NOTICE OF ALLOWANCE MAILED <u>9/16/02</u>	
☒ The term of this patent shall not extend beyond the expiration date of U.S. Patent. No. <u>6,311,555</u>	HELEN KWOK PRIMARY EXAMINER <u>Helen Kwok</u> <u>9-6-02</u> (Primary Examiner) (Date)			ISSUE FEE Amount Due <u>640</u> Date Paid <u>11-21-02</u>	
	☐ The terminal _____ months of this patent have been disclaimed.			ISSUE BATCH NUMBER <u>Theresa Khan</u> <u>9/17/02</u> (Legal Instruments Examiner) (Date)	

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Page 001

PATENT APPLICATION



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09/662438



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CONTENTS

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SERIAL NUMBER 09/662,438	FILING DATE 09/15/2000 RULE	CLASS 073	GROUP ART UNIT 2856	ATTORNEY DOCKET NO. USP9952A-GNC
APPLICANTS Hiram McCall, Simi Valley, CA; Ching-Fang Lin, Simi Valley, CA;				
** CONTINUING DATA ***** THIS APPLN CLAIMS BENEFIT OF 60/154,700 09/16/1999				
** FOREIGN APPLICATIONS *****				
** SMALL ENTITY **				
Foreign Priority claimed ☐ yes ☒ no 35 USC 119 (a-d) conditions met ☐ yes ☒ no ☐ Met after Allowance Verified and Acknowledged	STATE OR COUNTRY CA	SHEETS DRAWING 6	TOTAL CLAIMS 14	INDEPENDENT CLAIMS 1
ADDRESS Raymond Y C Chen 1050 Oakdale Ave Arcadia, CA 91006-2222				
TITLE Microelectromechanical system for measuring angular rate				
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In the United States Patent and Trademark Office

Mailed September 15, 2000

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Washington, District of Columbia 20231

Sir:

Please file the following enclosed patent application papers:

Applicant #1, Name: Hiram McCall

Applicant #2, Name: Ching-Fang Lin

Title: MicroElectroMechanical System for Measuring Angular Rate

☒ Specification, Claims, and Abstract: Nr. Of Sheets 38

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☒ Small Entity Declaration Of Inventor(s)

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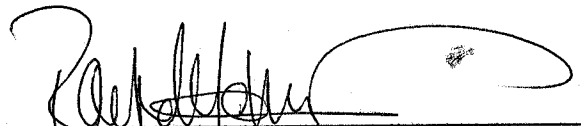
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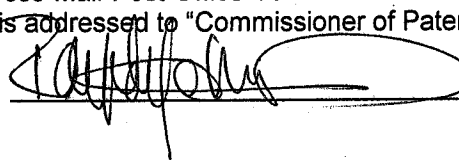
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Title

MicroElectroMechanical System for Measuring Angular Rate

Cross Reference of Related Application

This is a regular application of a provisional application having an application
5 number of 60/154,700, filed on September 16, 1999.

Background of the Present Invention

Field of the Present Invention

The present invention relates to a microelectromechanical system (MEMS), more particularly, relates to a microelectromechanical system (MEMS) to measure angular rate
10 of a carrier. The system of the present invention includes an angular rate sensor unit, microelectronic circuitry, and signal processing to obtain a highly accurate, sensitive, stable angular rate measurement of the carrier under dynamic environments.

Description of Related Arts

An angular rate measurement can be obtained by employing a conventional gyro.
15 Many types of approaches based on various sensing principles used to achieve an angular rate sensor have been invented in the past decades, are currently being invented, and will continue to be invented as the market for angular rate sensors continues to expand. For

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example, conventional spinning mass gyros are based principally on the Law of the Gyroscope. Existing ring laser gyros and Interferometric Fiber-Optic Gyros are dependant on the Sagnac Effects.

Conventional angular rate sensors have been commonly used in a wide variety of applications. However, their cost, size, and power prohibits their use in emerging commercial applications.

"MEMS" stands for "MicroElectroMechanical Systems", or small electrical/mechanical devices. MEMS devices involve creating controllable mechanical and movable structures using IC (Integrated Circuit) technologies. MEMS include the concepts of Microelectronics and Micromachining. Example MEMS devices include inkjet-printer cartridges, accelerometers that deploy car airbags, and miniature robots.

Microelectronics, the development of electronic circuitry on silicon chips, is a very well developed technology. Micromachining utilizes process technology developed by the integrated circuit industry to fabricate tiny sensors and actuators on silicon chips. In addition to shrinking the sensor size by several orders of magnitude, integrated electronics can be added to the same chip, creating an entire system on a chip. This instrument will result in, not only the redesign of conventional military products, but also new commercial applications that could not have existed without small, inexpensive inertial sensors.

Various MEMS angular rate sensor approaches have been developed to meet the need for inexpensive yet reliable angular rate sensors in fields ranging from

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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. The inherent symmetry of the circular design allows angular rate measurement about two axes simultaneously.

However, it is still very challenging work to design and manufacture a MEMS angular rate sensor with high accuracy, keen sensitivity, wide dynamic range, and high stability.

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Summary of the Present Invention

A main objective of the present invention is to provide a system to measure angular rate, wherein the angular rate sensor unit, microelectronic circuitry, and signal processing are fabricated into one silicon chip with the combination of surface micromachining layers of polysilicon and Integrated circuitry (IC) technology to obtain highly accurate, sensitive, stable angular rate measurements under dynamic environments.

Compared with existing MEMS angular rate sensors, the MEMS angular rate sensor of the present invention has several unique features that are described as follows:

1. Hinge to minimize number of resonance modes.
2. Mass distribution for resonance mode linearity.
3. Resonance mode locking circuitry.
4. Displacement regulation for scale factor stability.
5. Temperature stabilization for scale factor and bias stability.
6. Low mechanical damping through moderate vacuum.
7. Pickoff circuitry to minimize bias and scale factor shift.
8. The same driver comb used for both excitation and dither pickoff.

9. Closed loop design for scale factor linearity.

Another objective of the present invention is to provide a microelectromechanical system to measure angular rate. The present invention enables the core micro IMU, which has the following unique features:

5 (1) Attitude Heading Reference System (AHRS) Capable Core Sensor Module.

(2) Miniaturized (Length/Width/Height) and Light Weight.

(3) High Performance and Low Cost.

(4) Low Power Dissipation.

(5) Dramatic Improvement In Reliability (microelectromechanical systems -MEMS).

10 Another objective of the present invention is to provide a microelectromechanical system to measure angular rate. The present invention enables the core micro IMU to be incorporated into an integrated micro land navigator, which has the following unique features:

(1) Miniature, light weight, low power, low cost.

15 (2) AHRS, odometer, integrated GPS chipset and flux valve.

(3) Integration filter for sensor data fusion and zero velocity updating.

- (4) Typical applications: automobiles, railway vehicles, miniature land vehicles, robots, unmanned ground vehicles, personal navigators, and military land vehicles.

Another objective of the present invention is to provide a
5 microelectromechanical system to measure angular rate. The present invention enables the core micro IMU to function as aircraft inertial avionics, which has the following unique features:

(1) Rate Gyro

(2) Vertical Gyro

10 (3) Directional Gyro

(4) AHRS

(5) IMU

(6) Inertial Navigation System

(7) Fully-Coupled GPS/MEMS IMU Integrated System

15 (8) Fully-Coupled GPS/IMU/Radar Altimeter Integrated System

(9) Universal vehicle navigation and control box.

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Another objective of the present invention is to provide a microelectromechanical system to measure angular rate. The present invention enables the core micro IMU to be a Spaceborne MEMS IMU Attitude Determination System and a Spaceborne Fully-Coupled GPS/MEMS IMU Integrated system for orbit determination, attitude control, payload pointing, and formation flight, which has the following unique features:

- (1) Shock resistant and vibration tolerant
- (2) High anti-jamming
- (3) High dynamic performance
- (4) Broad operating range of temperatures
- (5) High resolution
- (6) Compact, low power and light weight unit
- (7) Flexible hardware and software architecture

Another objective of the present invention is to provide a microelectromechanical system to measure angular rate. The present invention enables the core micro IMU to be a marine INS with embedded GPS, which has the following unique features:

- (1) Micro MEMS IMU AHRS with Embedded GPS

(2) Built-in CDU (Control Display Unit)

(3) Optional DGPS (Differential GPS)

(4) Flexible Hardware and Software System Architecture

(5) Low Cost, Light Weight, High Reliability

5 Another objective of the present invention is to provide a microelectromechanical system to measure angular rate. The present invention enables the core micro IMU to be used in a micro pointing and stabilization mechanism, which has the following unique features:

(1) Micro MEMS IMU AHRS utilized for platform stabilization.

10 (2) MEMS IMU integrated with the electrical and mechanical design of the pointing and stabilization mechanism.

(3) Vehicle motion, vibration, and other interference cancelled by a stabilized platform.

(4) Variable pointing angle for tracker implementations.

15 (5) Micro MEMS IMU utilized for a micro fire control system for sniper rifles.

Typical applications: miniature antenna pointing and tracking control, laser beam pointing for optical communications, telescopic pointing for imaging, airborne laser pointing control for targeting, vehicle control and guidance.

The present invention can be used as a motion measurement device for both
5 commercial and military systems requiring phased array antenna systems for communication on-the-move. Specific applications include pointing control systems for mobile satellite reception for truckers and radiotelephone and direct broadcast satellite reception. The development of a low cost attitude and heading reference system is critical to the wide deployment of these systems in the commercial arena.

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Brief Description of the Drawings

Figure 1 shows the functional structure of the present invention.

Figure 2 shows the configuration of a Micromachined sensor unit.

Figure 3 shows variable capacitive signal pick off point connection design.

5 Figure 4 shows a picture of the packaged MEMS angular rate sensor.

Figure 5 illustrates cross sectional view showing layers of the surface machined fabrication process of a MEMS.

Figure 6 shows the diagram of the central circuitry.

Figure 7 shows the diagram of the digital processing system

Detailed description of the Preferred Embodiment

The present invention will be described as it applies to its preferred embodiment. It is not intended that the present invention be limited to the described embodiment. It is intended that the invention cover all alternatives, modifications, and
5 equivalences which may be included within the spirit and scope of the invention.

The present invention relates to a microelectromechanical system (MEMS), more particularly, relates to a microelectromechanical system (MEMS) to measure angular rates of a carrier.

Referring to Figure 1, the system of the present invention includes an angular rate
10 sensor unit 10, a central circuitry 20, and a digital signal processing system 30, which are fabricated into one chip using the combination of surface micromachining layers of polysilicon and Integrated circuitry (IC) technology to obtain highly accurate, sensitive, stable angular rate measurements under dynamic environments. A
microelectromechanical system (MEMS) for measuring angular rates of a carrier of the
15 present invention comprises:

1. an angular rate sensor unit 10, for receiving a dither driver signals, capacitive pickoff excitation signals and displacement restoring signals to output angle rate signals in response to the motion of the carrier and dither motion signals;

2. a central circuitry 20, for receiving the angle rate signals in response to the motion of the carrier and dither motion signals to output angular rate signals and digital low frequency inertial element displacement signals;
3. a digital signal processing system 30, for analyzing digital low frequency inertial element displacement signals to feed back the dither drive signals to the angular rate sensor unit 10.

The angular rate sensor unit can be a micromachined sensor unit. In principle, the present invention may incorporate with MEMS technology that employs a dynamic theory, Coriolis effect. The Coriolis effect can be seen that when an angular rate is applied to a translating body and a Coriolis force is generated. Its principle of operation and construction rely on a tuning fork that uses closed-loop capacitive sensing.

The MEMS of the present invention measures angular rate by picking-off a signal generated by an oscillating micromachined mass as it deviates from its plane of oscillation under the Coriolis force effect when the oscillating micromachined mass is submitted to a rotation about an axis perpendicular to the plane of oscillation.

Referring to Figure 2, which illustrates the configuration of the micromachined sensor unit.

The micromachined sensor unit 10 consists of two vibration devices which have opposite dither motion directions. A pair of differential measurements are formed to eliminate the effect of the gravity and acceleration induced interference force. The proof

masses are suspended by eight beams which also provide the elastic force for the vibration at the same time. The beams are attached to the substrate by anchors at the middle of the beams.

Two vibrating proof masses are attached by springs to each other and to the surrounding stationary material. The vibrating (dither) proof masses are driven in opposite directions by electrostatic comb drive motors to maintain lateral in-plane oscillation. The dither motion is in the plane of the wafer. When an angular rate is applied to the MEMS device about the input axis (which is in the plane of the tines), the proof masses are caused to oscillate out of plane by a Coriolis force due to the Coriolis effect.

The resulting out-of-plane up and down oscillation motion amplitude, proportional to the input angular rate, is detected and measured by capacitive pickoff plates underneath the proof masses. The comb drives move the masses out of phase with respect to each other. The masses will then respond in opposite directions to the Coriolis force.

The circuitry detects this perpendicular motion by measuring the change in capacitance. The sensitivity of the device is dependent on the amplitude of the dither motion, the frequency of the oscillation, the mass of the device and the detection method. The sensitivity is proportional to the product of the velocity of the device and the angular rate. Maximizing the amplitude and frequency of oscillation increases the sensitivity. To increase the amplitude of oscillation, the device is run at the resonant frequency of the supporting springs. This minimizes the energy required to drive the device. If the resonant frequency is too high (stiff springs) the perpendicular motion of the device is

decreased. Typical resonant frequencies are 1000 –3000 Hz. Some error can occur in the device if the dither motion is not truly linear.

The change in capacitance caused by the motion of the mass in response to a Coriolis force is determined by measuring the current flow from a high frequency signal (100 kHz to 1 MHz). The capacitance is on the order of 0.5 pf with changes in capacitance on the order of 1 ff. In order to achieve the greatest sensitivity, the design of the present invention places the electronics as close as possible to the pickoff electrodes on the device. In the MEMS of the present invention, this is done by either integrating the electronics on the same wafer as the micromachined sensor unit or by placing the electronics as close as possible to the sensor package. On chip electronics can detect changes in motion on the order of angstroms.

Referring to Figure 2, the micromachined sensor unit 10 comprises:

1. two proof masses 101, which are attached with beam springs to eight anchor points 102 and driven by the three stators to oscillate to sense Coriolis force.
2. Eight anchor points 102, which are scattered both sides of the two proof masses and connected with the silicon substrate and to support the two proof masses through beam strings.
3. A large anchor pad 103, which is connected with the silicon substrate and is connected with the four anchor points 102 through beam strings to improve and stabilize the oscillation of the two proof masses.

4. Two small anchor pads 104, which are connected with the silicon substrate and are connected with the four anchor points 102 through beam strings to improve and stabilize the oscillation of the two proof masses 101.

5. Three stators 105, which are connected with the silicon substrate and drive the two proof masses 101 through the comb drives 106.

When an angular rate is applied about the angular rate input axis of the micromachined sensor unit, the changed-capacitive signal can be sensed.

Referring to Figure 3, a total of six capacitors are formed by the micromachined sensor unit structure. Among them four capacitors are formed by the two proof masses and three stators to construct four pair of drive combs for the vibration drive mechanism. Two capacitors are formed by two pair of proof masses and sensor electrodes. When there is an angular rate in the gyro input axis, one proof mass will move towards its electrode and the other moves away from its electrode under the Coriolis force. Thus the two sensor capacitors can be used to form a differential measurement circuit.

Two techniques are presently employed to fabricate MEMS devices; bulk micromachining and surface micromachining. The preferred MEMS fabrication of the present patent is the surface micromachining process. Surface micromachined devices are typically a few microns to 10 microns thick. Angular rate sensors created with surface machining have very low masses. The advantage of surface machining is the low cost and the ease of incorporating the electronics close to the sensor.

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In surface micromachining, the sensor element is built onto the surface of a silicon wafer. To build a surface micromachined sensor, a few μm thick layer of sacrificial oxide is deposited on the passivation layer of a silicon wafer, in which n^+ wells have been previously diffused. Openings are then etched through both insulators to the diffused areas in the substrate. A thick layer of polysilicon is subsequently deposited over the entire sensor area, filling the openings and establishing both a mechanical and electrical bond with the n^+ diffused areas. The sensing elements are then etched into the layer of "floating" polysilicon. The sacrificial oxide is subsequently removed from under the polysilicon through further etching, leaving the polysilicon layer essentially suspended in mid-air, yet still attached to the substrate via the anchor posts, or pedestals, formed at the points of diffusion.

Surface micromachining starts with a wafer of material. In surface micromachining the wafer is the substrate --- the working surface --- on which multiple, alternating layers of structural and sacrificial material are deposited and etched. A typical cycle in a surface micromachining process begins with a deposition of either the sacrificial material, a material which will be completely removed in the final step of the fabrication process, or structural material, a material from which the functional components of the MEMS will be constructed. The layer is then masked with a desired pattern which is typically transferred using a photolithographic process, usually the exposure of a photosensitive material and development of the exposed photoresist. Next, the underlying material, not protected by the masking pattern, is etched, typically by reactive ion etching to transfer the mask pattern to that particular material layer. The deposition-masking-etching cycle is repeated on all laminated layers of structural and

sacrificial materials until the MEMS angular rate sensor is complete. The final step in surface micromachining is the release of the structural material from the laminations by etching or removing the underlying and surrounding sacrificial materials.

The most commonly used surface micromachining processes start with silicon wafers of the same grade and type used in microelectronics fabrication and uses layers of silicon dioxide as the sacrificial material and layers of polysilicon, a deposited, less crystalline form of silicon, as the structural material. Other deposited materials such as silicon nitride, polyimides, and aluminum are also used to provide electrically insulating materials, conducting materials, etchant masks, and additional structural materials. All of these materials are extensively used and available in standard microelectronics fabrication.

Because of the laminated structural and sacrificial material layers and the etching of material done by a process that is insensitive to crystalline structure, either because of the etch or because the material itself is non-crystalline, surface micromachining enables the fabrication of free form, complex, and multi-component integrated MEMS structures, liberating the MEMS designer to envision and build devices and systems that are impossible to realize with bulk process. Surface micromachining also frees the process developer and device designer to choose any material system that has complementary structural and sacrificial materials. It is this freedom to fabricate devices and systems without constraints on materials, geometry, assembly and interconnections that is the source for the richness and depth of MEMS applications that cut across so many areas.

from most customized surface micromachining processes in that it is designed to be as general as possible, and to be capable of supporting many different designs on a single silicon wafer. Since the process was not optimized with the purpose of fabricating any one specific device, the thickness of the structural and sacrificial layers were chosen to
5 suit most users, and the layout design rules were chosen conservatively to guarantee the highest yield possible.

Referring to Figure 6, the central circuitry 20 comprises a dither motion control circuitry 21 and an angle signal loop circuitry 22.

Referring to Figure 6, the dither motion control circuitry 21 comprises:

10 a trans impedance amplifier circuit 211, connected to the angular rate sensor unit 10, for changing an output impedance of the dither motion signals from a very high level, greater than 100 million ohms, to a low level, less than 100 ohms to achieve two dither displacement signals which are A/C voltage signals representing the displacement between the inertial elements and the anchor combs ;

15 a first amplifier and summer circuit 212, connected to the trans impedance amplifier circuit 211, for more than ten times amplifying the two dither displacement signals and enhancing the sensitivity for combining the two dither displacement signals to achieve a dither displacement differential signal by subtracting a center anchor comb signal with side anchor comb signals;

a first high-pass filter circuit 213, connected to the first amplifier and summer circuit 211, for removing residual dither drive signals and noise from the dither displacement differential signal to a filtered dither displacement differential signal;

5 a demodulator circuit 214, connected to the high-pass filter circuit 213, for receiving the capacitive pickoff excitation signals as phase reference signals from an oscillator and the filter dither displacement differential signal from the first high-pass filter, and extracting the in-phase portion of the filtered dither displacement differential signal to produce an inertial element displacement signal with known phase;

10 a first low-pass filter 215, connected to the demodulator circuit 214, for removing high frequency noise from the inertial element displacement signal input to form a low frequency inertial element displacement signal with bandwidth less than 3000 Hz;

an amplifier 216, connected with the first low-pass filter 215, for amplifying the filtered low frequency inertial element displacement signal;

15 an analog/digital converter 217, connected to amplifier 216, for converting the low frequency inertial element displacement signal that is an analog signal to produce a digitized low frequency inertial element displacement signal as a digital sampled signal.

Referring to Figure 6, the angle rate signal loop circuitry 22 comprises:

20 a second high-pass filter circuit 221, connected to the angular rate sensor unit 10, for removing low frequency noise of the angle rate signals which are voltage signals output from the angular rate sensor unit thereto to form filtered angle rate signals;

a discrete Fast Fourier Transform (FFT) module 301, receiving the digitized low frequency inertial element displacement signal from the analog/digital converter of dither motion control circuitry 21 to form amplitude data with the frequency spectrum of the input inertial element displacement signal.

5 a memory array of frequency and amplitude data module 302, receiving the amplitude data with frequency spectrum to form an array of amplitude data with frequency spectrum.

10 a maxima detection logic module 303 to process the array of the amplitude data with frequency spectrum to choose those frequencies with the largest amplitudes in the local segment of the frequency spectrum from the array of the amplitude data with frequency spectrum.

15 a Q analysis and selection logic module 304 to perform Q analysis on the chosen frequencies to select frequency and amplitude by computing the ratio of amplitude/area. The range for computing area is between $\pm 1/2$ of the peak for each maximum frequency point.

a phase-lock loop 305 to serve as a very narrow bandpass filter to reject noise of the selected frequency and to generate a dither drive signal with the selected frequency.

a D/A converter 306 to process the selected amplitude to form a dither drive signal with correct amplitude.

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What is Claimed is:

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

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

(2) central circuitry, for receiving said angle rate signals in response to said motion of said carrier and said dither motion signals to output angular rate signals and digital low frequency inertial element displacement signals;

(3) a digital signal processing system, for analyzing said digital low frequency inertial element displacement signals to feed back said dither driver signals to said angular rate sensor unit.

2. A microelectromechanical system (MEMS) for measuring angular rate of a carrier, as recited in claim 1, wherein said angular rate sensor unit further comprises:

A. two proof masses, attached with beam spring to eight anchor points and driven by three stators to oscillate to sense Coriolis force;

B. Eight anchor points, placed on both sides of said two proof masses and connected with the silicon substrate to support said two proof masses through said beam strings;

C. A large anchor pad, connected with said silicon substrate and connected with four anchor points through said beam strings to improve and stabilize said oscillating of said two proof masses;

5 D. Two small anchor pads, connected with said silicon substrate and connected with said four anchor points through said beam strings to improve and stabilize oscillating of said two proof masses;

E. Three stators, connected with said silicon substrate to drive said two proof masses 101 through said comb drives.

10 3. A microelectromechanical system (MEMS) for measuring angular rate of a carrier, as recited in claim 1, wherein said central circuitry comprises a dither motion control circuitry and an angle signal loop circuitry.

4. A microelectromechanical system (MEMS) for measuring angular rate of a carrier, as recited in claim 2, wherein said central circuitry comprises a dither motion control circuitry and an angle signal loop circuitry.

15 5. A microelectromechanical system (MEMS) for measuring angular rate of a carrier, as recited in claim 3, wherein said dither motion control circuitry comprises:

a trans impedance amplifier circuit, connected to said angular rate sensor unit, for changing an output impedance of said dither motion signals from a very high level, greater than 100 million ohms, to a low level, less than 100 ohms to achieve two dither

displacement signals which are A/C voltage signals representing said displacement between said inertial elements and said anchor combs;

5 a first amplifier and summer circuit, connected to said trans impedance amplifier circuit, for amplifying said two dither displacement signals by more than ten times and enhancing said sensitivity for combining said two dither displacement signals to achieve a dither displacement differential signal by subtracting a center anchor comb signal with a side anchor comb signals;

10 a first high-pass filter circuit, connected to said first amplifier and summer circuit, for removing residual dither drive signals and noise from said dither displacement differential signal to form a filtered dither displacement differential signal;

15 a demodulator circuit, connected to said high-pass filter circuit, for receiving said capacitive pickoff excitation signals as phase reference signals from an oscillator and said filtered dither displacement differential signal from said first high-pass filter, and extracting said in-phase portion of said filtered dither displacement differential signal to produce an inertial element displacement signal with known phase;

a first low-pass filter, connected to said demodulator circuit, for removing high frequency noise from said inertial element displacement signal input thereto to form a low frequency inertial element displacement signal with bandwidth less than 3000 Hz;

20 an amplifier, connected with said first low-pass filter, for amplifying said filtered low frequency inertial element displacement signal;

an analog/digital converter, connected to said amplifier, for converting said low frequency inertial element displacement signal that is an analog signal to produce a digitized low frequency inertial element displacement signal as a digital sampled signal.

6. A microelectromechanical system (MEMS) for measuring angular rate of a carrier, as recited in claim 4, wherein said dither motion control circuitry comprises:

a trans impedance amplifier circuit, connected to said angular rate sensor unit, for changing an output impedance of said dither motion signals from a very high level, greater than 100 million ohms, to a low level, less than 100 ohms to achieve two dither displacement signals which are A/C voltage signals representing said displacement between said inertial elements and said anchor combs;

a first amplifier and summer circuit, connected to said trans impedance amplifier circuit, for amplifying said two dither displacement signals by more than ten times and enhancing said sensitivity for combining said two dither displacement signals to achieve a dither displacement differential signal by subtracting a center anchor comb signal with a side anchor comb signals;

a first high-pass filter circuit, connected to said first amplifier and summer circuit, for removing residual dither drive signals and noise from said dither displacement differential signal to form a filtered dither displacement differential signal;

a demodulator circuit, connected to said high-pass filter circuit, for receiving said capacitive pickoff excitation signals as phase reference signals from an oscillator and said

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filtered dither displacement differential signal from said first high-pass filter, and extracting said in-phase portion of said filtered dither displacement differential signal to produce an inertial element displacement signal with known phase;

5 a first low-pass filter, connected to said demodulator circuit, for removing high frequency noise from said inertial element displacement signal input thereto to form a low frequency inertial element displacement signal with bandwidth less than 3000 Hz;

an amplifier, connected with said first low-pass filter, for amplifying said filtered low frequency inertial element displacement signal;

10 an analog/digital converter, connected to said amplifier, for converting said low frequency inertial element displacement signal that is an analog signal to produce a digitized low frequency inertial element displacement signal as a digital sampled signal.

7. A microelectromechanical system (MEMS) for measuring angular rate of a carrier, as recited in claim 5, wherein said angle rate signal loop circuitry comprises:

15 a second high-pass filter circuit, connected to said angular rate sensor unit, for removing low frequency noise of said angle rate signals which are voltage signals output from said angular rate sensor unit thereto to form filtered angle rate signals;

a voltage amplifier circuit, connected to said second high-pass filter circuit, for amplifying said filtered angle rate signals to an extent of at least 100 millivolts to form amplified angle rate signals;

an amplifier and summer circuit, connected to said voltage amplifier circuit, for subtracting said difference between said angle rates of said amplified angle rate signals to produce a differential angle rate signal;

5 a demodulator, connected to said amplifier and summer circuit, for extracting said amplitude of said in-phase differential angle rate signal from said differential angle rate signal and said reference signal from said oscillator;

a low-pass filter, connected to said demodulator, for removing said high frequency noises of said amplitude signal of said in-phase differential angle rate signal to form an angular rate signal output;

10 an integrator, connected with said low-pass filter, for integrating said angular rate signal to form a displacement restoring signal without an offset.

a driver amplifier, connected to said integrator, for amplifying said displacement restoring signal without an offset to form a driving signal to said angular rate sensor unit.

8. A microelectromechanical system (MEMS) for measuring angular rate of a carrier, as recited in claim 6, wherein said angle rate signal loop circuitry comprises:

15 a second high-pass filter circuit, connected to said angular rate sensor unit, for removing low frequency noise of said angle rate signals which are voltage signals output from said angular rate sensor unit thereto to form filtered angle rate signals;

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a second high-pass filter circuit, connected to said angular rate sensor unit, for removing low frequency noise of said angle rate signals which are voltage signals output from said angular rate sensor unit thereto to form filtered angle rate signals;

5 a voltage amplifier circuit, connected to said second high-pass filter circuit, for amplifying said filtered angle rate signals to an extent of at least 100 milivolts to form amplified angle rate signals;

an amplifier and summer circuit, connected to said voltage amplifier circuit, for subtracting said difference between said angle rates of said amplified angle rate signals to produce a differential angle rate signal;

10 a demodulator, connected to said amplifier and summer circuit, for extracting said amplitude of said in-phase differential angle rate signal from said differential angle rate signal and said reference signal from said oscillator;

15 a low-pass filter, connected to said demodulator, for removing said high frequency noises of said amplitude signal of said in-phase differential angle rate signal to form an angular rate signal output;

an integrator, connected with said low-pass filter, for integrating said angular rate signal to form a displacement restoring signal without an offset.

a driver amplifier, connected to said integrator, for amplifying said displacement restoring signal without an offset to form a driving signal to said angular rate sensor unit.

10. A microelectromechanical system (MEMS) for measuring angular rate of a carrier, as recited in claim 3, wherein said angle rate signal loop circuitry comprises:

a second high-pass filter circuit, connected to said angular rate sensor unit, for removing low frequency noise of said angle rate signals which are voltage signals output from said angular rate sensor unit thereto to form filtered angle rate signals;

a voltage amplifier circuit, connected to said second high-pass filter circuit, for amplifying said filtered angle rate signals to an extent of at least 100 millivolts to form amplified angle rate signals;

an amplifier and summer circuit, connected to said voltage amplifier circuit, for subtracting said difference between said angle rates of said amplified angle rate signals to produce a differential angle rate signal;

a demodulator, connected to said amplifier and summer circuit, for extracting said amplitude of said in-phase differential angle rate signal from said differential angle rate signal and said reference signal from said oscillator;

a low-pass filter, connected to said demodulator, for removing said high frequency noises of said amplitude signal of said in-phase differential angle rate signal to form an angular rate signal output;

an integrator, connected with said low-pass filter, for integrating said angular rate signal to form a displacement restoring signal without an offset.

a driver amplifier, connected to said integrator, for amplifying said displacement restoring signal without an offset to form a driving signal to said angular rate sensor unit.

11. A microelectromechanical system (MEMS) for measuring angular rate of a carrier, as recited in claim 5, wherein said digital signal processing system comprises:

5 a discrete Fast Fourier Transform (FFT) module, receiving said digitized low frequency inertial element displacement signals from said analog/digital converter of dither motion control circuitry to form amplitude data with said frequency spectrum of said input inertial element displacement signal;

10 a memory array of frequency and amplitude data module, receiving said amplitude data with frequency spectrum to form an array of amplitude data with frequency spectrum;

15 a maxima detection logic module to process said array of said amplitude data with frequency spectrum to choose those frequencies with said largest amplitudes in said local segment of said frequency spectrum from said array of said amplitude data with frequency spectrum;

a Q analysis and selection logic module to perform Q analysis on said chosen frequencies to select frequency and amplitude by computing said ratio of amplitude/area. Said frequency range for computing area is between $+1/2$ and $-1/2$ of said peak for each maximum frequency point;

a phase-lock loop to serve as a very narrow bandpass filter to reject noise of said selected frequency, to form a dither drive signal with said selected frequency;

a D/A converter to process said selected amplitude to form a dither drive signal with correct amplitude;

5 an amplifier to generate and amplify said dither drive signal to said angular rate sensor unit based on said dither drive signal with said selected frequency and correct amplitude.

12. A microelectromechanical system (MEMS) for measuring angular rate of a carrier, as recited in claim 6, wherein said digital signal processing system comprises:

10 a discrete Fast Fourier Transform (FFT) module, receiving said digitized low frequency inertial element displacement signals from said analog/digital converter of dither motion control circuitry to form amplitude data with said frequency spectrum of said input inertial element displacement signal;

a memory array of frequency and amplitude data module, receiving said 15 amplitude data with frequency spectrum to form an array of amplitude data with frequency spectrum;

a maxima detection logic module to process said array of said amplitude data with frequency spectrum to choose those frequencies with said largest amplitudes in said local segment of said frequency spectrum from said array of said amplitude data with 20 frequency spectrum;

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a Q analysis and selection logic module to perform Q analysis on said chosen frequencies to select frequency and amplitude by computing said ratio of amplitude/area. Said frequency range for computing area is between + 1/2 and -1/2 of said peak for each maximum frequency point;

5 a phase-lock loop to serve as a very narrow bandpass filter to reject noise of said selected frequency, to form a dither drive signal with said selected frequency;

a D/A converter to process said selected amplitude to form a dither drive signal with correct amplitude;

10 an amplifier to generate and amplify said dither drive signal to said angular rate sensor unit based on said dither drive signal with said selected frequency and correct amplitude.

13. A microelectromechanical system (MEMS) for measuring angular rate of a carrier, as recited in claim 7, wherein said digital signal processing system comprises:

15 a discrete Fast Fourier Transform (FFT) module, receiving said digitized low frequency inertial element displacement signals from said analog/digital converter of dither motion control circuitry to form amplitude data with said frequency spectrum of said input inertial element displacement signal;

20 a memory array of frequency and amplitude data module, receiving said amplitude data with frequency spectrum to form an array of amplitude data with frequency spectrum;

a maxima detection logic module to process said array of said amplitude data with frequency spectrum to choose those frequencies with said largest amplitudes in said local segment of said frequency spectrum from said array of said amplitude data with frequency spectrum;

5 a Q analysis and selection logic module to perform Q analysis on said chosen frequencies to select frequency and amplitude by computing said ratio of amplitude/area. Said frequency range for computing area is between $+1/2$ and $-1/2$ of said peak for each maximum frequency point;

10 a phase-lock loop to serve as a very narrow bandpass filter to reject noise of said selected frequency, to form a dither drive signal with said selected frequency;

a D/A converter to process said selected amplitude to form a dither drive signal with correct amplitude;

15 an amplifier to generate and amplify said dither drive signal to said angular rate sensor unit based on said dither drive signal with said selected frequency and correct amplitude.

14. A microelectromechanical system (MEMS) for measuring angular rate of a carrier, as recited in claim 8, wherein said digital signal processing system comprises:

a discrete Fast Fourier Transform (FFT) module, receiving said digitized low frequency inertial element displacement signals from said analog/digital converter of

dither motion control circuitry to form amplitude data with said frequency spectrum of said input inertial element displacement signal;

5 a memory array of frequency and amplitude data module, receiving said amplitude data with frequency spectrum to form an array of amplitude data with frequency spectrum;

a maxima detection logic module to process said array of said amplitude data with frequency spectrum to choose those frequencies with said largest amplitudes in said local segment of said frequency spectrum from said array of said amplitude data with frequency spectrum;

10 a Q analysis and selection logic module to perform Q analysis on said chosen frequencies to select frequency and amplitude by computing said ratio of amplitude/area. Said frequency range for computing area is between $+1/2$ and $-1/2$ of said peak for each maximum frequency point;

15 a phase-lock loop to serve as a very narrow bandpass filter to reject noise of said selected frequency, to form a dither drive signal with said selected frequency;

a D/A converter to process said selected amplitude to form a dither drive signal with correct amplitude;

20 an amplifier to generate and amplify said dither drive signal to said angular rate sensor unit based on said dither drive signal with said selected frequency and correct amplitude.

A MicroElectroMechanical System for Measuring Angular Rate

Abstract of the Disclosure

A microelectromechanical system (MEMS) for measuring angular rate of a carrier includes an angular rate sensor unit, microelectronic circuitry, and signal processing to
5 obtain highly accurate, sensitive, stable angular rate measurements of the carrier under dynamic environments. Wherein, the angular rate sensor unit receives dither driver signals, capacitive pickoff excitation signals, and displacement restoring signals to output angle rate signals in response to the motion of the carrier and dither motion signals; the central circuitry receives the angle rate signals in response to the motion of the carrier
10 and dither motion signals to output angular rate signals and digital low frequency inertial element displacement signals; a digital signal processing system analyzes digital low frequency inertial element displacement signals to feed back the dither drive signals to the angular rate sensor unit.

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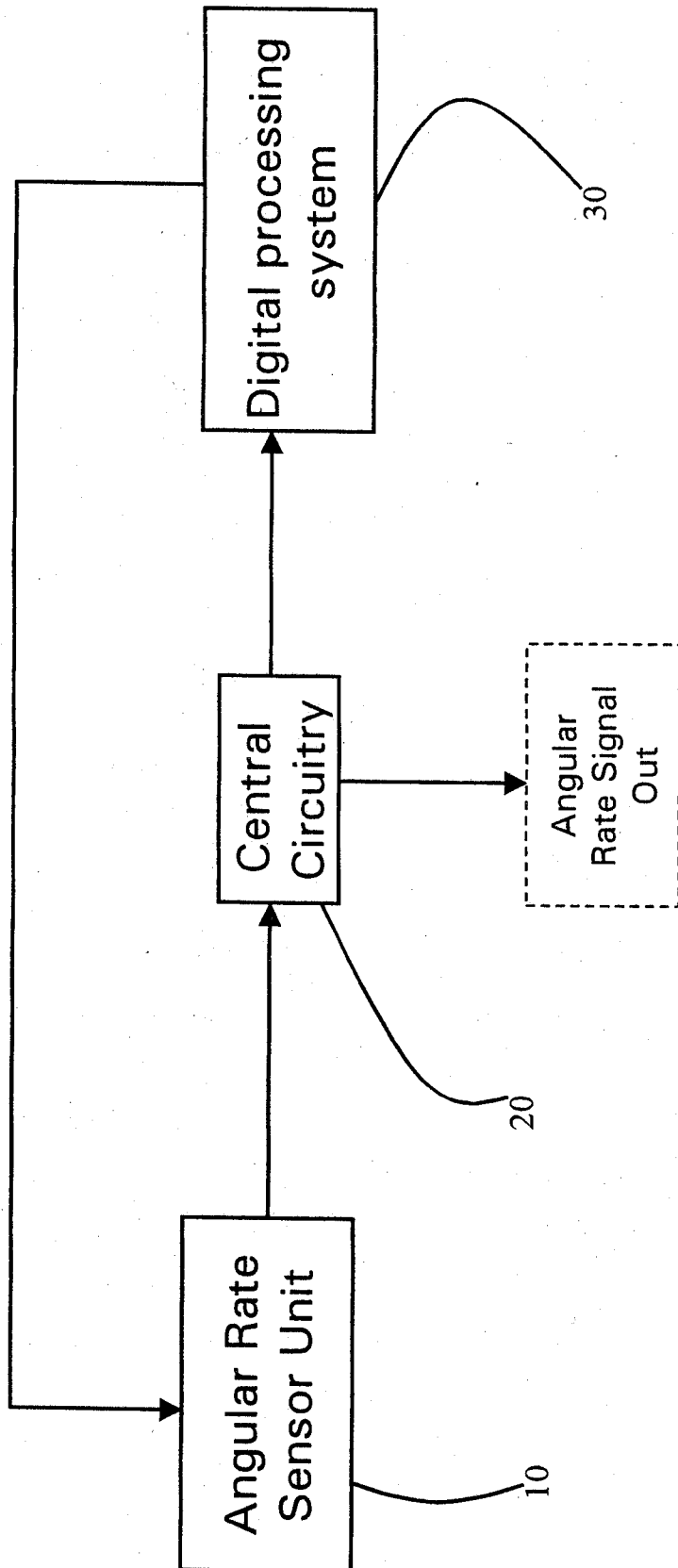


Figure 1

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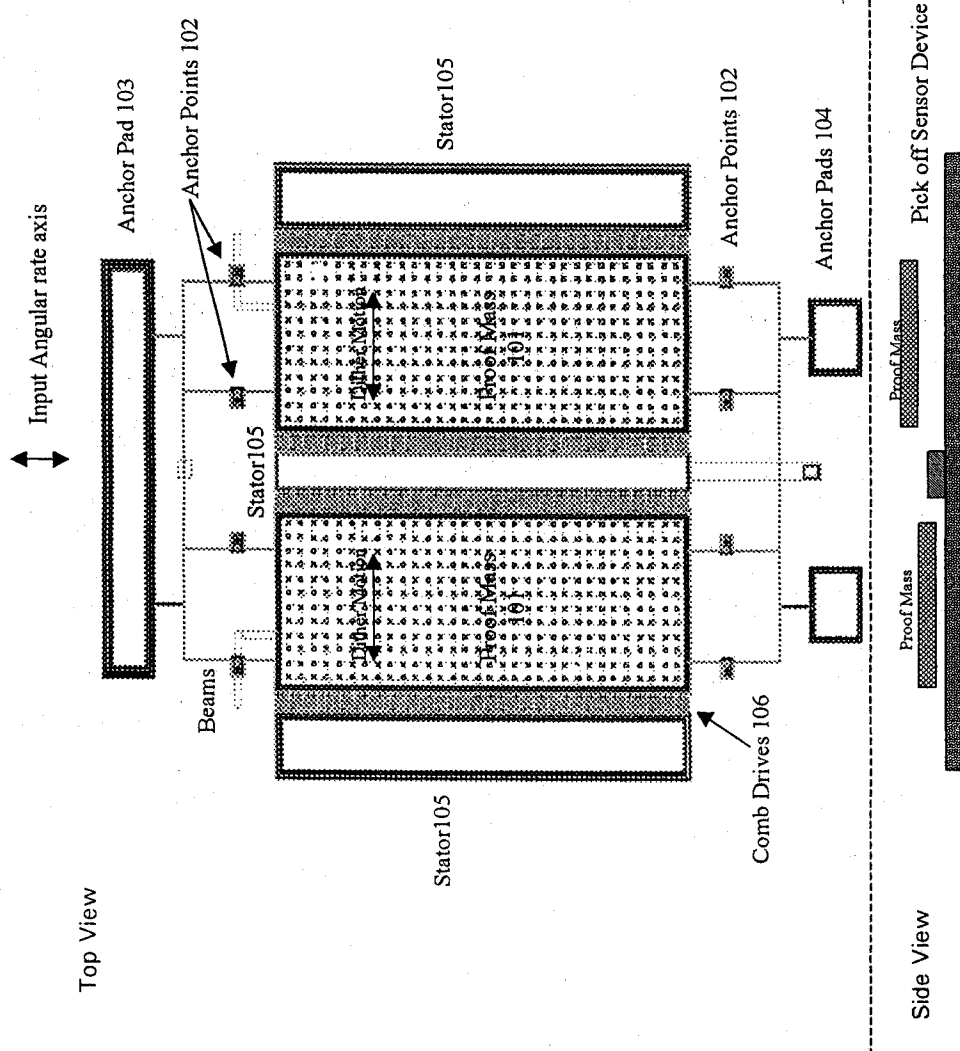


Figure 2

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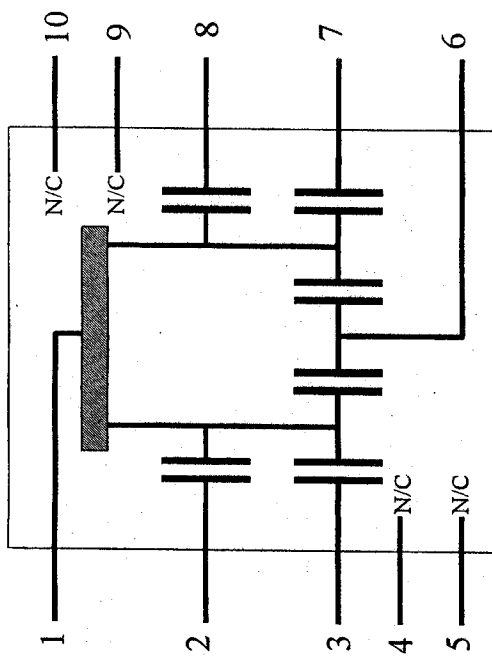


Figure 3

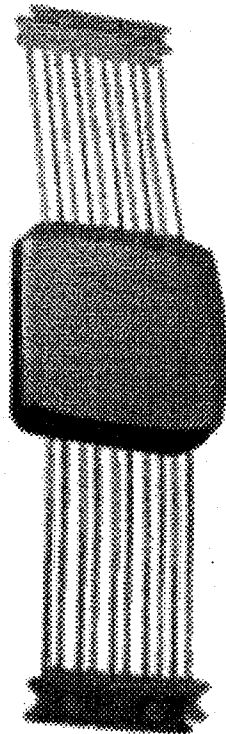


Figure 4

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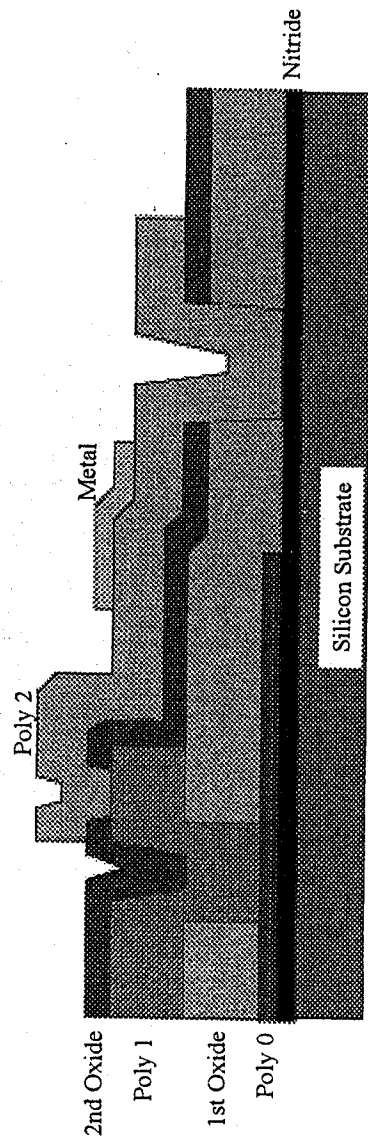


Figure 5

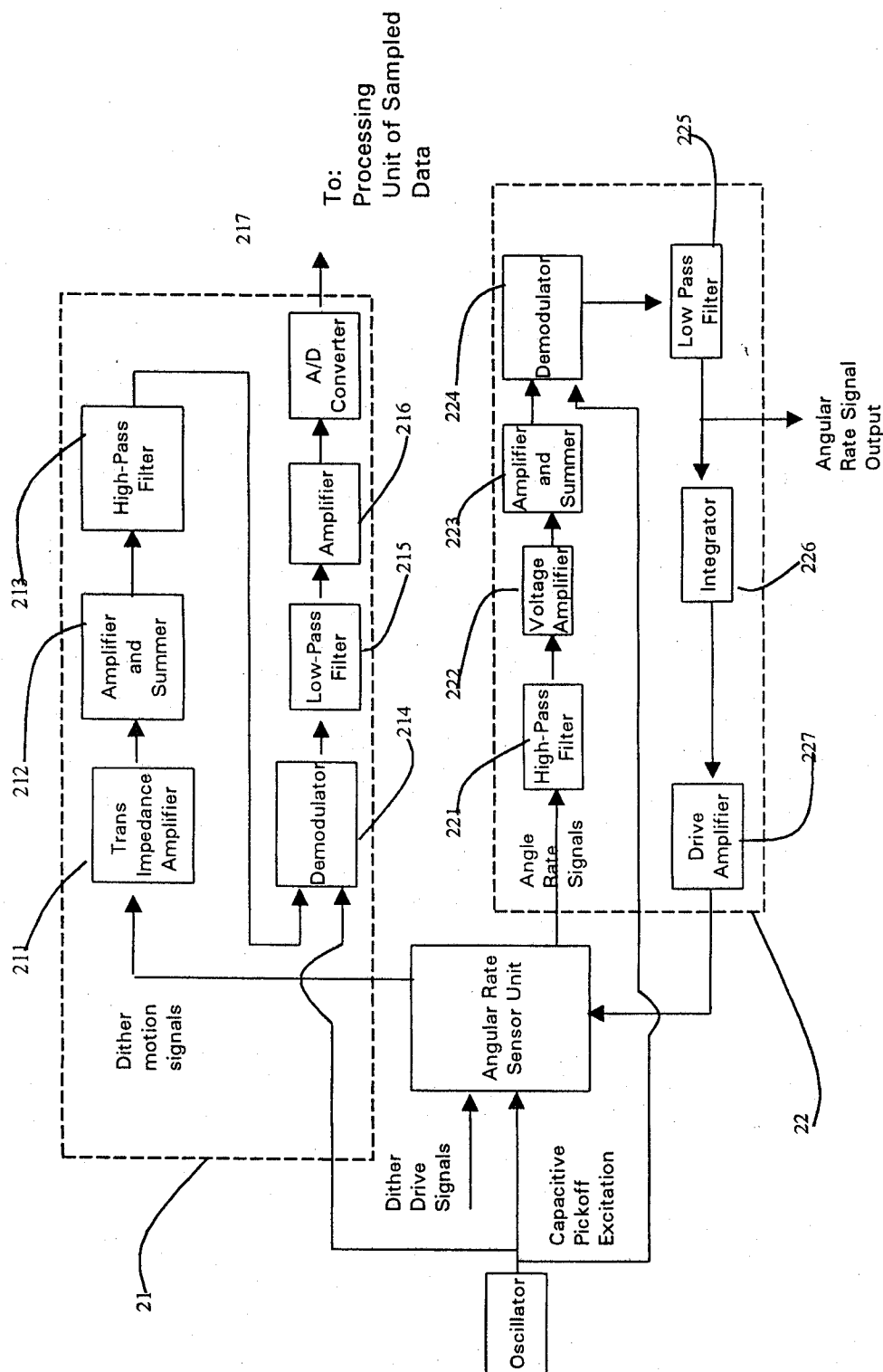


Figure 6

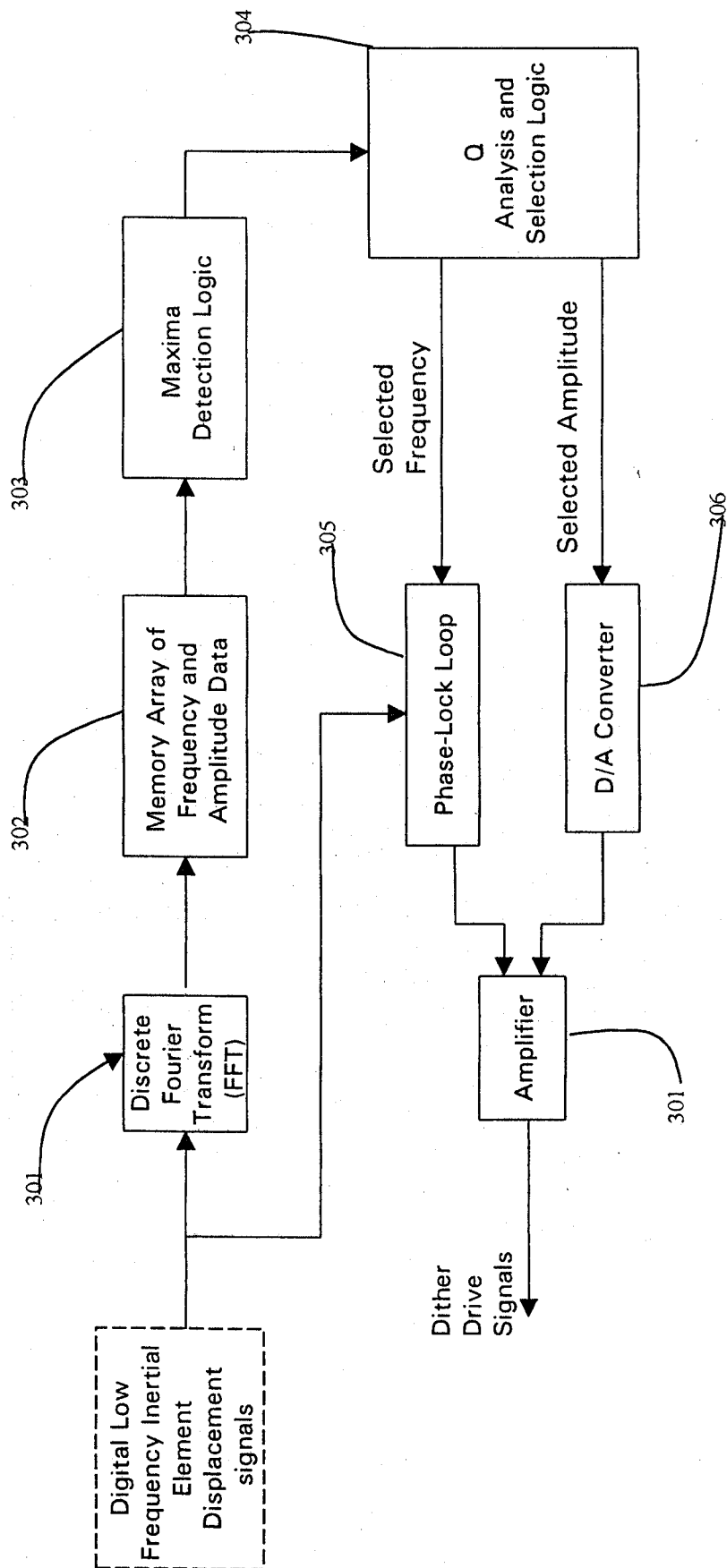


Figure 7

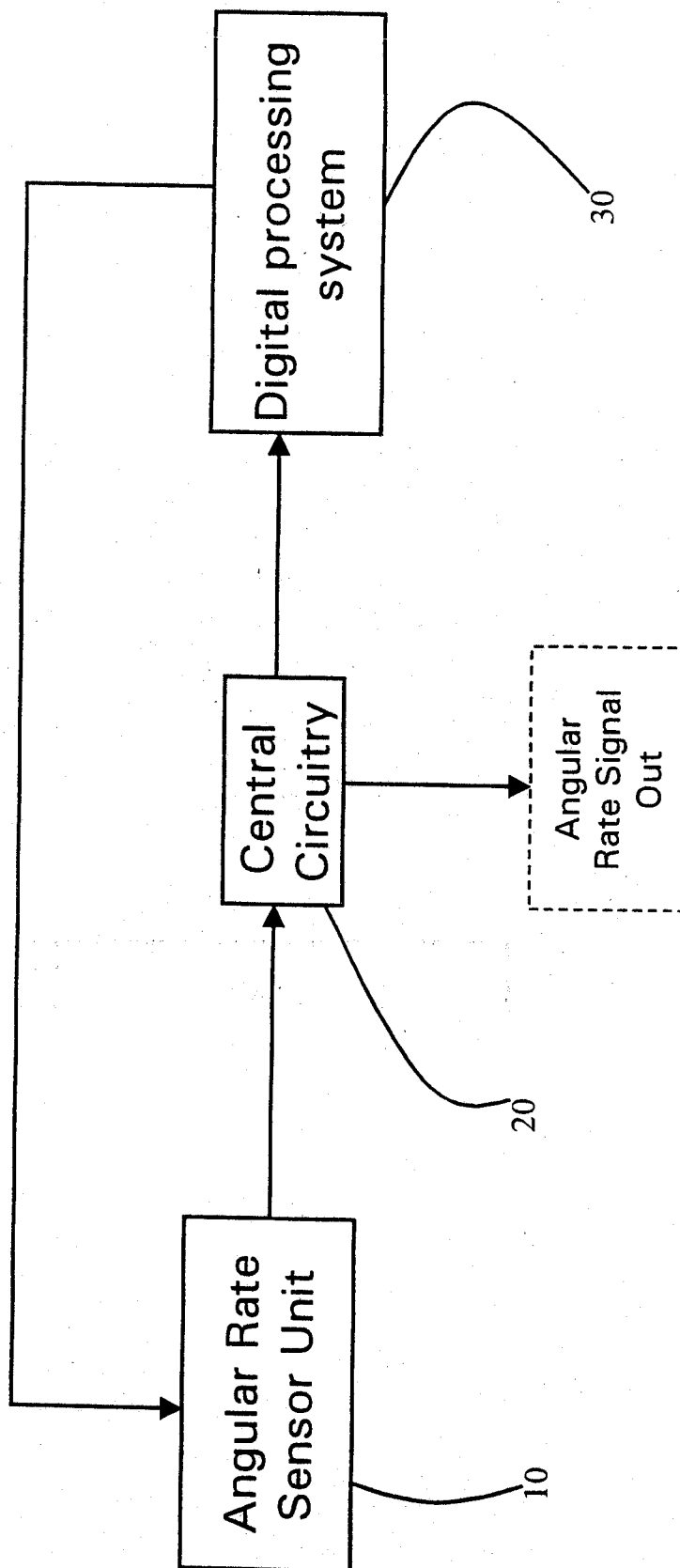


Figure 1

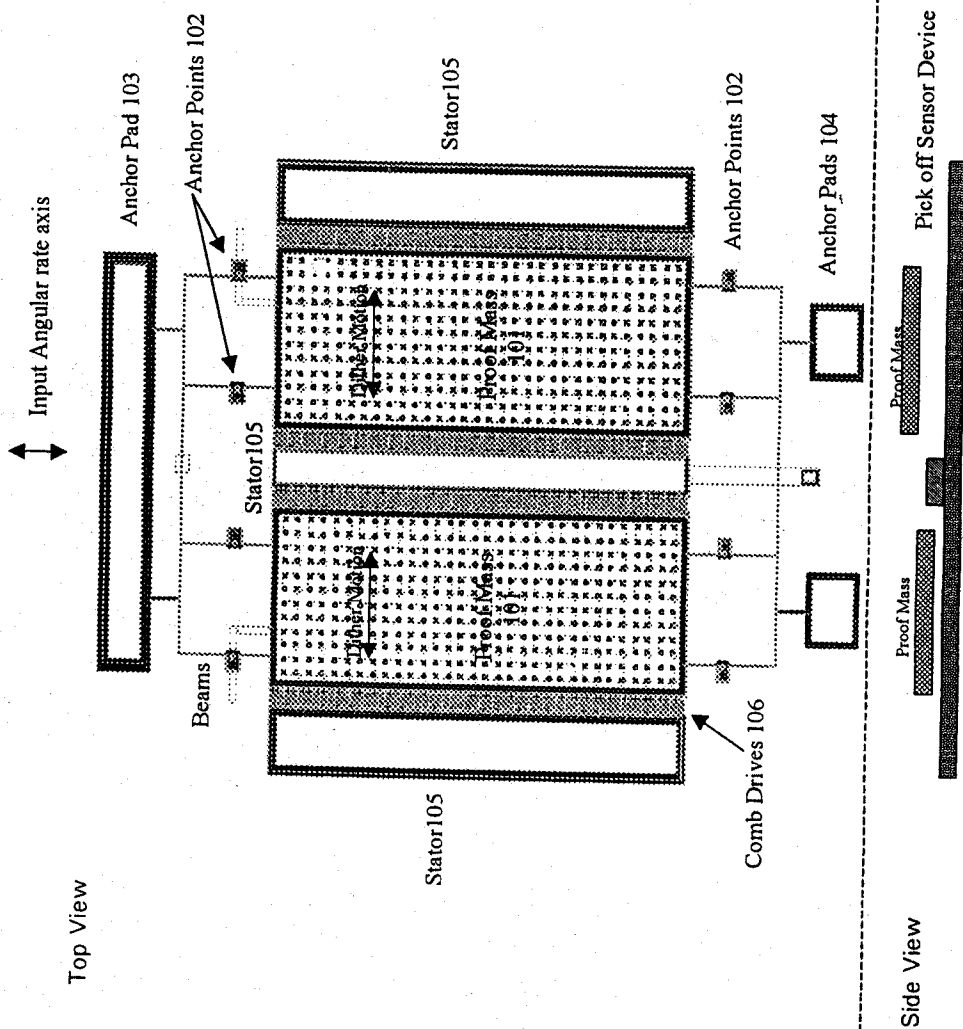


Figure 2

PRINT OF DRAWINGS
AS ORIGINALLY FILED

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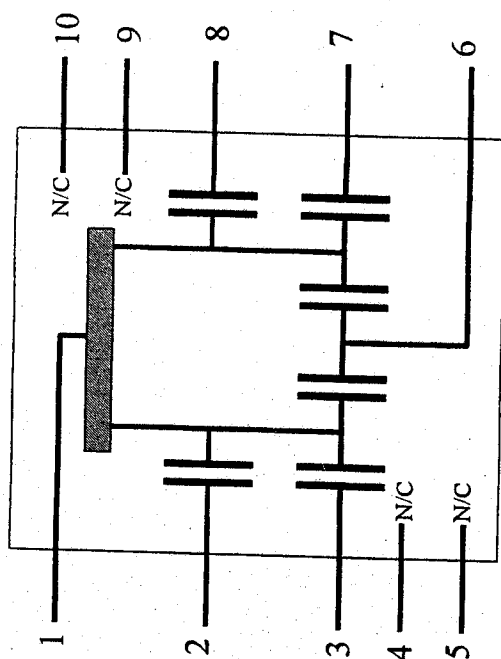


Figure 3

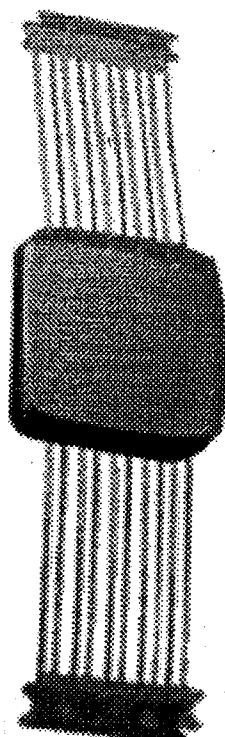


Figure 4

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AS ORIGINALLY FILM

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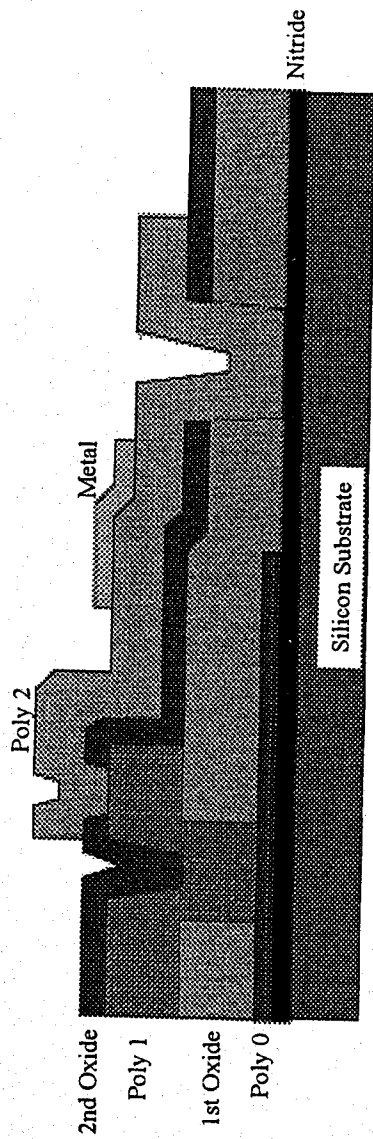


Figure 5

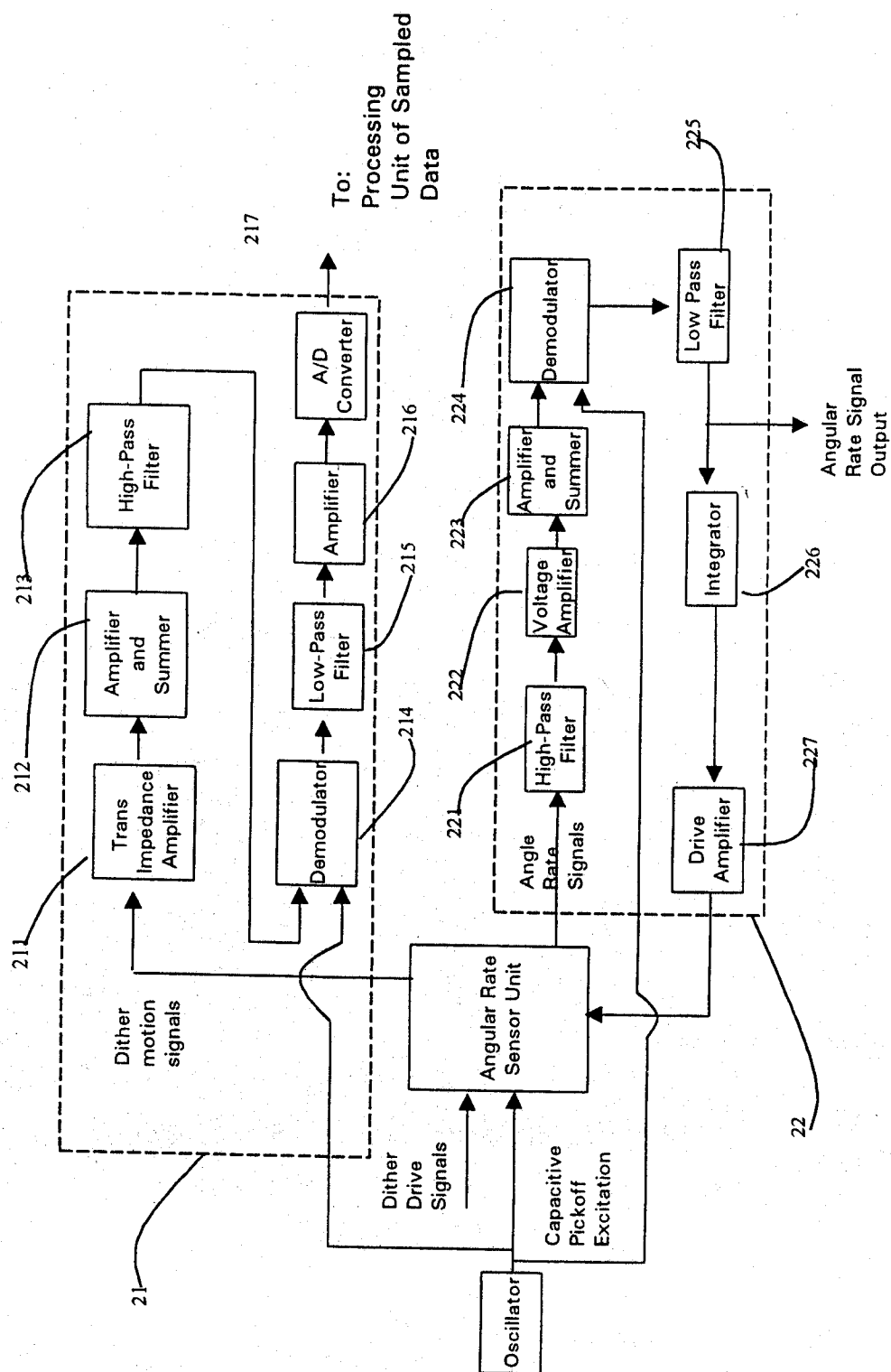


Figure 6

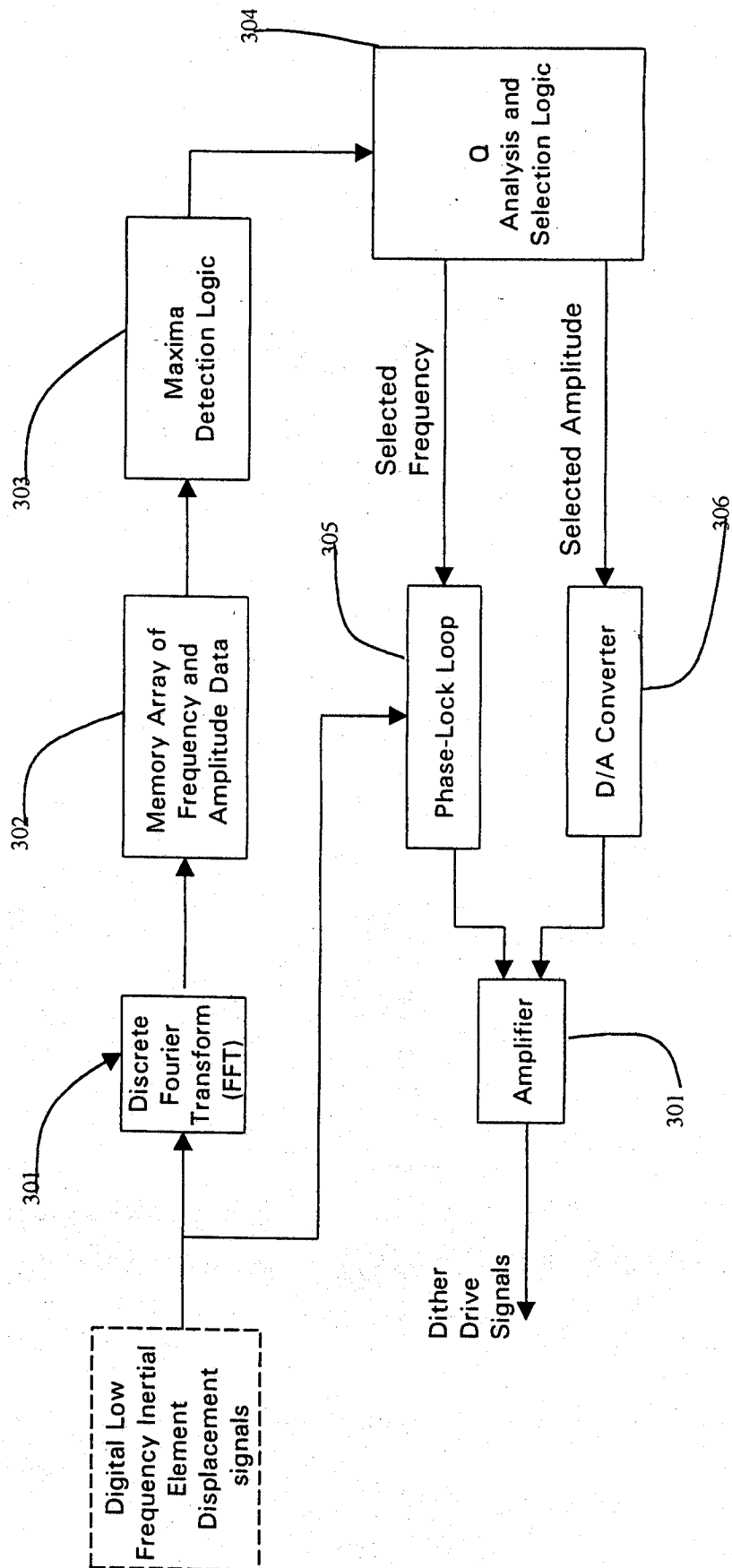


Figure 7

DECLARATION FOR PATENT APPLICATION

As a below named inventor, I hereby declare that:

My residence, post office address and citizenship are as stated below next to my name.

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled

MicroElectroMechanical System for Measuring Angular Rate

the specification of which is attached hereto unless the following box is checked:

☐ was filed on _____ as United States Application Number or PCT International Application Number _____ and was amended on _____ (if applicable).

I hereby state that I have reviewed and understand the contents of the above identified specification, including the claims, as amended by any amendment referred to above.

I acknowledge the duty to disclose information which is material to patentability as defined in 37 CFR 1.56.

I hereby claim foreign priority benefits under 35 USC 119 of any foreign application(s) for patent or inventor's certificate listed below and have also identified below any foreign application for patent or inventor's certificate having a filing date before that of the application on which priority is claimed.

Prior Foreign Application(s)

60/154,702

(Number)

09/18/1999

(Country)

pending

(Day/Month/Year Filed)

Priority Claimed

☐ Yes ☐ No

☐ Yes ☐ No

☐ Yes ☐ No

I hereby claimed the benefit under 35 USC 120 of any United States application(s) listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States application in the manner provided by the first paragraph of 35 USC 112, I acknowledge the duty to disclose information which is material to patentability as defined in 37 CFR 1.56 which became available between the filing date of the prior application and the national or PCT international filing date of this application.

(Application Number)

(Filing Date)

(Status-patented, pending, abandoned)

(Application Number)

(Filing Date)

(Status-patented, pending, abandoned)

I hereby appoint the following attorney(s) and/or agent(s), with full powers of substitution and revocation, to prosecute this application and to transact all business in the Patent and Trademark Office connected therewith:

Raymond Yat Chiu Chan, Reg. No. 37,484

Address all correspondence to: **1050 Oakdale Ln., Arcadia CA 91006**

Telephone Calls to: **(626) 571-9812**

I hereby declare that all Statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

Full name of sole or first inventor (given name, family name) Hiram McCall

Inventor's signature Hiram McCall

Date Sept. 15, 2000

Residence 888 Easy Street, Simi Valley CA 93065

Citizenship USA

Post Office Address 888 Easy Street, Simi Valley CA 93065

Full name of second joint inventor, if any (given name, family name) Ching-Fang Lin

Second Inventor's signature Ching-Fang Lin

Date Sept. 15, 2000

Residence 888 Easy Street, Simi Valley CA 93065

Citizenship USA

Post Office Address 888 Easy Street, Simi Valley CA 93065

☐ Additional inventors are being named on separately numbered sheets attached hereto.

PATENT
USP9952A-GNC

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant: American GNC Corporation
Filing Date: _____
Serial No.: _____
Examiner: _____
Art Unit: _____

Title MicroElectroMechanical System for Measuring Angular Rate

To: The Commissioner of
Patents and Trademarks
Washington, D.C. 20231

POWER OF ATTORNEY

As a named assignee of the above identified application, I hereby appoint the following attorney(s) and/or agent(s) to prosecute and transact all business in the Patent and trademark Office connected with the above application:

Raymond Yat Chiu Chan, Reg. No. 37,484

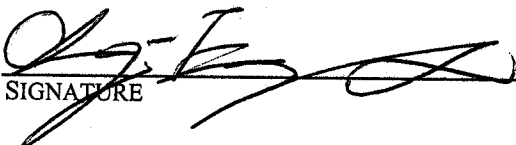
Please Send Correspondence to:

Raymond Y. C. Chan
1050 Oakdale Ave.,
Arcadia, CA 91006-2222

Please Direct Telephone Calls to:

Raymond Y. C. Chan
(626) 571-9812

NAME OF ASSIGNEE: American GNC Corporation
NAME OF PERSON SIGNING: Ching-Fang Lin
TITLE: President
ADDRESS: 888 Easy Street, Simi Valley CA 93065


SIGNATURE

Sept. 15, 2000
DATE

Applicant or Patentee: _____ At _____'s
Serial or Patent No.: _____ Docket No.: USP9952A-GNC
Filed or Issued: _____
For: _____

**VERIFIED STATEMENT (DECLARATION) CLAIMING SMALL ENTITY
STATUS (37 CFR 1.9 (f) and 1.27 (b)) – INDEPENDENT INVENTOR**

As a below named inventor, I hereby declare that I qualify as an independent inventor as defined in 37 CFR 1.9 (c) for purposes of paying reduced fees under section 41 (a) and (b) of Title 35, United States Code, to the Patent and Trademark Office with regard to the invention entitled:
MicroElectroMechanical System for Measuring Angular Rate described in:

- ☒ the specification filed herewith
☐ application serial no. _____, filed _____
☐ patent no. _____, issued _____

I have not assigned, granted, conveyed or licensed and am under no obligation under contract or law to assign, grant, convey or license, any rights in the invention to any person who could not be classified as an independent inventor under 37 CFR 1.9 (c) if that person had made the invention, or to any concern which would not qualify as a small business concern under 37 CFR 1.9 (d) or a non-profit organization under 37 CFR 1.9 (e).

Each person, concern or organization to which I have assigned, granted, conveyed, or licensed or am under an obligation under contract or law to assign, grant, convey, or license any rights in the invention is listed below:

- ☐ no such person, concern, or organization
☒ person, concern or organizations listed below*

*NOTE: Separate verified statements are required from each named person, concern or organization having rights to the invention averring to their status as small entities. (37 CFR 1.27)

FULL NAME American GNC Corporation
ADDRESS 888 Easy Street, Simi Valley CA 93065
☐ INDIVIDUAL ☒ SMALL BUSINESS CONCERN ☐ NONPROFIT ORGANIZATION

FULL NAME _____
ADDRESS _____
☐ INDIVIDUAL ☐ SMALL BUSINESS CONCERN ☐ NONPROFIT ORGANIZATION

FULL NAME _____
ADDRESS _____
☐ INDIVIDUAL ☐ SMALL BUSINESS CONCERN ☐ NONPROFIT ORGANIZATION

I acknowledge the duty to file, in this application or patent, notification of any change in status resulting in loss of entitlement to small entity status prior to paying, or at the time of paying, the earliest of the issue fee or any maintenance fee due after the date on which status as a small entity is no longer appropriate. (37 CFR 1.28 (b))

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application, any patent issuing thereon, or any patent to which this verified statements is directed.

Hiram McCall Ching-Fang Lin _____
NAME OF INVENTOR NAME OF INVENTOR NAME OF INVENTOR

Hiram McCall Ching-Fang Lin _____
Signature of Inventor Signature of Inventor Signature of Inventor

Sept. 15, 2000 Sept. 15, 2000 _____
Date Date Date

Applicant or Patentee: _____ A _____'s
Serial or Patent No.: _____ Docket No.: USP9952A-GNC
Filed or Issued: _____
For: _____

**VERIFIED STATEMENT (DECLARATION) CLAIMING SMALL ENTITY
STATUS (37 CFR 1.9 (f) and 1.27 (c)) – SMALL BUSINESS CONCERN**

I hereby declare that I am

- ☐ the owner of the small business concern identified below:
☒ an official of the small business concern empowered to act on behalf of the concern identified below:

Name of Concern: American GNC Corporation
Address of Concern: 888 Easy Street, Simi Valley CA 93065

I hereby declare that the above identified small business concern qualifies as a small business concern as defined in 13 CFR 121.3-18, and reproduced in 37 CFR 1.9 (d), for purposes of paying reduced fees under section 41(a) and (b) of title 35, United States Code, in that the number of employees of the concern, including those of its affiliates, does not exceed 500 persons. For purposes of this statement, (1) the number of employees is the average over the previous fiscal year of the concern of the persons employed on a full-time, part-time or temporary basis during each of the pay periods of the fiscal year, and (2) concerns are affiliates of each other when either, directly or indirectly, one concern controls or has the power of control the other, or a third party or parties controls or has the power to control both.

I hereby declare that rights under contract or law have been conveyed to and remain with the small business concern identified above with regard to the invention entitled:

MicroElectroMechanical System for Measuring Angular Rate

described in:

- ☒ the specification filed herewith
☐ application serial no. _____, filed _____
☐ patent no. _____, issued _____

If the rights held by the above identified small business concern are not exclusive, each individual, concern or organization having rights to the invention is listed below* and no rights to the invention are held by any person, other than the inventor, who could not qualify as a small business concern under 37 CFR 1.9(d) or by any concern which would not qualify as a small business concern under 37 CFR 1.9(d) or a nonprofit organization under 37 CFR 1.9(e).

*NOTE: Separate verified statements are required from each named person, concern or organization having rights to the invention averring to their status as a small entities. (37 CFR 1.27)

Full Name:

Address: ☐ INDIVIDUAL ☐ SMALL BUSINESS CONCERN ☐ NON PROFIT ORGANIZATION

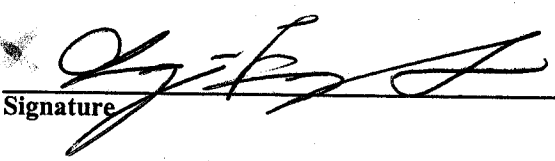
Full Name:

Address: ☐ INDIVIDUAL ☐ SMALL BUSINESS CONCERN ☐ NON PROFIT ORGANIZATION

I acknowledge the duty to file, in this application or patent, notification of any change in status resulting in loss of entitlement to small entity status prior to paying, or at the time of paying, the earliest of the issue fee or any maintenance fee due after the date on which status as a small entity is no longer appropriate. (37 CFR 1.28 (b))

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application, any patent issuing thereon, or any patent to which this verified statements is directed.

Name of Person Signing: Ching-Fang Lin
Title of Person Other than Owner: President
Address of Person Signing: 888 Easy Street, Simi Valley CA 93065

Signature 

Sept. 15, 2000
Date



UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER OF PATENTS AND TRADEMARKS
Washington, D.C. 20231
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/662,438	09/15/2000	Hiram McCall	USP9952A-GNC	4238

7590 02/08/2002
Raymond Y C Chan
1050 Oakdale Ave
Arcadia, CA 91006-2222

EXAMINER

KWOK, HELEN C

ART UNIT	PAPER NUMBER
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2856

DATE MAILED: 02/08/2002

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

09/662,438

Applicant(s)

McCall et al.

Examiner

H. Kwok

Art Unit

2856

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136 (a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☐ Responsive to communication(s) filed on _____.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11; 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-14 is/are pending in the application.
- 4a) Of the above, claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-14 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claims _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are objected to by the Examiner.
- 11) ☐ The proposed drawing correction filed on _____ is: a) ☐ approved b) ☐ disapproved.
- 12) ☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. § 119

- 13) ☐ Acknowledgement is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d).
- a) ☐ All b) ☐ Some* c) ☐ None of:
- ☐ Certified copies of the priority documents have been received.
 - ☐ Certified copies of the priority documents have been received in Application No. _____.
 - ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- *See the attached detailed Office action for a list of the certified copies not received.
- 14) ☐ Acknowledgement is made of a claim for domestic priority under 35 U.S.C. § 119(e).

Attachment(s)

- 15) ☒ Notice of References Cited (PTO-892) 18) ☐ Interview Summary (PTO-413) Paper No(s). _____
- 16) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948) 19) ☐ Notice of Informal Patent Application (PTO-152)
- 17) ☐ Information Disclosure Statement(s) (PTO-1449) Paper No(s). _____ 20) ☐ Other:

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DETAILED ACTION

Oath/Declaration

1. The oath or declaration is defective. A new oath or declaration in compliance with 37 CFR 1.67(a) identifying this application by application number and filing date is required. See MPEP §§ 602.01 and 602.02.

The oath or declaration is defective because the provisional application (60/154,702) cited in the declaration does not correspond with the provisional application (60/154,700) mentioned on page 1 of the specification. A new declaration claiming the provisional application (60/154,700) is required under the guidelines of MPEP §602.01 and §602.02.

Claim Objections

2. Claims 1-14 are objected to because of the following informalities. Appropriate correction is required.

In claim 1, line 3, the word "a" should be deleted. In line 4, the word - a -- should be inserted before the word "displacement". In line 5, the word -- said -- should be inserted before the word "dither". In line 7, the word -- said -- should be inserted before the word "output".

In claim 2, line 5, the word -- said -- should be inserted before the word "Eight". In line 14, the word -- said -- should be inserted before the word "Three". In line 15, the number "101" should be deleted.

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In claim 3, line 3, the word -- rate -- should be inserted after the word "angle" to provide proper antecedent basis for later claims.

In claim 4, line 3, the word -- rate -- should be inserted after the word "angle" to provide proper antecedent basis for later claims.

Claim Rejections - 35 USC § 112

3. The following is a quotation of the second paragraph of 35 U.S.C. 112:

The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

4. Claims 2 and 5-14 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

In claim 2, line 4, the phrase "to oscillate to sense Coriolis force" is not worded clearly. In line 6, the phrase "the silicon substrate" lacks antecedent basis. In line 7, the phrase "said beam strings" lacks antecedent basis. In line 8, the phrase "said silicon substrate" lacks antecedent basis. In line 9, the phrase "said beam strings" lacks antecedent basis. In line 11, the phrase "said silicon substrate" lacks antecedent basis. In line 12, the phrase "said beam strings" lacks antecedent basis. In line 14, the phrase "said silicon substrate" lacks antecedent basis. In line 15, the phrase "said comb drives" lacks antecedent basis.

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In claim 5, line 6, the phrase "said displacement" lacks antecedent basis. In line 7, the phrase "said inertial elements" lacks antecedent basis. In line 7, the phrase "said anchor combs" lacks antecedent basis. In line 10, the phrase "said sensitivity" lacks antecedent basis. In line 12, the word "signals" should be changed to -- signal --. In line 19, the phrase "said in-phase portion" lacks antecedent basis. In line 22, the word -- filtered -- should be inserted after the word "a". In line 26, the word -- filtered -- should be inserted before the word "low". In line 28, the word -- filtered -- should be inserted after the word "digitized".

In claim 6, line 6, the phrase "said displacement" lacks antecedent basis. In line 7, the phrase "said inertial elements" lacks antecedent basis. In line 7, the phrase "said anchor combs" lacks antecedent basis. In line 10, the phrase "said sensitivity" lacks antecedent basis. In line 12, the word "signals" should be changed to -- signal --. In line 19, the phrase "said in-phase portion" lacks antecedent basis. In line 22, the word -- filtered -- should be inserted after the word "a". In line 26, the word -- filtered -- should be inserted before the word "low".

In claim 7, line 10, the phrase "said difference" lacks antecedent basis. In line 11, the phrase "said angle rates" lacks antecedent basis. In lines 13-14, the phrase "said amplitude" lacks antecedent basis. In line 14, the phrase "said in-phase differential angle rate signal" lacks antecedent basis. In line 15, the phrase "said reference signal" lacks antecedent basis. In line 15, the phrase "said oscillator" lacks antecedent basis. In lines 16-17, the phrase "said high frequency noises" lacks antecedent basis. In line 17, the phrase "said amplitude signal" lacks antecedent basis. In line 17, the phrase "said in-phase differential angle rate signal" lacks antecedent basis.

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In claim 8, line 10, the phrase "said difference" lacks antecedent basis. In line 11, the phrase "said angle rates" lacks antecedent basis. In lines 13-14, the phrase "said amplitude" lacks antecedent basis. In line 14, the phrase "said in-phase differential angle rate signal" lacks antecedent basis. In line 15, the phrase "said reference signal" lacks antecedent basis. In line 15, the phrase "said oscillator" lacks antecedent basis. In lines 16-17, the phrase "said high frequency noises" lacks antecedent basis. In line 17, the phrase "said amplitude signal" lacks antecedent basis. In line 17, the phrase "said in-phase differential angle rate signal" lacks antecedent basis.

In claim 9, line 10, the phrase "said difference" lacks antecedent basis. In line 11, the phrase "said angle rates" lacks antecedent basis. In lines 13-14, the phrase "said amplitude" lacks antecedent basis. In line 14, the phrase "said in-phase differential angle rate signal" lacks antecedent basis. In line 15, the phrase "said reference signal" lacks antecedent basis. In line 15, the phrase "said oscillator" lacks antecedent basis. In lines 16-17, the phrase "said high frequency noises" lacks antecedent basis. In line 17, the phrase "said amplitude signal" lacks antecedent basis. In line 17, the phrase "said in-phase differential angle rate signal" lacks antecedent basis.

In claim 10, line 10, the phrase "said difference" lacks antecedent basis. In line 11, the phrase "said angle rates" lacks antecedent basis. In lines 13-14, the phrase "said amplitude" lacks antecedent basis. In line 14, the phrase "said in-phase differential angle rate signal" lacks antecedent basis. In line 15, the phrase "said reference signal" lacks antecedent basis. In line 15, the phrase "said oscillator" lacks antecedent basis. In lines 16-17, the phrase "said high frequency

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noises' lacks antecedent basis. In line 17, the phrase 'said amplitude signal' lacks antecedent basis. In line 17, the phrase "said in-phase differential angle rate signal" lacks antecedent basis.

In claim 11, line 3, the word -- filtered -- should be inserted after the word "digitized". In line 4, the word "signals" should be changed to -- signal --. In line 5, the word -- said -- should be inserted before the word "dither". In line 5, the phrase "said frequency spectrum" lacks antecedent basis. In line 6, the phrase "said input inertial element displacement signal" lacks antecedent basis. In lines 7-8, the phrase "said amplitude data" lacks antecedent basis. In line 11, what is the word "those" referring to? In line 11, the phrase "said largest amplitudes" lacks antecedent basis. In lines 11-12, the phrase "said local segment" lacks antecedent basis. In line 12, the phrase "said frequency spectrum" is vague. Which "frequency spectrum" is being referred to? In line 15, the letter "Q" is not clear on its meaning. What does "Q" mean? In line 15, the phrase "said chosen frequencies" lacks antecedent basis. In line 16, the phrase "said ratio of amplitude/area" lacks antecedent basis. In line 16, the period after the word "area" should be deleted and be replaced with a comma. In line 17, the word "Said frequency range" lacks antecedent basis. In line 17, the phrase "said peek" lacks antecedent basis. In line 23 and 24, the phrase "said dither drive signal" is vague. Is this referring to the "dither drive signal" as mentioned in line 20 or line 21 of the claim?

In claim 12, line 3, the word -- filtered -- should be inserted after the word "digitized". In line 4, the word "signals" should be changed to -- signal --. In line 5, the word -- said -- should be inserted before the word "dither". In line 5, the phrase "said frequency spectrum" lacks

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antecedent basis. In line 6, the phrase "said input inertial element displacement signal" lacks antecedent basis. In lines 7-8, the phrase "said amplitude data" lacks antecedent basis. In line 11, what is the word "those" referring to? In line 11, the phrase "said largest amplitudes" lacks antecedent basis. In lines 11-12, the phrase "said local segment" lacks antecedent basis. In line 12, the phrase "said frequency spectrum" is vague. Which "frequency spectrum" is being referred to? In line 15, the letter "Q" is not clear on its meaning. What does "Q" mean? In line 15, the phrase "said chosen frequencies" lacks antecedent basis. In line 16, the phrase "said ratio of amplitude/area" lacks antecedent basis. In line 16, the period after the word "area" should be deleted and be replaced with a comma. In line 17, the word "Said frequency range" lacks antecedent basis. In line 17, the phrase "said peek" lacks antecedent basis. In line 23 and 24, the phrase "said dither drive signal" is vague. Is this referring to the "dither drive signal" as mentioned in line 20 or line 21 of the claim?

In claim 13, line 3, the word -- filtered -- should be inserted after the word "digitized". In line 4, the word "signals" should be changed to -- signal --. In line 5, the word -- said -- should be inserted before the word "dither". In line 5, the phrase "said frequency spectrum" lacks antecedent basis. In line 6, the phrase "said input inertial element displacement signal" lacks antecedent basis. In lines 7-8, the phrase "said amplitude data" lacks antecedent basis. In line 11, what is the word "those" referring to? In line 11, the phrase "said largest amplitudes" lacks antecedent basis. In lines 11-12, the phrase "said local segment" lacks antecedent basis. In line 12, the phrase "said frequency spectrum" is vague. Which "frequency spectrum" is being referred

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to? In line 15, the letter "Q" is not clear on its meaning. What does "Q" mean? In line 15, the phrase "said chosen frequencies" lacks antecedent basis. In line 16, the phrase "said ratio of amplitude/area" lacks antecedent basis. In line 16, the period after the word "area" should be deleted and be replaced with a comma. In line 17, the word "Said frequency range" lacks antecedent basis. In line 17, the phrase "said peek" lacks antecedent basis. In line 23 and 24, the phrase "said dither drive signal" is vague. Is this referring to the "dither drive signal" as mentioned in line 20 or line 21 of the claim?

In claim 14, line 3, the word -- filtered -- should be inserted after the word "digitized". In line 4, the word "signals" should be changed to -- signal --. In line 5, the word -- said -- should be inserted before the word "dither". In line 5, the phrase "said frequency spectrum" lacks antecedent basis. In line 6, the phrase "said input inertial element displacement signal" lacks antecedent basis. In lines 7-8, the phrase "said amplitude data" lacks antecedent basis. In line 11, what is the word "those" referring to? In line 11, the phrase "said largest amplitudes" lacks antecedent basis. In lines 11-12, the phrase "said local segment" lacks antecedent basis. In line 12, the phrase "said frequency spectrum" is vague. Which "frequency spectrum" is being referred to? In line 15, the letter "Q" is not clear on its meaning. What does "Q" mean? In line 15, the phrase "said chosen frequencies" lacks antecedent basis. In line 16, the phrase "said ratio of amplitude/area" lacks antecedent basis. In line 16, the period after the word "area" should be deleted and be replaced with a comma. In line 17, the word "Said frequency range" lacks antecedent basis. In line 17, the phrase "said peek" lacks antecedent basis. In line 23 and 24, the

Art Unit: 2856

phrase "said dither drive signal" is vague. Is this referring to the "dither drive signal" as mentioned in line 20 or line 21 of the claim?

Double Patenting

5. The nonstatutory double patenting rejection is based on a judicially created doctrine grounded in public policy (a policy reflected in the statute) so as to prevent the unjustified or improper timewise extension of the "right to exclude" granted by a patent and to prevent possible harassment by multiple assignees. See *In re Goodman*, 11 F.3d 1046, 29 USPQ2d 2010 (Fed. Cir. 1993); *In re Longi*, 759 F.2d 887, 225 USPQ 645 (Fed. Cir. 1985); *In re Van Ornum*, 686 F.2d 937, 214 USPQ 761 (CCPA 1982); *In re Vogel*, 422 F.2d 438, 164 USPQ 619 (CCPA 1970); and, *In re Thorington*, 418 F.2d 528, 163 USPQ 644 (CCPA 1969).

A timely filed terminal disclaimer in compliance with 37 CFR 1.321© may be used to overcome an actual or provisional rejection based on a nonstatutory double patenting ground provided the conflicting application or patent is shown to be commonly owned with this application. See 37 CFR 1.130(b).

Effective January 1, 1994, a registered attorney or agent of record may sign a terminal disclaimer. A terminal disclaimer signed by the assignee must fully comply with 37 CFR 3.73(b).

6. Claims 1-14 are rejected under the judicially created doctrine of obviousness-type double patenting as being unpatentable over claims 1-69 of U.S. Patent No. 6,311,555 (McCall et al.).

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Although the conflicting claims are not identical, they are not patentably distinct from each other because the claims in the pending Application Serial No. 09/662,438 are broader than the claims in U.S. Patent 6,311,555. Hence, the pending Application Serial No. 09/662,438 is much broader and the claims in the pending Application Serial No. 09/662,438 are not patentably distinct from the claims of U.S. Patent 6,311,555.

Claim Rejections - 35 USC § 102

7. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless --

(e) the invention was described in a patent granted on an application for patent by another filed in the United States before the invention thereof by the applicant for patent, or on an international application by another who has fulfilled the requirements of paragraphs (1), (2), and (4) of section 371© of this title before the invention thereof by the applicant for patent.

8. Claims 1 and 3-4 are rejected under 35 U.S.C. 102(e) as being anticipated by U.S. Patent 5,983,718 (Wyse et al.).

Wyse et al. discloses a signal processing system for an inertial sensor comprising, as illustrated in Figures 2-9, an angular rate sensor unit a central circuitry; digital signal processing system wherein the central circuitry includes a dither motion control circuitry and an angle signal loop circuitry. (See, column 4, line 51 to column 12, line 65).

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9. Claims 1-14 are rejected under 35 U.S.C. 102(e) as being anticipated by U.S. Patent 6,311,555 (McCall et al.).

McCall et al. discloses an angular rate producer comprising, as illustrated in Figures 1-10, an angular rate sensor unit a central circuitry; digital signal processing system wherein the central circuitry includes a dither motion control circuitry and an angle signal loop circuitry.

Furthermore, McCall et al. further discloses the circuitry arrangement as claimed. (See, column 5, line 33 to column 12, line 32).

Claim Rejections - 35 USC § 103

10. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

11. Claims 2 and 5-14 are rejected under 35 U.S.C. 103(a) as being unpatentable over U.S. Patent 5,983,718 (Wyse et al.) in view of U.S. Patent 6,311,555 (McCall et al.).

With regards to claims 2 and 5-14, Wyse et al. does not suggest the claimed features of the angular rate sensor unit and the circuitry arrangement. McCall et al. discloses an angular rate producer, as illustrated in Figures 1-10, the claimed features of the angular rate sensor unit and the circuit arrangement as claimed. It would have been obvious to a person of ordinary skill in the

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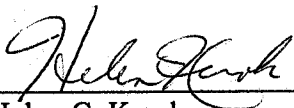
art at the time of invention to have readily recognize the advantages and desirability of employing the features as suggested by McCall et al. to the apparatus of Wyse et al. to obtain a highly accurate, sensitive, stale angular rate measurements under dynamic environments.

Conclusion

12. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure.

The references cited are related to sensors having processing circuitry.

13. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Helen Kwok whose telephone number is (703) 308-8149.


Helen C. Kwok
Art Unit 2856

hck
February 1, 2002

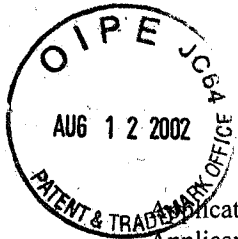
Notice of References Cited	Applicant/Patent McCall et al.	Application/Control No. 09/662,438	
	Examiner H. Kwok	Art Unit 2856	Page 1 of 1

U.S. PATENT DOCUMENTS					
	Document Number Country Code-Number-Kind Code	Date MM-YYYY ¹	Name	Classification ²	
A	5,131,749	7/1992	Varnham	356	350
B	5,319,976	6/1994	Hulsing, II	73	504.12
C	5,635,638	6/1997	Geen	73	504.12
D	5,949,545	9/1999	Lo et al.	356	350
E	5,983,718	11/1999	Wyse et al.	73	504.12
F	6,311,555	11/2001	McCall et al.	73	488
G					
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I					
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FOREIGN PATENT DOCUMENTS					
	Document Number Country Code-Number-Kind Code	Date MM-YYYY ¹	Country	Name	Classification ²
N					
O					
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T					

NON-PATENT DOCUMENTS	
Include, as applicable: Author, Title, Date, Publisher, Edition or Volume, Pertinent Pages	
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* A copy of this reference is not being furnished with this Office action. See MPEP § 707.05(a).¹ Dates in MM-YYYY format are publication dates.² Classifications may be U.S. or foreign.



#3
GP 2856 \$
GOT (3M)
SDavis
8/24/02

In The United States Patent and Trademark Office

Application Number: 09/662,438 ✓
Applicants: Hiram McCall et al
Filing Date: 09/15/2000 ✓
Title: Microelectromechanical System for Measuring Angular Rate ✓
Examiner: Helen C. Kwok
Group Art Unit: 2856

PETITION FOR EXTENSION OF TIME UNDER 37 C.F.R. 1.136

Honorable Commissioner of Patents
and Trademarks
Washington, D.C. 20231

Sir.:

It is respectfully requested that an Extension of Time for the period indicated below be granted in accordance with the provisions of 37 C.F.R. 1.136 to take the action required in the application identified in caption, as reflected by the papers submitted.

☐ First Month	\$110.00 (\$55.00)*
☐ Second Month	\$400.00 (\$200.00)*
☒ Third Month	\$920.00 (\$460.00)*
☐ Fourth Month	\$1,440.00 (\$720.00)*
☐ Fifth Month	\$1,960.00 (\$980.00)
*Small Entity	TOTAL: \$ 460.00

☒ A check in the amount of the above total fee is attached.
This amount is believed to be correct; however, the Commissioner is hereby authorized to charge any deficiency or credit any overpayment to Deposit Account No. _____ A duplicate copy of this letter is attached.

☐ Please charge any fee which may be required to Deposit Account No. _____ A duplicate copy of this letter is attached.

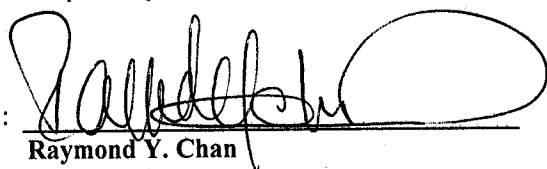
09/14/2002 HDEMESS1 00000024 09662438

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460.00 DP

Respectfully submitted,

By :



Raymond Y. Chan
Reg. No. : 37,484
1050 Oakdale Ave.
Arcadia, CA 91006

August 08, 2002

(Date)

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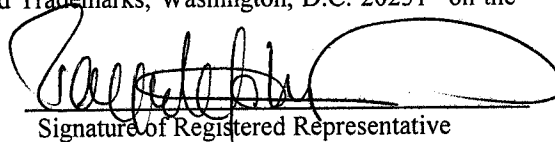
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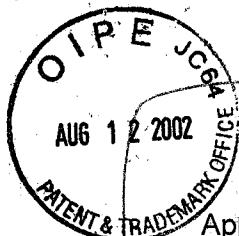
~~460.00 DP~~

CERTIFICATE OF MAILING

I certify that this correspondence will be deposited with the United States Postal Service as First Class Mail in an envelope addressed to: "Commissioner of Patents and Trademarks, Washington, D.C. 20231" on the date below.

August 08, 2002
Date of Deposit


Signature of Registered Representative



#4A
Amend/Decl
S Davis
8/24/02

In The United States Patent and Trademark Office

Application Number: 09/662,438 ✓
Applicants: Hiram McCally et al
Filing Date: 09/15/2000 ✓
Title: Microelectromechanical System for Measuring Angular Rate

Examiner: Helen C. Kwok
Group Art Unit: 2856

Date: August 08, 2002

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AMENDMENT A

Honorable Commissioner of Patents and Trademarks
Washington, D.C. 20231

Sir:

In response to the Office Action mailed 02/08/2002, kindly amend the above application as follows.

IN THE CLAIMS:

Please cancel claims of record 1 to 14 without prejudice or disclaimer and replace with the newly drafted claims as follows:

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.

216. The microelectromechanical system, as recited in claim 15, wherein said angular rate sensor unit further comprises:

a silicon substrate;

two proof masses which is arranged to be caused a oscillation out of plane by a Coriolis force to sense said motion of said carrier in accordance with Coriolis effect

three stators connected with said silicon substrate, wherein one of said stators is connected between inner sides of said two proof masses through two comb drives respectively while other two of said stators are connected with outer sides of said two proof masses through another two comb drives;

a first anchor pad, which is connected with said silicon substrate;

two second anchor pads, which are connected with said silicon substrate; and

a first set and a second set of anchor points connected with said silicon substrate, wherein said first set of anchor points is scattered one end of said two proof masses and connected with said first anchor pad through a first set of beam strings, and said second set of anchor points is scattered another end of said two proof masses and connected with said second anchor pads through a second set of beam strings, so as to enhance and stabilize said oscillation of said two proof masses.

3 17. The microelectromechanical system, as recited in claim 15, wherein said central circuitry comprises a dither motion control circuitry and an angle rate signal loop circuitry.

4 18. The microelectromechanical system, as recited in claim 10, wherein said central circuitry comprises a dither motion control circuitry and an angle rate signal loop circuitry.

5 19. The microelectromechanical system, as recited in claim 17, wherein said dither motion control circuitry comprises:

a trans impedance amplifier circuit, which is connected to said angular rate sensor unit, changing an output impedance of said dither motion signals from a very high level, greater than 100 million ohms, to a low level, less than 100 ohms, to achieve two dither displacement signals, which are A/C voltage signals, representing a displacement between inertial elements and anchor combs;

a first amplifier and summer circuit, which is connected to said trans impedance amplifier circuit, amplifying said two dither displacement signals by at least ten times and enhancing a sensitivity for combining said two dither displacement signals to achieve a dither displacement differential signal by subtracting a center anchor comb signal with a side anchor comb signal;

Q1 (contd)
a first high-pass filter circuit, which is connected to said first amplifier and summer circuit, removing residual dither drive signals and noise from said dither displacement differential signal to form a filtered dither displacement differential signal;

a demodulator circuit, which is connected to said first high-pass filter circuit, receiving said capacitive pickoff excitation signals as phase reference signals from an oscillator and said filtered dither displacement differential signal from said first high-pass filter, and extracting an in-phase portion of said filtered dither displacement differential signal to produce an inertial element displacement signal with a known phase;

a first low-pass filter, which is connected to said demodulator circuit, removing a high frequency noise from said inertial element displacement signal inputted thereto to form a filtered low frequency inertial element displacement signal with a bandwidth less than 3000 Hz;

an amplifier, which is connected with said first low-pass filter, amplifying said filtered low frequency inertial element displacement signal; and

an analog/digital converter, which is connected to said amplifier, converting said filtered low frequency inertial element displacement signal that is an analog signal to produce a digitized filtered low frequency inertial element displacement signal as a digital sampled signal.

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6-20. The microelectromechanical system, as recited in claim 18, wherein said dither motion control circuitry comprises:

a trans impedance amplifier circuit, which is connected to said angular rate sensor unit, changing an output impedance of said dither motion signals from a very high level, greater than 100 million ohms, to a low level, less than 100 ohms, to achieve two dither displacement signals, which are A/C voltage signals, representing a displacement between inertial elements and anchor combs;

a first amplifier and summer circuit, which is connected to said trans impedance amplifier circuit, amplifying said two dither displacement signals by at least ten times and enhancing a sensitivity for combining said two dither displacement signals to achieve a dither displacement differential signal by subtracting a center anchor comb signal with a side anchor comb signal;

a first high-pass filter circuit, which is connected to said first amplifier and summer circuit, removing residual dither drive signals and noise from said dither displacement differential signal to form a filtered dither displacement differential signal;

a demodulator circuit, which is connected to said first high-pass filter circuit, receiving said capacitive pickoff excitation signals as phase reference signals from an oscillator and said filtered dither displacement differential signal from said first high-pass filter, and extracting an in-phase portion of said filtered dither displacement differential signal to produce an inertial element displacement signal with a known phase;

a first low-pass filter, which is connected to said demodulator circuit, removing a high frequency noise from said inertial element displacement signal inputted thereto to form a filtered low frequency inertial element displacement signal with a bandwidth less than 3000 Hz;

an amplifier, which is connected with said first low-pass filter, amplifying said filtered low frequency inertial element displacement signal; and

an analog/digital converter, which is connected to said amplifier, converting said filtered low frequency inertial element displacement signal that is an analog signal to produce a digitized filtered low frequency inertial element displacement signal as a digital sampled signal.

1. 21. The microelectromechanical system, as recited in claim 3, wherein said angle rate signal loop circuitry comprises:

a second high-pass filter circuit, which is connected to said angular rate sensor unit, removing low frequency noise of said angle rate signals which are voltage signals outputted from said angular rate sensor unit thereto to form filtered angle rate signals;

a voltage amplifier circuit, which is connected to said second high-pass filter circuit, amplifying said filtered angle rate signals to an extent of at least 100 millivolts to form amplified angle rate signals;

an amplifier and summer circuit, which is connected to said voltage amplifier circuit, subtracting a difference between angle rates of said amplified angle rate signals to produce a differential angle rate signal;

a demodulator, which is connected to said amplifier and summer circuit, extracting an amplitude of an in-phase differential angle rate signal from said differential angle rate signal and a reference signal from an oscillator;

a low-pass filter, which is connected to said demodulator, removing high frequency noises of an amplitude signal of said in-phase differential angle rate signal to form an angular rate signal output;

an integrator, which is connected with said low-pass filter, integrating said angular rate signal to form a displacement restoring signal without an offset; and

a driver amplifier, which is connected to said integrator, amplifying said displacement restoring signal without said offset to form a driving signal to said angular rate sensor unit.

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8 ~~22~~ 4 The microelectromechanical system, as recited in claim ~~19~~ 4, wherein said angle rate signal loop circuitry comprises:

a second high-pass filter circuit, which is connected to said angular rate sensor unit, removing low frequency noise of said angle rate signals which are voltage signals outputted from said angular rate sensor unit thereto to form filtered angle rate signals;

a voltage amplifier circuit, which is connected to said second high-pass filter circuit, amplifying said filtered angle rate signals to an extent of at least 100 millivolts to form amplified angle rate signals;

A (Contd)
an amplifier and summer circuit, which is connected to said voltage amplifier circuit, subtracting a difference between angle rates of said amplified angle rate signals to produce a differential angle rate signal;

a demodulator, which is connected to said amplifier and summer circuit, extracting an amplitude of an in-phase differential angle rate signal from said differential angle rate signal and a reference signal from an oscillator;

a low-pass filter, which is connected to said demodulator, removing high frequency noises of an amplitude signal of said in-phase differential angle rate signal to form an angular rate signal output;

an integrator, which is connected with said low-pass filter, integrating said angular rate signal to form a displacement restoring signal without an offset; and

a driver amplifier, which is connected to said integrator, amplifying said displacement restoring signal without said offset to form a driving signal to said angular rate sensor unit.

9 ~~23~~ 5 The microelectromechanical system, as recited in claim ~~19~~ 5, wherein said angle rate signal loop circuitry comprises:

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a second high-pass filter circuit, which is connected to said angular rate sensor unit, removing low frequency noise of said angle rate signals which are voltage signals outputted from said angular rate sensor unit thereto to form filtered angle rate signals;

a voltage amplifier circuit, which is connected to said second high-pass filter circuit, amplifying said filtered angle rate signals to an extent of at least 100 millivolts to form amplified angle rate signals;

an amplifier and summer circuit, which is connected to said voltage amplifier circuit, subtracting a difference between angle rates of said amplified angle rate signals to produce a differential angle rate signal;

a demodulator, which is connected to said amplifier and summer circuit, extracting an amplitude of an in-phase differential angle rate signal from said differential angle rate signal and a reference signal from said oscillator;

a low-pass filter, which is connected to said demodulator, removing high frequency noises of an amplitude signal of said in-phase differential angle rate signal to form an angular rate signal output;

an integrator, which is connected with said low-pass filter, integrating said angular rate signal to form a displacement restoring signal without an offset; and

a driver amplifier, which is connected to said integrator, amplifying said displacement restoring signal without said offset to form a driving signal to said angular rate sensor unit.

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24. The microelectromechanical system, as recited in claim ~~20~~⁶, wherein said angle rate signal loop circuitry comprises:

a second high-pass filter circuit, which is connected to said angular rate sensor unit, removing low frequency noise of said angle rate signals which are voltage signals outputted from said angular rate sensor unit thereto to form filtered angle rate signals;

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a voltage amplifier circuit, which is connected to said second high-pass filter circuit, amplifying said filtered angle rate signals to an extent of at least 100 millivolts to form amplified angle rate signals;

an amplifier and summer circuit, which is connected to said voltage amplifier circuit, subtracting a difference between angle rates of said amplified angle rate signals to produce a differential angle rate signal;

a demodulator, which is connected to said amplifier and summer circuit, extracting an amplitude of an in-phase differential angle rate signal from said differential angle rate signal and a reference signal from said oscillator;

a low-pass filter, which is connected to said demodulator, removing high frequency noises of an amplitude signal of said in-phase differential angle rate signal to form an angular rate signal output;

an integrator, which is connected with said low-pass filter, integrating said angular rate signal to form a displacement restoring signal without an offset; and

a driver amplifier, which is connected to said integrator, amplifying said displacement restoring signal without said offset to form a driving signal to said angular rate sensor unit.

11-25. The microelectromechanical system, as recited in claim 10, wherein said digital signal processing system comprises:

a discrete Fast Fourier Transform (FFT) module, receiving said digitized filtered low frequency inertial element displacement signal from said analog/digital converter of said dither motion control circuitry to form amplitude data with frequency spectrum of said inertial element displacement signal inputted;

a memory array of frequency and amplitude data module, receiving said amplitude data with said frequency spectrum to form an array of said amplitude data with said frequency spectrum;

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a maxima detection logic module, processing said array of said amplitude data with said frequency spectrum to choose frequencies having largest amplitudes in a local segment of said frequency spectrum from said array of said amplitude data;

an analysis and selection logic module to perform an analysis on said frequencies being chosen to select a selected frequency and a correct amplitude by computing a ratio of amplitude/area, wherein a frequency range for computing area is between $+1/2$ and $-1/2$ of a peak for each maximum frequency point;

a phase-lock loop served as a very narrow bandpass filter to reject noise of said frequency being selected to form one of said dither driver signals that contains said selected frequency;

a D/A converter, processing said amplitude being selected to form one of said dither driver signals that contains said correct amplitude; and

an amplifier generating and amplifying said dither driver signals to said angular rate sensor unit based on said dither driver signals containing said selected frequency and said correct amplitude.

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26. The microelectromechanical system, as recited in claim 20, wherein said digital signal processing system comprises:

a discrete Fast Fourier Transform (FFT) module, receiving said digitized filtered low frequency inertial element displacement signal from said analog/digital converter of said dither motion control circuitry to form amplitude data with frequency spectrum of said inertial element displacement signal inputted;

a memory array of frequency and amplitude data module, receiving said amplitude data with said frequency spectrum to form an array of said amplitude data with said frequency spectrum;

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a maxima detection logic module, processing said array of said amplitude data with said frequency spectrum to choose frequencies having largest amplitudes in a local segment of said frequency spectrum from said array of said amplitude data;

an analysis and selection logic module to perform an analysis on said frequencies being chosen to select a selected frequency and a correct amplitude by computing a ratio of amplitude/area, wherein a frequency range for computing area is between $+1/2$ and $-1/2$ of a peak for each maximum frequency point;

a phase-lock loop served as a very narrow bandpass filter to reject noise of said frequency being selected to form one of said dither driver signals that contains said selected frequency;

a D/A converter, processing said amplitude being selected to form one of said dither driver signals that contains said correct amplitude; and

an amplifier generating and amplifying said dither driver signals to said angular rate sensor unit based on said dither driver signals containing said selected frequency and said correct amplitude.

13. The microelectromechanical system, as recited in claim 2, wherein said digital signal processing system comprises:

a discrete Fast Fourier Transform (FFT) module, receiving said digitized filtered low frequency inertial element displacement signal from said analog/digital converter of said dither motion control circuitry to form amplitude data with frequency spectrum of said inertial element displacement signal inputted;

a memory array of frequency and amplitude data module, receiving said amplitude data with said frequency spectrum to form an array of said amplitude data with said frequency spectrum;

a maxima detection logic module, processing said array of said amplitude data with said frequency spectrum to choose frequencies having largest amplitudes in a local segment of said frequency spectrum from said array of said amplitude data;

an analysis and selection logic module to perform an analysis on said frequencies being chosen to select a selected frequency and a correct amplitude by computing a ratio of amplitude/area, wherein a frequency range for computing area is between $+1/2$ and $-1/2$ of a peak for each maximum frequency point;

a phase-lock loop served as a very narrow bandpass filter to reject noise of said frequency being selected to form one of said dither driver signals that contains said selected frequency;

a D/A converter, processing said amplitude being selected to form one of said dither driver signals that contains said correct amplitude; and

an amplifier generating and amplifying said dither driver signals to said angular rate sensor unit based on said dither driver signals containing said selected frequency and said correct amplitude.

¹⁴ 26. The microelectromechanical system, as recited in claim ⁸ 22, wherein said digital signal processing system comprises:

a discrete Fast Fourier Transform (FFT) module, receiving said digitized filtered low frequency inertial element displacement signal from said analog/digital converter of said dither motion control circuitry to form amplitude data with frequency spectrum of said inertial element displacement signal inputted;

a memory array of frequency and amplitude data module, receiving said amplitude data with said frequency spectrum to form an array of said amplitude data with said frequency spectrum;

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a maxima detection logic module, processing said array of said amplitude data with said frequency spectrum to choose frequencies having largest amplitudes in a local segment of said frequency spectrum from said array of said amplitude data;

an analysis and selection logic module to perform an analysis on said frequencies being chosen to select a selected frequency and a correct amplitude by computing a ratio of amplitude/area, wherein a frequency range for computing area is between $+1/2$ and $-1/2$ of a peak for each maximum frequency point;

a phase-lock loop served as a very narrow bandpass filter to reject noise of said frequency being selected to form one of said dither driver signals that contains said selected frequency;

a D/A converter, processing said amplitude being selected to form one of said dither driver signals that contains said correct amplitude; and

an amplifier generating and amplifying said dither driver signals to said angular rate sensor unit based on said dither driver signals containing said selected frequency and said correct amplitude.

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20. The microelectromechanical system, as recited in claim 20, wherein said digital signal processing system comprises:

a discrete Fast Fourier Transform (FFT) module, receiving said digitized filtered low frequency inertial element displacement signal from said analog/digital converter of said dither motion control circuitry to form amplitude data with frequency spectrum of said inertial element displacement signal inputted;

a memory array of frequency and amplitude data module, receiving said amplitude data with said frequency spectrum to form an array of said amplitude data with said frequency spectrum;

a maxima detection logic module, processing said array of said amplitude data with said frequency spectrum to choose frequencies having largest amplitudes in a local segment of said frequency spectrum from said array of said amplitude data;

an analysis and selection logic module to perform an analysis on said frequencies being chosen to select a selected frequency and a correct amplitude by computing a ratio of amplitude/area, wherein a frequency range for computing area is between $+1/2$ and $-1/2$ of a peak for each maximum frequency point;

a phase-lock loop served as a very narrow bandpass filter to reject noise of said frequency being selected to form one of said dither driver signals that contains said selected frequency;

a D/A converter, processing said amplitude being selected to form one of said dither driver signals that contains said correct amplitude; and

an amplifier generating and amplifying said dither driver signals to said angular rate sensor unit based on said dither driver signals containing said selected frequency and said correct amplitude.

16 20 The microelectromechanical system, as recited in claim *10* ~~24~~, wherein said digital signal processing system comprises:

a discrete Fast Fourier Transform (FFT) module, receiving said digitized filtered low frequency inertial element displacement signal from said analog/digital converter of said dither motion control circuitry to form amplitude data with frequency spectrum of said inertial element displacement signal inputted;

a memory array of frequency and amplitude data module, receiving said amplitude data with said frequency spectrum to form an array of said amplitude data with said frequency spectrum;

a maxima detection logic module, processing said array of said amplitude data with said frequency spectrum to choose frequencies having largest amplitudes in a local segment of said frequency spectrum from said array of said amplitude data;

an analysis and selection logic module to perform an analysis on said frequencies being chosen to select a selected frequency and a correct amplitude by computing a ratio of amplitude/area, wherein a frequency range for computing area is between $+1/2$ and $-1/2$ of a peak for each maximum frequency point;

a phase-lock loop served as a very narrow bandpass filter to reject noise of said frequency being selected to form one of said dither driver signals that contains said selected frequency;

a D/A converter, processing said amplitude being selected to form one of said dither driver signals that contains said correct amplitude; and

an amplifier generating and amplifying said dither driver signals to said angular rate sensor unit based on said dither driver signals containing said selected frequency and said correct amplitude.

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REMARKS-General

1. The newly drafted independent claim 15 incorporates all structural limitations of the original claim 1 and includes further limitations previously brought forth in the disclosure. No new matter has been included. All new claims 15 to 30 are submitted to be of sufficient clarity and detail to enable a person of average skill in the art to make and use the instant invention, so as to be pursuant to 35 USC 112.

2. A new declaration is filed herewith, as required by the Examiner, to substitute the defective declaration filed on 09/15/2000, as pursuant to MPEP §602.1 and §602.2.

Response to Rejection of Claims 1 to 14 under 35USC112

3. The applicant submits that the newly drafted claims 15 to 30 particularly point out and distinctly claim the subject matter of the instant invention, as pursuant to 35USC112.

Response to Rejection of Claims 1 to 14 under Obviousness Double Patenting

4. The applicant submits a terminal disclaimer herewith, in compliance with 37CFR1.321(c), to disclaim the terminal part of the statutory term of any patent granted on instant application which would extend beyond the expiration date of the full statutory term defined in 35 U.S.C. 154 to 156 and 173, as presently shortened by any terminal disclaimer, of prior Patent No. 6,311,555, in order to overcome the rejection of the claims 1 to 14, which are rewritten to the newly drafted claims 15 to 30, under the judicially created doctrine of obviousness-type double patenting as being unpatentable over claims 1 to 69 of the U.S. Patent No. 6,311,555.

Response to Rejection of Claims 1 and 3-4 under 35USC102(e)

5. The Examiner rejected claims 1 and 3-4 under 35 USC 102(e) as being anticipated by Wyse et al (U.S. 5,983,718), in which the Examiner appears to reason that since Wyse et al discloses a signal processing system for an inertial sensor comprising, as illustrated in Fig. 2-9, an angular rate unit a central circuitry; digital signal processing system wherein the central circuitry includes a dither motion control circuitry and an angle signal loop circuitry.

6. The applicants respectfully submit that, regarding to the broadest independent claim 1 of Wyse et al and in view of the disclosure thereof, Wyse et al fails to read upon the instant invention and the claims 1 and 3-4 also do not read upon Wyse et al. Wyse et al fails to suggest the claimed features of the angular rate sensor unit as claimed in the newly drafted claim 15 and the circuitry arrangement as claimed in the newly drafted claims 15 to 30 of the instant invention. Wyse et al, in addition, does not suggest the central circuitry and the digital signal processing system that could analyze the digital low frequency inertial element displacement signals. Accordingly, applicants believe that the newly drafted claims 15 to 30 are allowable in view of the cited art, Wyse et al, under 35 USC 102(e).

Response to Rejection of Claims 1 to 14 under 35USC102(e)

7. The Examiner also rejected claims 1 to 14 under 35 USC 102(e) as being anticipated by the applicants' previous issued patent U.S. 6,311,555.

Pursuant to 35 U.S.C. 102(e), "a person shall be entitled to a patent unless:

(e) the invention was described in a patent granted on an application for patent **by another** filed in the United States before the invention thereof by the applicant for patent, or an international application **by another** who has fulfilled the requirements of paragraphs (1), (2), and (4) of section 371(c) of this title before the invention thereof by the applicant for patent."

8. In view of 35 U.S.C. 102(e), it is apparent that a person shall not be entitled to a patent when his or her invention was described in a patent by another patent filed in the United States before the invention thereof by the applicant. However, the instant invention is filed on 08/15/2000 which is about one year earlier than the date of patent, 11/06/2001, of the '555 patent.

9. Also, the '555 patent and the instant invention are not the same invention according to the fact that the independent claims 1 and 49 of the 555 patent does not read upon the instant invention and the newly drafted independent claim 15 of the instant invention does not read upon the '555 patent too.

10. Moreover, both the instant invention and the '555 patent are invented by Dr. Ching-Fang Lin and Dr. Hiram McCall and owed by the assignee American GNC Corporation. In other words, **the '555 is not a patent granted on application for patent by another**, the 35USC102(e) does not apply to the instant invention. Accordingly, applicants believe that the rejection of claims 1 to 14 under 35USC102(e) as anticipated by the '555 patent is improper and should be withdrawn.

Response to Rejection of Claims 2 and 5-14 under 35USC103

11. The Examiner rejected claims 2 and 5-14 over Wyse et al (U.S. 5,983,718) in view of the applicants' own previous patent U.S. 6,311,555, wherein the Examiner appears to reason that although Wyse et al does not **suggest** the claimed features of the angular rate sensor unit and the circuitry arrangement. But this is clearly **not** a proper basis for combining references in making out an obviousness rejection of the present claims. Rather, the invention must be **considered as a whole** and there **must be something in the reference that suggests the combination or the modification**. See Lindemann Maschinenfabrik GMBH v. American Hoist & Derrick, 221 U.S.P.Q. 481, 488 (Fed. Cir. 1984) ("The claimed invention must be considered as a whole, and the question is **whether there is something in the prior art as a whole to suggest the desirability, and thus the obviousness, of making the combination**"), In re Gordon, 221 U.S.P.Q. 1125, 1127 (Fed. Cir. 1984), ("The mere fact that the prior art could be so modified would not have made the modification obvious unless the prior art suggested the desirability of the modification.") In re Laskowski, 10 U.S.P.Q.2d 1397, 1398 (Fed. Cir. 1989), ("Although the Commissioner suggests that [the structure in the primary prior art reference] could readily be modified to form the [claimed] structure, "[t]he mere fact that the prior art could be modified would not have made the modification obvious unless the prior art suggested the desirability of the modification.")

12. In the present case, there is no such suggestion. The Examiner admits that Wyse et al does not suggest the claimed features of the angular rate sensor and the circuitry arrangement. In other words, Wyse et al fails to contain something as a whole to suggest the desirability, and thus the obviousness, of making the combination. Furthermore, only a published patent that has a publication date earlier than the filing date of the instant invention would be qualified as a cited reference of the instant invention. However, the cited art, U.S. 6,311,555, was patented and published more



than one year after the filing date of the instant invention and thus the '555 patent is not a prior art of the instant invention. In addition, a terminal disclaimer is filed with this Amendment A substantially precludes the applicants' own '555 patent as reference to reject the instant invention,

13. Accordingly, the '555 patent should be precluded as reference to reject the instant invention and the applicants believe that the rejection of the instant invention under 35USC103 as being unpatentable over Wyse et al in view of the '555 patent is improper and should be withdrawn.

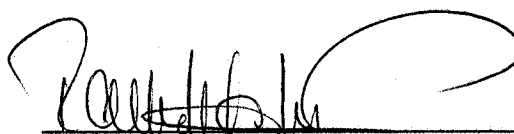
The Cited but Non-Applied References

14. The cited but not relied upon references have been studied and are greatly appreciated, but are deemed to be less relevant than the relied upon references.

15. A terminal disclaimer is filed herewith, in which a check in an amount of US\$55.00 is submitted herewith to pay the statutory disclaimer fee. This amount is believed to be correct; however, the Commissioner is hereby authorized to charge any deficiency or credit any overpayment to Deposit Account No. 502111.

16. In view of the above, it is submitted that the claims are in condition for allowance. Reconsideration and withdrawal of the rejection are requested. Allowance of the newly drafted claims 15 to 30 at an early date is solicited.

Respectfully submitted, ✓

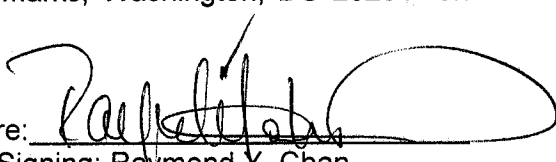


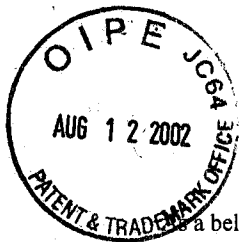
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CERTIFICATE OF MAILING

I hereby certify that this corresponding is being deposited with the United States Postal Service by First Class Mail, with sufficient postage, in an envelope addressed to "Box Amendments, Commissioner of Patents and Trademarks, Washington, DC 20231" on the date below.

Date: August 08, 2002

Signature: 
Person Signing: Raymond Y. Chan



Attorney/Docket No: USP9952A-GNC

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DECLARATION FOR PATENT APPLICATION

I, a below named inventor, I hereby declare that:

My residence, post office address and citizenship are as stated below next to my name.

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled

MicroElectroMechanical System for Measuring Angular Rate

the specification of which is attached hereto unless the following box is checked:

☒ was filed on 09/15/2000 as United States Application Number or PCT International Application Number 09/7662,438 and was amended on _____ (if applicable).

I hereby state that I have reviewed and understand the contents of the above identified specification, including the claims, as amended by any amendment referred to above.

I acknowledge the duty to disclose information which is material to patentability as defined in 37 CFR 1.56.

I hereby claim foreign priority benefits under 35 USC 119 of any foreign application(s) for patent or inventor's certificate listed below and have also identified below any foreign application for patent or inventor's certificate having a filing date before that of the application on which priority is claimed.

Prior Foreign Application(s)

_____ (Number)	_____ (Country)	_____ (Day/Month/Year Filed)
_____ (Number)	_____ (Country)	_____ (Day/Month/Year Filed)
_____ (Number)	_____ (Country)	_____ (Day/Month/Year Filed)

Priority Claimed

☐ Yes ☐ No
☐ Yes ☐ No
☐ Yes ☐ No

I hereby claimed the benefit under 35 USC 120 of any United States application(s) listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States application in the manner provided by the first paragraph of 35 USC 112, I acknowledge the duty to disclose information which is material to patentability as defined in 37 CFR 1.56 which became available between the filing date of the prior application and the national or PCT international filing date of this application.

<u>60/154,700</u> (Application Number)	<u>09/16/1999</u> (Filing Date)	<u>Pending</u> (Status-patented, pending, abandoned)
_____ (Application Number)	_____ (Filing Date)	_____ (Status-patented, pending, abandoned)

I hereby appoint the following attorney(s) and/or agent(s), with full powers of substitution and revocation, to prosecute this application and to transact all business in the Patent and Trademark Office connected therewith:

Raymond Yat Chiu Chan, Reg. No. 37,484
Address all correspondence to: **516 San Luis Rey Road, Arcadia, CA 91007**
Telephone Calls to: **(818) 571-9812**

I hereby declare that all Statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

Full name of sole or first inventor (given name, family name) Hiram McCall

Inventor's signature Hiram McCall Date AUGUST 8, 2002
Residence 9131 Mason Ave., Chatsworth, CA 91311 Citizenship U.S.A.
Post Office Address 9131 Mason Ave., Chatsworth, CA 91311

Full name of second joint inventor, if any (given name, family name) Ching-Fang Lin

Second Inventor's signature Ching-Fang Lin Date AUGUST 8, 2002
Residence 9131 Mason Ave., Chatsworth, CA 91311 Citizenship U.S.A.
Post Office Address 9131 Mason Ave., Chatsworth, CA 91311

☐ Additional inventors are being named on separately numbered sheets attached hereto.



Docket N

USP9952A-GNC

TERMINAL DISCLAIMER
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**TERMINAL DISCLAMINER TO OBVIATE A DOUBLE PATENTING REJECTION
OVER A PRIOR PATENT**

In re Application of:
Application No.: 09/662,438
Filed: 09/15/2000
For: MicroElectroMechanical System for Measuring Angular Rate

#5

OFFICE OF THE SPECIAL
PROGRAMS EXAMINER

AUG 28 2002

The owner*, American GNC Corporation, of one hundred percent interest in the instant application hereby disclaims, except as provided below, the terminal part of the statutory term of any patent granted on instant application which would extend beyond the expiration date of the full statutory term defined in 35 U.S.C.154 to 156 and 173, as presently shortened by any terminal disclaimer, of prior Patent No. US 6,311,555 B1. The owner hereby agrees that any patent so granted on the instant application shall be enforceable only for and during such period that it and the prior patent are commonly owned. This agreement runs with any patent granted on the instant application and is binding upon the grantee, its successors or assigns.

In making the above disclaimer, the owner does not disclaim the terminal part of any patent granted on the instant application that would extend to the expiration date of the full statutory term as defined in 35U.S.C.154 to 156 and 173 of the prior patent, as presently shortened by any terminal disclaimer, in the event that it later: expires for failure to pay a maintenance fee, is held unenforceable, is found invalid by a court of competent jurisdiction, is statutorily disclaimed in whole or terminally disclaimed under 37CFR1.321, has all claims canceled by a reexamination certificate, is reissued, or is in any manner terminated prior to the expiration of its full statutory term as presently shortened by any terminal disclaimer.

Check either box 1 or 2 below, if appropriate.

1. ☐ For submissions on behalf of an organization (e.g., corporation, partnership, university, government agency, etc.), the undersigned is empowered to act on behalf of the organization.

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

2. ☒ The undersigned is an attorney or agent of record.

08/14/2002 HDEMESS1 00000024 09662438

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Signature
Raymond Y. Chan
Reg. No. 37,484

August 08, 2002
Date

Terminal disclaimer fee under 37 CFR 1.20(d) included.

*Statement under 37 CFR 3.73(b) is required if terminal disclaimer is signed by the assignee (owner).

TECHNOLOGY CENTER 2800

AUG 20 2002

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In The United States Patent and Trademark Office

Application Number: 09/662,438
Applicants: Hiram McCall et al
Filing Date: 09/15/2000

Examiner: Helen C. Kwok
Group Art Unit: 2856

Title: Microelectromechanical System for Measuring Angular Rate

Date: August 13, 2002

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SUPPLEMENTAL AMENDMENT

Honorable Commissioner of Patents and Trademarks
Washington, D.C. 20231

Sir:

In addition to the response filed on August 08, 2002 in responsive to the Office Action mailed 02/08/2002, the applicants further submit the following supplemental argument **regarding to the rejection of claims 1-14 under 35USC102 and 35USC103** with respect to the cited art, Wyse et al:

1. The applicants respectfully submit that the instant invention is applied to a gyro which outputs a signal by producing a sine wave of varying amplitude formed from the difference of the two plate displacements. The instant invention as claimed in the newly drafted independent claim 15 is different from the cited art, Wyse et al, U.S. 5,983,718 that the instant invention is for an angular rate measurement device utilizing a change of angular momentum as manifested by a change in displacement and not from an external torqueing force such as an electric field as in the reference. The instant invention does not use or need a notch filter or servo compensator and posses any means to retorque the sensing element.
2. Referring to the claim 2 of the cited art, Wyse et al, no high pass filter is connected to a cosine demodulator or to a quadrature phase signal processing channel nor is there an acceleration feedback loop. However, the instant invention suggests a Digital Phase lock loop and digital phase and frequency selection logic (Q selection logic) is used to produce low uncertainty in phase and gain variations, the referenced

claim three uses a filter to reject the dither frequency rather than to select a optimum frequency.

3. Regarding to the claim 4 of Wyse et al, it uses a sine demodulator and cosine demodulator to pickoff the rate signal while the instant invention uses an amplitude demodulator only.

4. Regarding to the claim 5 of Wyse et al, it uses a lookup table to provide the reference signals and a summer to produce specified amplitude and phase. However, the instant invention uses a Quality factor selection logic or maximum amplitude detection logic to select reference frequency. The amplitude is, not selected by is only controlled to be a constant.

5. Regarding to the claim 6 of Wyse et al, it adjusts the dither angular velocity to be in phase with the cosine waveform while the instant invention has no requirement to be in phase.

6. The claim 7 of Wyse et al claims the use of a notch filter and the instant invention does not need a notch filter because it does not use rebalance torques.

7. The claim 8 of Wyse et al makes use of a servo compensation circuit and a remodulator while the instant invention does not use a servo compensation loop or remodulator.

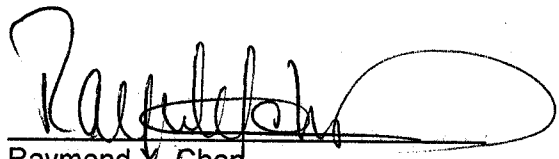
8. The claim 9 of Wyse et al uses a feedback torque and notch filter while the instant invention use a feedback torque or a notch filter.

9. The claim 10 of Wyse et al detects a linear acceleration signal and uses it to produce a correction term and the instant invention has no means or circuitry to measure or compensated for liner acceleration.

10. The claim 11 of Wyse et al uses an adjustment to provide an in phase signal to the dither angular velocity but the instant invention does not use any phase adjusting techniques.

11. In view of the above, it is submitted that the claims are in condition for allowance. Reconsideration and withdrawal of the rejection are requested. Allowance of the newly drafted claims 15 to 30 at an early date is solicited.

Respectfully submitted,



Raymond Y. Chan
Reg. Nr.: 37,484
1050 Oakdale Ave.
Arcadia, CA 91006-2222
Tel.: 1-626-571-9812
Fax.: 1-626-571-9813

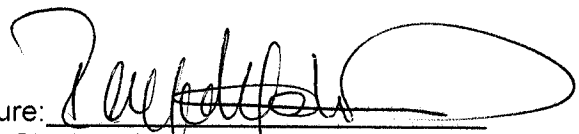
CERTIFICATE OF MAILING

I hereby certify that this corresponding is being deposited with the United States Postal Service by First Class Mail, with sufficient postage, in an envelope addressed to "Box Amendments, Commissioner of Patents and Trademarks, Washington, DC 20231" on the date below.

Date:

August 13, 2002

Signature:


Person Signing: Raymond Y. Chan

Notice of Allowability

Application No.

09/662,438

Applicant(s)

McCall et al.

Examiner

H. Kwok

Art Unit

2856



--The MAILING DATE of this communication appears on the cover sheet with the correspondence address--

All claims being allowable, PROSECUTION ON THE MERITS IS (OR REMAINS) CLOSED in this application. If not included herewith (or previously mailed), a Notice of Allowance (PTOL-85) or other appropriate communication will be mailed in due course. **THIS NOTICE OF ALLOWABILITY IS NOT A GRANT OF PATENT RIGHTS.** This application is subject to withdrawal from issue at the initiative of the Office or upon petition by the applicant. See 37 CFR 1.313 and MPEP 1308.

1. ☒ This communication is responsive to August 12, 2002 and August 19, 2002.
2. ☒ The allowed claim(s) is/are 15-30.
3. ☒ The drawings filed on 9-15-00 are accepted by the Examiner.
4. ☐ Acknowledgement is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d).
- a) ☐ All b) ☐ Some* c) ☐ None of the:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____.
3. ☐ Copies of the certified copies of the priority documents have been received in this national stage application from the International Bureau (PCT Rule 17.2(a)).

*Certified copies not received: _____

5. ☒ Acknowledgement is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).
- (a) ☐ The translation of the foreign language provisional application has been received.
6. ☐ Acknowledgement is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Applicant has THREE MONTHS FROM THE "MAILING DATE" of this communication to file a reply complying with the requirements noted below. Failure to timely comply will result in ABANDONMENT of this application. **THIS THREE-MONTH PERIOD IS NOT EXTENDABLE.**

7. ☐ A SUBSTITUTE OATH OR DECLARATION must be submitted. Note the attached EXAMINER'S AMENDMENT or NOTICE OF INFORMAL PATENT APPLICATION (PTO-152) which gives reason(s) why the oath or declaration is deficient.
8. ☐ CORRECTED DRAWINGS must be submitted.
- (a) ☐ including changes required by the Notice of Draftsperson's Patent Drawing Review (PTO-948) attached
- 1) ☐ hereto or 2) ☐ to Paper No. _____.
- (b) ☐ including changes required by the proposed drawing correction filed _____, which has been approved by the examiner.
- (c) ☐ including changes required by the attached Examiner's Amendment/Comment or in the Office action of Paper No. _____.

Identifying indicia such as the application number (see 37 CFR 1.84(c)) should be written on the drawings in the top margin (not the back) of each sheet. The drawings should be filed as a separate paper with a transmittal letter addressed to the Official Draftsperson.

9. ☐ DEPOSIT OF and/or INFORMATION about the deposit of BIOLOGICAL MATERIAL must be submitted. Note the attached Examiner's comment regarding REQUIREMENT FOR THE DEPOSIT OF BIOLOGICAL MATERIAL.

Attachment(s)

- | | |
|--|--|
| 1 ☐ Notice of References Cited (PTO-892) | 2 ☐ Notice of Informal Patent Application (PTO-152) |
| 3 ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948) | 4 ☐ Interview Summary (PTO-413), Paper No. _____ |
| 5 ☐ Information Disclosure Statement(s) (PTO-1449), Paper No(s). _____ | 6 ☒ Examiner's Amendment/Comment |
| 7 ☐ Examiner's Comment Regarding Requirement for Deposit of Biological Material | 8 ☐ Examiner's Statement of Reasons for Allowance |
| 9 ☐ Other | |

Application/Control Number: 09/662,438

Page 2

Art Unit: 2856

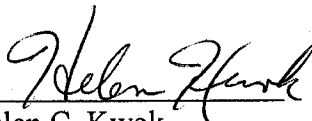
DETAILED ACTION

Examiner's Amendment/Comment

1. The terminal disclaimer filed on August 12, 2002 disclaiming the terminal portion of any patent granted on this application which would extend beyond the expiration date of any patent granted on Application Number 09/442,596 (U.S. Patent 6,311,555) has been reviewed and is accepted. The terminal disclaimer has been recorded.

Conclusion

2. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Helen Kwok whose telephone number is (703) 308-8149.


Helen C. Kwok
Art Unit 2856

hck
September 6, 2002



UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER OF PATENTS AND TRADEMARKS
Washington, D.C. 20231
www.uspto.gov

NOTICE OF ALLOWANCE AND FEE(S) DUE

7590

09/16/2002

Raymond Y C Chan
1050 Oakdale Ave
Arcadia, CA 91006-2222

EXAMINER

KWOK, HELEN C

ART UNIT

CLASS-SUBCLASS

2856

073-514320

DATE MAILED: 09/16/2002

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/662,438	09/15/2000	Hiram McCall	USP9952A-GNC	4238

TITLE OF INVENTION: MICROELECTROMECHANICAL SYSTEM FOR MEASURING ANGULAR RATE

APPLN. TYPE	SMALL ENTITY	ISSUE FEE	PUBLICATION FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	YES	\$640	\$0	\$640	12/16/2002

THE APPLICATION IDENTIFIED ABOVE HAS BEEN EXAMINED AND IS ALLOWED FOR ISSUANCE AS A PATENT. **PROSECUTION ON THE MERITS IS CLOSED.** THIS NOTICE OF ALLOWANCE IS NOT A GRANT OF PATENT RIGHTS. THIS APPLICATION IS SUBJECT TO WITHDRAWAL FROM ISSUE AT THE INITIATIVE OF THE OFFICE OR UPON PETITION BY THE APPLICANT. SEE 37 CFR 1.313 AND MPEP 1308.

THE ISSUE FEE AND PUBLICATION FEE (IF REQUIRED) MUST BE PAID WITHIN **THREE MONTHS** FROM THE MAILING DATE OF THIS NOTICE OR THIS APPLICATION SHALL BE REGARDED AS ABANDONED. **THIS STATUTORY PERIOD CANNOT BE EXTENDED.** SEE 35 U.S.C. 151. THE ISSUE FEE DUE INDICATED ABOVE REFLECTS A CREDIT FOR ANY PREVIOUSLY PAID ISSUE FEE APPLIED IN THIS APPLICATION. THE PTOL-85B (OR AN EQUIVALENT) MUST BE RETURNED WITHIN THIS PERIOD EVEN IF NO FEE IS DUE OR THE APPLICATION WILL BE REGARDED AS ABANDONED.

HOW TO REPLY TO THIS NOTICE:

I. Review the SMALL ENTITY status shown above.

If the SMALL ENTITY is shown as YES, verify your current SMALL ENTITY status:

A. If the status is the same, pay the TOTAL FEE(S) DUE shown above.

B. If the status is changed, pay the PUBLICATION FEE (if required) and twice the amount of the ISSUE FEE shown above and notify the United States Patent and Trademark Office of the change in status, or

If the SMALL ENTITY is shown as NO:

A. Pay TOTAL FEE(S) DUE shown above, or

B. If applicant claimed SMALL ENTITY status before, or is now claiming SMALL ENTITY status, check the box below and enclose the PUBLICATION FEE and 1/2 the ISSUE FEE shown above.

☐ Applicant claims SMALL ENTITY status.
See 37 CFR 1.27.

II. PART B - FEE(S) TRANSMITTAL should be completed and returned to the United States Patent and Trademark Office (USPTO) with your ISSUE FEE and PUBLICATION FEE (if required). Even if the fee(s) have already been paid, Part B - Fee(s) Transmittal should be completed and returned. If you are charging the fee(s) to your deposit account, section "4b" of Part B - Fee(s) Transmittal should be completed and an extra copy of the form should be submitted.

III. All communications regarding this application must give the application number. Please direct all communications prior to issuance to Box ISSUE FEE unless advised to the contrary.

IMPORTANT REMINDER: Utility patents issuing on applications filed on or after Dec. 12, 1980 may require payment of maintenance fees. It is patentee's responsibility to ensure timely payment of maintenance fees when due.

PART B - FEE(S) TRANSMITTAL

Complete and send this form, together with applicable fee(s), to: **Mail** **Box ISSUE FEE**
Commissioner for Patents
Washington, D.C. 20231
Fax **(703)746-4000**

INSTRUCTIONS: This form should be used for transmitting the ISSUE FEE and PUBLICATION FEE (if required). Blocks 1 through 4 should be completed where appropriate. All further correspondence including the Patent, advance orders and notification of maintenance fees will be mailed to the current correspondence address as indicated unless corrected below or directed otherwise in Block 1, by (a) specifying a new correspondence address; and/or (b) indicating a separate "FEE ADDRESS" for maintenance fee notifications.

CURRENT CORRESPONDENCE ADDRESS (Note: Legibly mark-up with any corrections or use Block 1)
7590 09/16/2002

Raymond Y C Chan
1050 Oakdale Ave
Arcadia, CA 91006-2222

Note: A certificate of mailing can only be used for domestic mailings of the Fee(s) Transmittal. This certificate cannot be used for any other accompanying papers. Each additional paper, such as an assignment or formal drawing, must have its own certificate of mailing or transmission.

Certificate of Mailing or Transmission
I hereby certify that this Fee(s) Transmittal is being deposited with the United States Postal Service with sufficient postage for first class mail in an envelope addressed to the Box Issue Fee address above, or being facsimile transmitted to the USPTO, on the date indicated below.

(Depositor's name)
(Signature)
(Date)

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/662,438	09/15/2000	Hiram McCall	USP9952A-GNC	4238

TITLE OF INVENTION: MICROELECTROMECHANICAL SYSTEM FOR MEASURING ANGULAR RATE

APPLN. TYPE	SMALL ENTITY	ISSUE FEE	PUBLICATION FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	YES	\$640	\$0	\$640	12/16/2002

EXAMINER	ART UNIT	CLASS-SUBCLASS
KWOK, HELEN C	2856	073-514320

1. Change of correspondence address or indication of "Fee Address" (37 CFR 1.363).

- ☐ Change of correspondence address (or Change of Correspondence Address form PTO/SB/122) attached.
- ☐ "Fee Address" indication (or "Fee Address" Indication form PTO/SB/47; Rev 03-02 or more recent) attached. Use of a Customer Number is required.

2. For printing on the patent front page, list (1) the names of up to 3 registered patent attorneys or agents OR, alternatively, (2) the name of a single firm (having as a member a registered attorney or agent) and the names of up to 2 registered patent attorneys or agents. If no name is listed, no name will be printed.

1 _____

2 _____

3 _____

3. ASSIGNEE NAME AND RESIDENCE DATA TO BE PRINTED ON THE PATENT (print or type)

PLEASE NOTE: Unless an assignee is identified below, no assignee data will appear on the patent. Inclusion of assignee data is only appropriate when an assignment has been previously submitted to the USPTO or is being submitted under separate cover. Completion of this form is NOT a substitute for filing an assignment.

(A) NAME OF ASSIGNEE

(B) RESIDENCE: (CITY and STATE OR COUNTRY)

Please check the appropriate assignee category or categories (will not be printed on the patent) ☐ individual ☐ corporation or other private group entity ☐ government

4a. The following fee(s) are enclosed:

- ☐ Issue Fee
- ☐ Publication Fee
- ☐ Advance Order - # of Copies _____

4b. Payment of Fee(s):

- ☐ A check in the amount of the fee(s) is enclosed.
- ☐ Payment by credit card. Form PTO-2038 is attached.
- ☐ The Commissioner is hereby authorized by charge the required fee(s), or credit any overpayment, to Deposit Account Number _____ (enclose an extra copy of this form).

Commissioner for Patents is requested to apply the Issue Fee and Publication Fee (if any) or to re-apply any previously paid issue fee to the application identified above.

(Authorized Signature)

(Date)

NOTE: The Issue Fee and Publication Fee (if required) will not be accepted from anyone other than the applicant; a registered attorney or agent; or the assignee or other party in interest as shown by the records of the United States Patent and Trademark Office.

This collection of information is required by 37 CFR 1.311. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 12 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, Washington, D.C. 20231. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Commissioner for Patents, Washington, DC 20231.

Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number.

TRANSMIT THIS FORM WITH FEE(S)



UNITED STATES PATENT AND TRADEMARK OFFICE

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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/662,438	09/15/2000	Hiram McCall	USP9952A-GNC	4238
7590	09/16/2002		EXAMINER	
Raymond Y C Chan 1050 Oakdale Ave Arcadia, CA 91006-2222			KWOK, HELEN C	
			ART UNIT	PAPER NUMBER
			2856	

DATE MAILED: 09/16/2002

Determination of Patent Term Adjustment under 35 U.S.C. 154 (b)
(application filed on or after May 29, 2000)

The patent term adjustment to date is 0 days. If the issue fee is paid on the date that is three months after the mailing date of this notice and the patent issues on the Tuesday before the date that is 28 weeks (six and a half months) after the mailing date of this notice, the term adjustment will be 0 days.

If a continued prosecution application (CPA) was filed in the above-identified application, the filing date that determines patent term adjustment is the filing date of the most recent CPA.

Applicant will be able to obtain more detailed information by accessing the Patent Application Information Retrieval (PAIR) system. (<http://pair.uspto.gov>)



UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/662,438	09/15/2000	Hiram McCall	USP9952A-GNC	4238
7590	09/16/2002		EXAMINER	
Raymond Y C Chan 1050 Oakdale Ave Arcadia, CA 91006-2222 UNITED STATES			KWOK, HELEN C	
			ART UNIT	PAPER NUMBER
			2856	

DATE MAILED: 09/16/2002

Notice of Possible Fee Increase on October 1, 2002

If a reply to a "Notice of Allowance and Fee(s) Due" is filed in the Office on or after October 1, 2002, then the amount due may be higher than that set forth in the "Notice of Allowance and Fee(s) Due" since there may be an increase in fees effective on October 1, 2002. See Revision of Patent and Trademark Fees for Fiscal Year 2003: Notice of Proposed Rulemaking, 67 Fed. Reg. 30634, 30636 (May 7, 2002). Although a change to the amount of the publication fee is not currently proposed for October 2002, if the issue fee or publication fee is to be paid on or after October 1, 2002, applicant should check the USPTO web site for the current fees before submitting the payment. The USPTO Internet address for the fee schedule is: <http://www.uspto.gov/main/howtofees.htm>.

If the issue fee paid is the amount shown on the "Notice of Allowance and Fee(s) Due," but not the correct amount in view of any fee increase, a "Notice to Pay Balance of Issue Fee" will be mailed to applicant. In order to avoid processing delays associated with mailing of a "Notice to Pay Balance of Issue Fee," if the response to the Notice of Allowance and Fee(s) due form is to be filed on or after October 1, 2002 (or mailed with a certificate of mailing on or after October 1, 2002), the issue fee paid should be the fee that is required at the time the fee is paid. If the issue fee was previously paid, and the response to the "Notice of Allowance and Fee(s) Due" includes a request to apply a previously-paid issue fee to the issue fee now due, then the difference between the issue fee amount at the time the response is filed and the previously paid issue fee should be paid. See Manual of Patent Examining Procedure, Section 1308.01 (Eighth Edition, August 2001).

Questions relating to issue and publication fee payments should be directed to the Customer Service Center of the Office of Patent Publication at (703) 305-8283.



UNITED STATES DEPARTMENT OF COMMERCE
Patent and Trademark Office
ASSISTANT SECRETARY AND COMMISSIONER
OF PATENTS AND TRADEMARKS
Washington, D.C. 20231

H/S

ATTN: MR. KUNDERT
AFMC LO/JAZ
2240 B STREET, ROOM 100
WRIGHT-PATTERSON AFB, OH 45433-7109

PATENT & TRADEMARK OFFICE
MAILED

SEP 10 2002

LICENSING & REVIEW

ATTN: MR. KUNDERT

The application identified below was referred to you for review under 35 U.S.C. §181 on 10/16/00. The Patent and Trademark Office has not received a communication from you regarding secrecy of this application under §181.

Examination of this application has been completed and has been found to be in condition for allowance. Since the Patent and Trademark Office has no authority to withhold the issue of a patent absent a recommendation for a secrecy order under §181, this application is being prepared for issue as a patent.

The Access Acknowledgment mailed to you must be returned to this Office.

Referred Application
Serial Number

~~Serial Number of File Wrapper~~
Continuation Application (if any)

Filing Date of
Referred Appl

09/662,438

09/15/00

Sincerely,

Joyce B. Brown
Joyce B. Brown
Review Supervisor
Licensing & Review

4/9/01
Waters
JK

**ACCESS ACKNOWLEDGMENT
and
SECURITY ORDER RECOMMENDATION BY DEFENSE AGENCY**

Application Serial No.: 09662438

Defense Agency: NAVY

Filing Date: Sep 15, 2000

Date Referred: Oct 05, 2000

I hereby acknowledge as indicated by my signature on this form that I have inspected this application in administration of 35 USC 181 on behalf of the Agency/Command specified below. I promise not to divulge any information from this application for any purpose other than administration of 35 USC 181.

Recommendation

(e.g. 'Security Not Recommended (SNR)')

Reviewer(s) Signature/Date/Command

SNR	Ana P. Puffer 10/12/00 NAVY
-----	-----------------------------

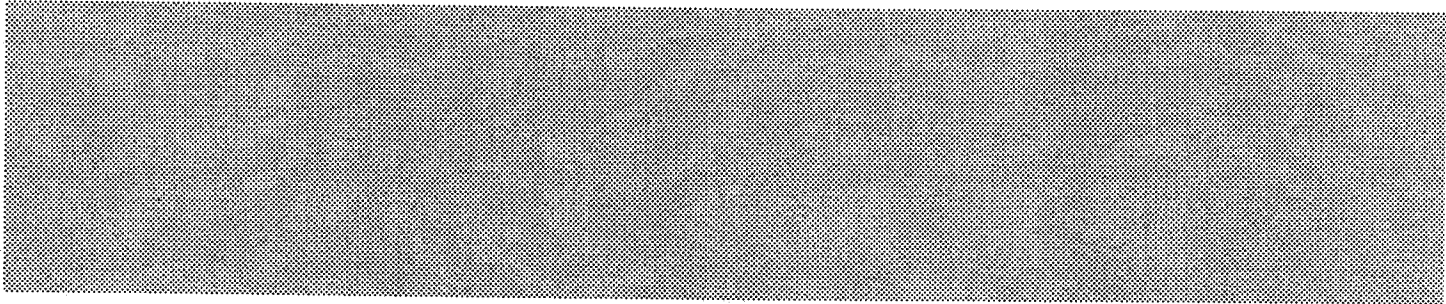
NOV - 1 AM 9:22

Instructions to Reviewers:

1. All individuals reviewing this application are required under 35 USC 181 to sign and date this form regardless of whether they are making a security order recommendation.
2. The attached copy of the application, any copies made therefrom and this form must be returned to the PTO once a recommendation not to impose security has been made or a security order has been rescinded.

Time for Completion of Review:

Pursuant to 35 U.S.C. 184, the subject matter of this application may be filed in a foreign country for the purpose of filing a patent application without a license any time after the expiration of 6 months from filing date unless the application becomes the subject of a security order.



4/19/01
Winters

ACCESS ACKNOWLEDGMENT
and
SECRECY ORDER RECOMMENDATION BY DEFENSE AGENCY

Application Serial No.: 09662438

Defense Agency: ARMY

Filing Date: Sep 15, 2000

Date Referred: Oct 05, 2000

I hereby acknowledge as indicated by my signature on this form that I have inspected this application in administration of 35 USC 181 on behalf of the Agency/Command specified below. I promise not to divulge any information from this application for any purpose other than administration of 35 USC 181.

Recommendation

(e.g. 'Secrecy Not Recommended (SNR)')

Reviewer(s) Signature/Date/Command

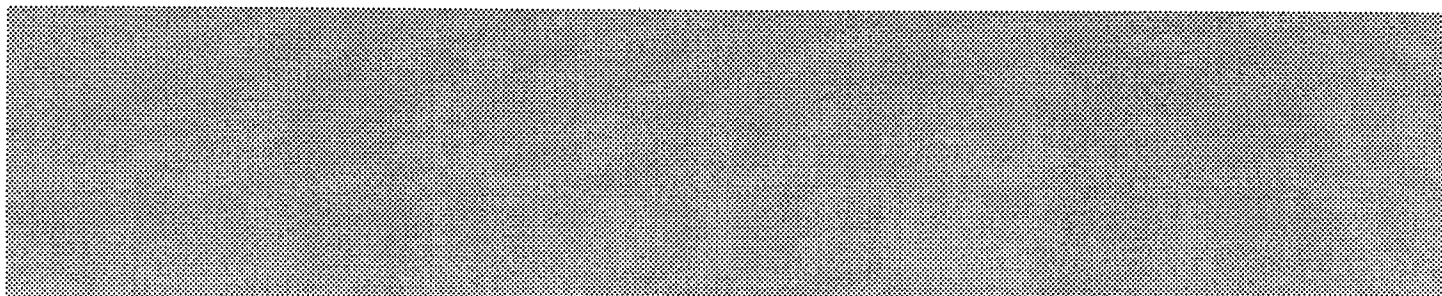
SNR	<i>Alan P. Klein</i> OCT 12 2000 U.S. ARMY CO OCT 23 11 3:23
-----	--

Instructions to Reviewers:

1. All individuals reviewing this application are required under 35 USC 181 to sign and date this form regardless of whether they are making a secrecy order recommendation.
2. The attached copy of the application, any copies made therefrom and this form must be returned to the PTO once a recommendation not to impose secrecy has been made or a secrecy order has been rescinded.

Time for Completion of Review:

Pursuant to 35 U.S.C. 184, the subject matter of this application may be filed in a foreign country for the purpose of filing a patent application without a license any time after the expiration of 6 months from filing date unless the application becomes the subject of a secrecy order.





HM

#9
DM
12/10/02

PTO/SB/122 (10-01)
Approved for use through 10/31/2002. OMB 0651-0035
U.S. Patent and Trademark Office: U.S. DEPARTMENT OF COMMERCE
Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number.

CHANGE OF CORRESPONDENCE ADDRESS Application Address to: Assistant Commissioner for Patents Washington, D.C. 20231	Application Number	09/662,438
	Filing Date	09/15/2000
	First Named Inventor	Hiram McCall
	Art Unit	2856
	Examiner Name	Kwak, Helen C.
	Attorney Docket Number	USP9952A-6NC

Please change the Correspondence Address for the above-identified application to:

☒ Customer Number 30265 → Place Customer
Number Bar Code
Label here

Type Customer Number here

OR

☒ Firm or Individual Name	RAYMOND Y. CHAN				
Address	108 N. YNEZ AVENUE, SUITE 128				
Address					
City	MONTEREY PARK	State	CA	ZIP	91754
Country	USA				
Telephone	626-571-9812	Fax	626-571-9813		

This form cannot be used to change the data associated with a Customer Number. To change the data associated with an existing Customer Number use "Request for Customer Number Data Change" (PTO/SB/124).

I am the :

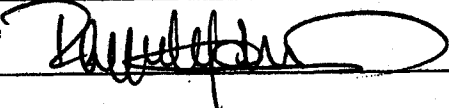
☐ Applicant/Inventor.

☐ Assignee of record of the entire interest.
Statement under 37 CFR 3.73(b) is enclosed. (Form PTO/SB/96).

☒ Attorney or Agent of record.

☐ Registered practitioner named in the application transmittal letter in an application without an executed oath or declaration. See 37 CFR 1.33(a)(1). Registration Number _____

Typed or Printed Name **RAYMOND Y. CHAN**

Signature 

Date **11/18/2002**

NOTE: Signatures of all the inventors or assignees of record of the entire interest or their representative(s) are required. Submit multiple forms if more than one signature is required, see below.

☒ Total of 1 forms are submitted.

Burden Hour Statement: This form is estimated to take 3 minutes to complete. Time will vary depending upon the needs of the individual case. Any comments on the amount of time you are required to complete this form should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, Washington, DC 20231. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Assistant Commissioner for Patents, Washington, DC 20231.

PART B - FEE(S) TRANSMITTAL



Complete and send this form, together with applicable fee(s), to: **Mail Box ISSUE FEE**
Commissioner for Patents
Washington, D.C. 20231
Fax (703)746-4000

INSTRUCTIONS: This form should be used for transmitting the **ISSUE FEE** and **PUBLICATION FEE** (if required). Blocks 1 through 4 should be completed where appropriate. All further correspondence including the Patent, advance orders and notification of maintenance fees will be mailed to the current correspondence address as indicated unless corrected below or directed otherwise in Block 1, by (a) specifying a new correspondence address; and/or (b) indicating a separate "FEE ADDRESS" for maintenance fee notifications.

CURRENT CORRESPONDENCE ADDRESS (Note: Legibly mark-up with any correction or use Block 1)
 7590 09/16/2002

Raymond Y C Chan
 1050 Oakdale Ave
 Arcadia, CA 91006-2222

Note: A certificate of mailing can only be used for domestic mailings of the Fee(s) Transmittal. This certificate cannot be used for any other accompanying papers. Each additional paper, such as an assignment or formal drawing, must have its own certificate of mailing or transmission.

Certificate of Mailing or Transmission
 I hereby certify that this Fee(s) Transmittal is being deposited with the United States Postal Service with sufficient postage for first class mail in an envelope addressed to the Box Issue Fee address above, or being facsimile transmitted to the USPTO, on the date indicated below.

RAYMOND Y. CHAN	(Depositor's name)
<i>[Signature]</i>	(Signature)
11/18/2002	(Date)

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/662,438	09/15/2000	Hiram McCall	USP9952A-GNC	4238

TITLE OF INVENTION: MICROELECTROMECHANICAL SYSTEM FOR MEASURING ANGULAR RATE

APPLN. TYPE	SMALL ENTITY	ISSUE FEE	PUBLICATION FEE	TOTAL FEE(S) DUE	DATE PAID
nonprovisional	YES	\$640	\$0	\$640	12/16/2002

EXAMINER	ART UNIT	CLASS-SUBCLASS
KWOK, HELEN C	2856	073-514320

1. Change of correspondence address or indication of "Fee Address" (37 CFR 1.363).
- ☐ Change of correspondence address (or Change of Correspondence Address form PTO/SB/122) attached.
- ☐ "Fee Address" indication (or "Fee Address" Indication form PTO/SB/47; Rev 03-02 or more recent) attached. Use of a Customer Number is required.

2. For printing on the patent front page, list (1) the names of up to 3 registered patent attorneys or agents OR, alternatively, (2) the name of a single firm (having as a member a registered attorney or agent) and the names of up to 2 registered patent attorneys or agents. If no name is listed, no name will be printed.

RAYMOND Y. CHAN
 DAVID AND RAYMOND
 PATENT GROUP

3. ASSIGNEE NAME AND RESIDENCE DATA TO BE PRINTED ON THE PATENT (print or type)

PLEASE NOTE: Unless an assignee is identified below, no assignee data will appear on the patent. Inclusion of assignee data is only appropriate when an assignment has been previously submitted to the USPTO or is being submitted under separate cover. Completion of this form is NOT a substitute for filing an assignment.

(A) NAME OF ASSIGNEE

(B) RESIDENCE: (CITY and STATE OR COUNTRY)

AMERICAN GNC CORPORATION

SIMI VALLEY, CA

Please check the appropriate assignee category or categories (will not be printed on the patent) ☐ individual ☒ corporation or other private group entity ☐ government

4a. The following fee(s) are enclosed:

- ☒ Issue Fee
☐ Publication Fee
☐ Advance Order - # of Copies _____

4b. Payment of Fee(s):

- ☒ A check in the amount of the fee(s) is enclosed.
☐ Payment by credit card. Form PTO-2038 is attached.
☒ The Commissioner is hereby authorized by charge the required fee(s), or credit any overpayment, to Deposit Account Number 502111 (enclose an extra copy of this form).

Commissioner for Patents is requested to apply the Issue Fee and Publication Fee (if any) or to re-apply any previously paid issue fee to the application identified above.

(Authorized Signature) *[Signature]* (Date) 11/18/2002

NOTE: The Issue Fee and Publication Fee (if required) will not be accepted from anyone other than the applicant, a registered attorney or agent, or the assignee or other party in interest as shown by the records of the United States Patent and Trademark Office.

This collection of information is required by 37 CFR 1.311. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 12 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, Washington, D.C. 20231. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Commissioner for Patents, Washington, DC 20231.

Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number.

11/22/2002 NDELETER 00000030 09662438
 01 FC12501 640.00 DP

TRANSMIT THIS FORM WITH FEE(S)

PTOL-85 (REV. 04-02) Approved for use through 01/31/2004. OMB 0651-0033

U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE



UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NUMBER	PATENT NUMBER	GROUP ART UNIT	FILE WRAPPER LOCATION
09/662,438	6508122	2856	9200M100311028107



Correspondence Address/Fee Address Change

The following fields have been set to Customer Number 30265 on 09/30/2008

- Correspondence Address
- Maintenance Fee Address
- Power of Attorney Address

The address of record for Customer Number 30265 is:

30265
DAVID AND RAYMOND PATENT FIRM
108 N. YNEZ AVE., SUITE 128
MONTEREY PARK, CA 91754

PART 1 - ATTORNEY/APPLICANT COPY

page 1 of 1

AO 120 (Rev. 08/10)

TO: Mail Stop 8 Director of the U.S. Patent and Trademark Office P.O. Box 1450 Alexandria, VA 22313-1450	REPORT ON THE FILING OR DETERMINATION OF AN ACTION REGARDING A PATENT OR TRADEMARK
---	---

In Compliance with 35 U.S.C. § 290 and/or 15 U.S.C. § 1116 you are hereby advised that a court action has been
filed in the U.S. District Court **FOR THE EASTERN DISTRICT OF TEXAS** on the following

☐ Trademarks or ☒ Patents. (☐ the patent action involves 35 U.S.C. § 292.):

DOCKET NO. 2:17-cv-107	DATE FILED 2/3/2017	U.S. DISTRICT COURT FOR THE EASTERN DISTRICT OF TEXAS
PLAINTIFF American GNC Corporation		DEFENDANT ZTE Corporation, ZTE (USA) Inc., and ZTE (TX) Inc.
PATENT OR TRADEMARK NO.	DATE OF PATENT OR TRADEMARK	HOLDER OF PATENT OR TRADEMARK
1 6,311,555	11/6/2001	American GNC Coporation
2 6,415,227	7/2/2002	American GNC Coporation
3 6,508,122	1/21/2003	American GNC Coporation
4 6,516,283	2/4/2003	American GNC Coporation
5 6,671,648	12/30/2003	American GNC Coporation

In the above—entitled case, the following patent(s)/ trademark(s) have been included:

DATE INCLUDED	INCLUDED BY ☐ Amendment ☐ Answer ☐ Cross Bill ☐ Other Pleading	
PATENT OR TRADEMARK NO.	DATE OF PATENT OR TRADEMARK	HOLDER OF PATENT OR TRADEMARK
1		
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In the above—entitled case, the following decision has been rendered or judgement issued:

DECISION/JUDGEMENT

CLERK	(BY) DEPUTY CLERK	DATE
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Copy 1—Upon initiation of action, mail this copy to Director Copy 3—Upon termination of action, mail this copy to Director
Copy 2—Upon filing document adding patent(s), mail this copy to Director Copy 4—Case file copy

AO 120 (Rev. 08/10)

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☐ Trademarks or ☒ Patents. (☐ the patent action involves 35 U.S.C. § 292.);

DOCKET NO. 2:17-cv-00119	DATE FILED 2/9/2017	U.S. DISTRICT COURT FOR THE EASTERN DISTRICT OF TEXAS
PLAINTIFF American GNC Corporation		DEFENDANT LG Electronics Inc., LG Electronics USA, Inc., LG Electronics Mobilecomm USA, Inc., and LG Electronics Mobile Research USA, LLC
PATENT OR TRADEMARK NO.	DATE OF PATENT OR TRADEMARK	HOLDER OF PATENT OR TRADEMARK
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Effective December 29, 1999

662438

(Column 1) (Column 2)

SMALL ENTITY TYPE ☐		OR	OTHER THAN SMALL ENTITY	
RATE	FEE		RATE	FEE
	345.00	OR		690.00
X\$ 9=		OR	X\$18=	
X39=		OR	X78=	
+130=		OR	+260=	
TOTAL		OR	TOTAL	

SMALL ENTITY		OR	OTHER THAN SMALL ENTITY	
RATE	ADDITIONAL FEE		RATE	ADDITIONAL FEE
X\$ 9=		OR	X\$18=	
X39=		OR	X78=	
+130=		OR	+260=	
TOTAL ADDIT. FEE		OR	TOTAL ADDIT. FEE	

(Column 1)	(Column 2)	(Column 3)
1	2	3
4	5	6
7	8	9
10	11	12
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22	23	24
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349	350	351
352	353	354
355	356	357
358	359	360
361	362	363
364	365	366
3		

RATE	ADDITIONAL FEE		RATE	ADDITIONAL FEE
X\$ 9=		OR	X\$18=	
X39=		OR	X78=	
+130=		OR	+260=	
TOTAL ADDIT. FEE		OR	TOTAL ADDIT. FEE	

AMENDMENT B

RATE	ADDITIONAL FEE		RATE	ADDITIONAL FEE
X\$ 9=		OR	X\$18=	
X39=		OR	X78=	
+130=		OR	+260=	
TOTAL ADDIT FEE		OR	TOTAL ADDIT FEE	

AMENDMENT C

* If the entry in column 1 is less than the entry in column 2, write "0" in column 3.
 ** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 20, enter "20."
 ***If the "Highest Number Previously Paid For" IN THIS SPACE is less than 3, enter "3."
 The "Highest Number Previously Paid For" (Total or Independent) is the highest number

PATENT APPLICATION FEE DETERMINATION RECORD

Effective 01/01/2001

09/662438

CLAIMS AS FILED - PART I

	(Column 1)	(Column 2)
TOTAL CLAIMS		
FOR	NUMBER FILED	NUMBER FILED
TOTAL CHARGEABLE CLAIMS	minus 20 =	
INDEPENDENT CLAIMS	minus 3 =	
MULTIPLE DEPENDENT CLAIMS PRESENT		☐

If the difference in columns 1 is less than 20, enter "0" in column 2.

SMALL ENTITY TYPE ☐

OTHER THAN SMALL ENTITY OR ☐

RATE	FEE
BASIC FEE	\$400
X\$9=	
X42=	
+140=	
TOTAL ADDIT. FEE	

RATE	FEE
BASIC FEE	\$700
X\$18=	
X84=	
+280=	
TOTAL ADDIT. FEE	

CLAIMS AS AMENDED - PART II

	(Column 1)		(Column 2)	(Column 3)
	CLAIMS REMAINING AFTER AMENDMENT		HIGHEST NUMBER PREVIOUSLY PAID FOR	PRESENT EXTRA
Total	* 16	Minus	** 20	= /
Independent	* 1	Minus	** 3	= /
FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM				☐

SMALL ENTITY TYPE ☐

OTHER THAN SMALL ENTITY OR ☐

RATE	ADDITIONAL FEE
X\$9=	/
X42=	/
+140=	/
TOTAL ADDIT. FEE	/

RATE	ADDITIONAL FEE
X\$18=	/
X84=	/
+280=	/
TOTAL ADDIT. FEE	/

	(Column 1)		(Column 2)	(Column 3)
	CLAIMS REMAINING AFTER AMENDMENT		HIGHEST NUMBER PREVIOUSLY PAID FOR	PRESENT EXTRA
Total	*	Minus	**	=
Independent	*	Minus	***	=
FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM				☐

RATE	ADDITIONAL FEE
X\$9=	
X42=	
+140=	
TOTAL ADDIT. FEE	

RATE	ADDITIONAL FEE
X\$18=	
X84=	
+280=	
TOTAL ADDIT. FEE	

	(Column 1)		(Column 2)	(Column 3)
	CLAIMS REMAINING AFTER AMENDMENT		HIGHEST NUMBER PREVIOUSLY PAID FOR	PRESENT EXTRA
Total	*	Minus	**	=
Independent	*	Minus	***	=
FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM				☐

RATE	ADDITIONAL FEE
X\$9=	
X42=	
+140=	
TOTAL ADDIT. FEE	

RATE	ADDITIONAL FEE
X\$18=	
X84=	
+280=	
TOTAL ADDIT. FEE	

- * If the entry in column 1 is less than the entry in column 2, write "0" in column 3.
- ** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 20, enter "20"
- *** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 3, enter "3."

The "Highest Number Previously Paid For" (Total or Independent) is the highest number found in the appropriate box in column 1.

28
10-27-00

POSITION	INITIALS	ID NO.	DATE
FEÉ DETERMINATION	YRW	75331	
O.I.P.E. CLASSIFIER		P	10-2-00
FORMALITY REVIEW	AL	JC-859	10/26/00
RESPONSE FORMALITY REVIEW			

INDEX OF CLAIMS

- ✓ Rejected
= Allowed
- (Through numeral)... Canceled
÷ Restricted
- N Non-elected
I Interference
A Appeal
O Objected

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Claim	Date
Final Original	
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2	9-6-02
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Claim	Date
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If more than 150 claims or 10 actions
staple additional sheet here

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SEARCHED			
Class	Sub.	Date	Exmr.
73	504.12 504.13 504.14 504.15 504.16 504.04	1/31/01	HZ
702	145 147		
700	1 73 302 303 304		
701	1		
Updated	Search	9/6/02	HZ

INTERFERENCE SEARCHED			
Class	Sub.	Date	Exmr.
73	504.12 488	9/6/02 1	HZ 1

SEARCH NOTES (INCLUDING SEARCH STRATEGY)		
	Date	Exmr.
CAST Search	2/1/01	HZ