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APPLICATION NUMBER	FILING or 371(c) DATE	GRP ART UNIT	FIL FEE REC'D	ATTY. DOCKET NO	TOT CLAIMS	IND CLAIMS
62/050,590	09/15/2014		130	116523.		

CONFIRMATION NO. 4632

21324
HAHN LOESER & PARKS, LLP
One GOJO Plaza
Suite 300
AKRON, OH 44311-1076

FILING RECEIPT



Date Mailed: 09/30/2014

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Inventor(s)

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Power of Attorney:

Brendan Clark--67691

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The country code and number of your priority application, to be used for filing abroad under the Paris Convention, is **US 62/050,590**

Projected Publication Date: None, application is not eligible for pre-grant publication

Non-Publication Request: No

Early Publication Request: No

** SMALL ENTITY **

Title

VEHICLE LEVELING ASSEMBLY WITH DIGITAL SENSOR

Statement under 37 CFR 1.55 or 1.78 for AIA (First Inventor to File) Transition Applications: No

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Application Data Sheet 37 CFR 1.76		Attorney Docket Number	116523.
		Application Number	
Title of Invention	VEHICLE LEVELING ASSEMBLY WITH DIGITAL SENSOR		
The application data sheet is part of the provisional or nonprovisional application for which it is being submitted. The following form contains the bibliographic data arranged in a format specified by the United States Patent and Trademark Office as outlined in 37 CFR 1.76. This document may be completed electronically and submitted to the Office in electronic format using the Electronic Filing System (EFS) or the document may be printed and included in a paper filed application.			

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☐	Portions or all of the application associated with this Application Data Sheet may fall under a Secrecy Order pursuant to 37 CFR 5.2 (Paper filers only. Applications that fall under Secrecy Order may not be filed electronically.)
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	Bernard	F.	Garceau			
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Application Information:

Title of the Invention	VEHICLE LEVELING ASSEMBLY WITH DIGITAL SENSOR		
Attorney Docket Number	116523.	Small Entity Status Claimed	☒
Application Type	Provisional		
Subject Matter	Utility		
Total Number of Drawing Sheets (if any)	4	Suggested Figure for Publication (if any)	

Filing By Reference :

ETN1008

4/35

Application Data Sheet 37 CFR 1.76		Attorney Docket Number	116523.
		Application Number	
Title of Invention	VEHICLE LEVELING ASSEMBLY WITH DIGITAL SENSOR		

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Application number of the previously filed application	Filing date (YYYY-MM-DD)	Intellectual Property Authority or Country

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5/35

Application Data Sheet 37 CFR 1.76		Attorney Docket Number	116523.
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Title of Invention	VEHICLE LEVELING ASSEMBLY WITH DIGITAL SENSOR		

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Application Data Sheet 37 CFR 1.76		Attorney Docket Number	116523.
		Application Number	
Title of Invention	VEHICLE LEVELING ASSEMBLY WITH DIGITAL SENSOR		

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Phone Number		Fax Number	ETN1008

Application Data Sheet 37 CFR 1.76		Attorney Docket Number	116523.
		Application Number	
Title of Invention	VEHICLE LEVELING ASSEMBLY WITH DIGITAL SENSOR		
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First Name	BRENDAN E.	Last Name	CLARK	Registration Number
				67691
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Application Data Sheet 37 CFR 1.76		Attorney Docket Number	116523.
		Application Number	
Title of Invention	VEHICLE LEVELING ASSEMBLY WITH DIGITAL SENSOR		

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VEHICLE LEVELING ASSEMBLY WITH DIGITAL SENSOR

TECHNICAL FIELD

[0001] The disclosures herein relate in general to control of the orientation of structures in regard to a reference angle. More particularly, aspects herein relate to using a 6-axis digital sensor for feedback for controlling the extension or retraction of jacks to effect such orientation.

BACKGROUND

[0002] Large structures or vehicles which remain in place for extended periods of time (such as recreational vehicles, or RVs) can benefit from being leveled with respect to the ground on which they are placed. To level such vehicles, a plurality of jacks connected to the frame of the structure are provided, which extend or retract to raise, lower, and adjust the attitude of the structure. Solutions for automatic vehicle leveling rely upon user-actuated or semi-automatic leveling controls which provide feedback. Some automatic solutions have been proposed as well. These solutions utilize two axis tilt sensors which provide analog signals to controllers or signaling components to determine the pitch or roll of the structure with respect to a predefined reference line (*e.g.*, direction of gravity) or plane (*e.g.*, plane perpendicular to direction of gravity).

SUMMARY

[0003] An embodiment provides an assembly for correcting the attitude of at least a selected portion of a structure, the assembly comprising a controller operatively coupled with one or more jacks operable to change the attitude of a structure; and a 6-axis digital sensor operatively coupled with the controller. The 6-axis digital sensor provides digital signals to the controller describing the angular orientation of at least the selected portion of the structure, and the controller moves a selected portion of the structure into a desired attitude by transmitting jack

control signals to extend and retract the one or more jacks. The control signals are based on the digital signals.

[0004] In embodiments there is also provided a method for analyzing the attitude of a structure relative, the method comprising analyzing the current angular orientation of the structure using a 6-axis digital sensor to produce data related to the current angular orientation of the structure; transmitting the data related to the current angular orientation of the structure to a controller operatively coupled to one or more jacks for moving the structure from the current angular orientation of the structure to a desired angular orientation of the structure; and comparing the data related to the current angular orientation of the structure to the desired angular orientation of the structure.

BRIEF DESCRIPTION OF DRAWINGS

[0005] To better understand and appreciate the invention, refer to the following detailed description in connection with the accompanying drawings:

[0006] FIG. 1 is an isometric view of the vehicle leveling system installed on the frame of a vehicle such as a recreational vehicle;

[0007] FIG. 2 is a schematic representation of a pseudo four-leg vehicle leveling system in accordance with the invention;

[0008] FIG. 3 is a flow chart illustrating a security feature for a jack-leveled vehicle; and

[0009] FIG. 4 is a diagram of a jack-leveled vehicle.

DETAILED DESCRIPTION

[0010] A leveling assembly and method for analyzing the attitude of a platform or structure such as a motor vehicle is described. A control system actuates leveling jacks attached to or in contact with the platform or structure using feedback from a 6-axis digital sensor. The 6-axis digital sensor can include a 3-axis gyroscope and 3-axis accelerometer and a processor for interpreting motion data from the gyroscope and accelerometer. Using data from the gyroscope and accelerometer, the attitude (*e.g.*, pitch, roll, or other relative metrics) of the structure can be calculated, and the accelerometer can be used to determine the rate of change of the attitude. Attitude and rate of change can be measured in reference to any point, line, or plane pre-defined or selected on-the-fly.

[0011] With this arrangement, the leveling controller and associated systems can be programmable to allow for customization. Included in such leveling systems are memory, temperature adjustments, and directional inputs. The accelerometer can be programmable, and in embodiments includes ranges of, for example, $\pm 2g$, $\pm 4g$, $\pm 8g$, and $\pm 16g$. The 6-axis digital sensor can further include on-chip 16-bit ADCs, programmable digital filters, a precision clock with small drift (*e.g.*, 1% or less across a temperature range such as -40°C to 85°C), an embedded temperature sensor, and programmable interrupts. The sensor can further include I2C and SPI serial interfaces, a VDD operating range of 1.71 to 3.6V, and a separate digital IO supply, VDDIO from 1.71V to 3.6V. Sensor communication can occur with registers using, *e.g.*, I2C at 400kHz or SPI at 1MHz. In alternative or complementary embodiments, the sensor and interrupt registers may be read using SPI at 20MHz. Due to the mobile application, the sensor can also be shock-resistant (*e.g.*, supporting 10,000g shock reliability).

[0012] Systems and methods herein can also include security features. Such features can include security codes having lock-out functionality that lock the system down in a level position (in a fully static position or allowing automatic re-leveling but no other activity) to prevent tampering with the vehicle level, theft, *et cetera*.

[0013] Level sensors can be integrated, for example, to the jacks and an automatic control device or user control interface to engage or disengage jack movement or various signals to a user related to the status of a leveling operation.

[0014] Various components can be integrated with the control system in addition to the 6-axis digital sensor. The sensor can be connected to a controller having various communication ports (wired and/or wireless), one or more processors, memory (RAM and/or storage), clocks or timers, motors, display devices, and other components typically utilized with jack systems (*e.g.*, hydraulic, electromechanical) and associated controllers.

[0015] While embodiments described herein relate at times to leveling assemblies or techniques in a recreational vehicle application, one of ordinary skill in the art will recognize such are readily adaptable to other leveling applications and may be utilized with any suitable structure for the purpose of leveling that structure.

[0016] Using information from the 6-axis digital sensor, the controller modifies the jack extension distances and rates to respond to vehicle dynamics and vehicle attitude. The sensitivity of the 6-axis digital sensor and controller can be calibrated. The sample rate of the 6-axis digital sensor can be constant or dynamic depending on user input (*e.g.*, user dictates rate or rates) or operational context (*e.g.*, initial leveling versus re-leveling, amount of tilt). The controller can limit the speed at which jacks extend, in order to control the amount of angular adjustment in a time period. In alternative or complementary embodiments, the controller can cause one or more jacks to accelerate faster than the standard limited rate to correct for a possible error in operation (*e.g.*, tipping of the structure).

[0017] The controller can additionally estimate noise at the 6-axis digital sensor. In an embodiment, noise can be estimated after jack movement has ceased and the system has settled. In further embodiments, the controller can pause or delay any later jack actuation until a static period has passed permitting multiple sensor measurements with the structure and controller constantly oriented. In this fashion, noise estimates can be developed from the variance of successive sensor readings during the static period.

[0018] The controller can also change jack drive rates dynamically to control the tilt rate based upon inputs other than tilt angle. For example, if the amount of over or undershoot measured is beyond a specific threshold the drive rate will be decreased. “Level Stop” readings can be part of the adaptive process that indicates whether further changes are necessary for the next level cycle (*e.g.*, whether stop point accuracy can be further improved).

[0019] The controller can automatically select between multiple jack grounding procedures based on vehicle conditions (*e.g.*, initial vehicle attitude) and is able to infer jack ground contact from changes in tilt angle without using inputs from discrete sensors. Other sensors related to the jacks can be used as an alternative or supplemental means for inferring jack ground contact or other conditions.

[0020] In one technique for leveling, the controller levels a vehicle by extending the jacks in pairs parallel to longitudinal pitch and lateral roll vehicle axes. The controller detects and corrects the “worst” axis (the axis around which the greatest out-of-level condition exists) first when commencing a leveling operation. Other techniques, such as where jacks are extended singularly, can also be utilized. The technique can be automatically selected, or selected by a user. In embodiments, the user can control an initial leveling, then turn to automatic selection of leveling thereafter. In the automatic mode, the controller can automatically correct long-term vehicle attitude changes that occur after initial leveling.

[0021] The controller can employ adaptive filtering to maximize signal stability based on rate of angular change and estimated signal noise. Through adaptive filtering, controller response to sensor data can be automatically changed depending on at least conditions observed. This allows the controller to automatically manipulate sensor output in different ways to provide a desired result.

[0022] Adaptive filtering is accomplished by the controller programmed with a software filter algorithm. In embodiments, the filtering can function as and can be similar to a low pass filter. The order of the filter and the pole location is changed depending on operational mode and noise. When the 6-axis digital sensor is attempting to detect ground contact during initial grounding of the jacks, the 6-axis digital sensor must be very sensitive to changes in movement. While extending the jacks to contact, the order is lowered and the frequency bandwidth is

increased. However, when a leveling sequence is in progress and changes are occurring per the predefined rate, higher accuracy can be sought and the signal can be more aggressively filtered.

[0023] When levelers are not being actuated (in an initialization mode) the continuous sensor reading is checked for the amount of noise that is present when there is no movement (*e.g.*, “no movement” noise). If a lot of “no movement” noise is sensed, the initial filter value is increased accordingly.

[0024] During initial extension of the jacks at the beginning of a leveling operation, to ensure a quick and robust leveling sequence, the controller can stop the jacks after they are firmly engaged with the ground but before the structure is level. The adaptive filtering algorithm allows the controller to recognize ground contact by looking at specific output characteristics received from 6-axis digital sensor. Output characteristics monitored can include noise, rate of change, scale factor and temperature.

[0025] The adaptive filter algorithm allows an optimal extension sequence to take place and ensures the most reliable sensing of ground contact. In one embodiment, two jacks are extended simultaneously until the controller senses that the jacks have contacted the ground. The controller then actuates the remaining set(s) of jacks, two at a time, until the controller senses that they have contacted the ground. In response to initial ground contact of all the jacks, the adaptive filter is adjusted and the controller extends each individual jack, one at a time, until all four levelers are firmly grounded.

[0026] As is described above, the filter parameters can be changed dynamically to allow a greater sensitivity and to limit excess leveler travel. The order and/or the filter frequency (sample rate and/or shift number) is increased.

[0027] Each software mode in the controller can selectively adjust the filter to obtain optimal performance in response, stability, noise immunity, *etc.* Different variables hold different filtered results and different coefficients depending on modes.

[0028] The 6-axis digital sensor is operatively coupled (*e.g.*, capable of communicating with using wired or wireless transmission and reception) to the controller and may be mounted at any point on a vehicle to be leveled. The 6-axis digital sensor is configured to provide digital

signals to the controller representing, for example, the degree of longitudinal pitch and lateral roll of a vehicle to which the 6-axis digital sensor is connected. The controller is configured to receive and use those signals to determine vehicle attitude relative to various parameters or values (*e.g.*, a calibrated sensitivity factor and a user-defined zero point). Therefore, a motor vehicle leveler in accordance with these disclosures allows a user or installer to determine which portion(s) of the vehicle will be level relative to gravity despite the location of the 6-axis digital sensor. The 6-axis digital sensor may, therefore, be located anywhere in the vehicle. The module that houses the 6-axis digital sensor includes a visual to allow an installer to properly orient the 6-axis digital sensor in a vehicle, or may be agnostic of a particular arrangement on the vehicle.

[0029] In embodiments, systems and methods herein can include temperature compensation to ensure maximum resolution and stability over a wide range of temperature conditions.

[0030] In normal operation, the system includes automatic and semiautomatic leveling modes. In both the automatic and the semiautomatic modes, the unit achieves and maintains a level attitude via various leveling algorithms. In embodiments, such algorithms can include a preset relative zero value, an axis-to-level algorithm, and subsequent auto correction feature. The relative zero value can be preset during unit installation and may be used by the controller as a reference value in a “smart” zeroing process. Any relative zero value can be passed to an algorithm that decides how to optimally level the vehicle (*e.g.*, achieve the zero state each time the vehicle is subsequently leveled). Relative zeros can be arbitrary or determined with respect to a point, line (*e.g.*, gravity) or plane (*e.g.*, perpendicular to gravity). The controller can determine an optimum axis sequence that will achieve the zero state with the least overshoot and jack extension, then executes that sequence by transmitting control signals to the jacks. The controller executes that sequence to level the vehicle either automatically or semiautomatically. In the automatic mode, the controller operates the proper jacks according to the optimum sequence. In the semiautomatic mode, the controller indicates to an operator the proper sequence in which to manually actuate the levers, according to the optimum axis sequence, but the operator may deviate using at least partial manual control.

[0031] The system continuously monitors the attitude of the vehicle after each leveling operation and continues to adjust the jacks as necessary to prevent the vehicle from being tipped out-of-level by such factors as vehicle settling, ground shift, *et cetera*. The controller continuously monitors values received from the 6-axis digital sensor and, relative to the preset zero state, adjusts the adaptive filter algorithm. The controller further automatically adjusts the vehicle attitude after the vehicle has moved to an out-of-level attitude. In embodiments, adjustments occur when the vehicle has been out-of-level by a threshold amount for longer than a predetermined minimum time period. As the vehicle approaches level and the controller senses that the 6-axis digital sensor is approaching the preset zero state, the filter order can be decreased and the response increased so that phase delay is reduced. In particular embodiments, no individual jack needs to be actuated during this sequence, only pairs of devices are activated at any one time.

[0032] In either fully automatic or semi-automatic mode, the controller can also dynamically change the rate at which the jacks are actuated. This allows the controller to optimize the jack extension rate to suit any particular vehicle, surface condition, and/or output data characteristics of the sensor.

[0033] Control aspects herein can be implemented using remote devices, including through use of leveling control or visualization applications installed on computers or mobile devices. For example, a cellular telephone or smart phone “app” can be installed to communicate with a controller and/or the six-axis digital sensor (*e.g.*, wirelessly through Bluetooth™ or WiFi™, wirelessly through the Internet where the controller is internet-enabled, wired through USB, or others). The app can transmit information to and receive information from the controller and/or six-axis digital sensor. With information received from the controller and/or the six-axis digital sensor, text or graphics depicting the attitude of the structure can be provided in real-time when the structure is static or in motion. In alternative or complementary embodiments, the app can include user input options to provide control commands to the controller to manually or semi-automatically effect leveling or other reorientation of the structure. In further alternative or complementary embodiments, security features can be provided through or built into the app. For example, the phone can implement a security control (*e.g.*, password, PIN, code, pattern, biometric scan, and others) that can prevent extension of

jacks, retraction of jacks, initial leveling, re-leveling, energizing of the six-axis digital sensor, transmitting or receiving data to or from the app, or other activity relate to leveling or unrelated to leveling (*e.g.*, secure doors or windows) based upon permission granted through successful passing of the security control.

[0034] Referring now to FIGS. 1 and 2, a system 10 includes pairs of jacks 12 and 16 for leveling a structure. In the embodiment of FIGS. 1 and 2, hydraulic jacks are employed, but other options will be apparent upon review of the disclosures. The pairs of jacks 12 and 16 can be operated in parallel or independently as individual jacks. In embodiments where jacks are operated in pairs, each pair of jacks 12 and 16 can be in continuous fluid communication.

[0035] System 10 includes a 6-axis digital sensor 122, which may be mounted to the vehicle in any satisfactory location. As illustrated, 6-axis digital sensor 122 is mounted to one of the frame members, such as 18. 6-axis digital sensor 122 can be physically or logically interposed between actuator assembly 24 and a controller. 6-axis digital sensor 122 provides data about the angular orientation and rates of change with respect to the structure to a controller. System 10 can further include a control panel 124 to facilitate user interaction with the system.

[0036] Actuator assembly 24 includes a controller 110 which receives signals from 6-axis digital sensor 122 to provide control signals to, *e.g.*, motor assembly 96 for control of pairs of jacks 12 and 16. Controller 110 and/or 6-axis digital sensor can communicate by any suitable wired or wireless means.

[0037] Supply/return control valve 104 and retraction restricting valve 137 control the flow of hydraulic fluid through passages in an associated valve block to both pairs of jacks 12 and 16. Common passages can include branch points from which hydraulic fluid can be supplied to pairs of jacks 12 and 16 through different passages. Although FIG. 2 shows a branch point being located within the valve block, it may be desirable to locate branch points external to the valve block. Because there are no control valves between the jacks of the pair of jacks 12, the hydraulic fluid pressure in both will equalize during operation.

[0038] Pairs of jacks 12 and 16 can be mounted on longitudinal frame members 22 and 18, respectively, at a location close to the front transverse frame member 14. Transverse frame

member 28 is located opposite transverse frame member 14. Various lines 50 can provide hydraulic fluid or other operative connectivity between components of system 10. To provide fluid, motor assembly 96 is connected to one or more frame members. Motor assembly 96 includes motor 128 and can provide hydraulic fluid from reservoir 94.

[0039] Various valves can assist with management of hydraulic fluid, and can be controlled automatically by their own function, automatically by a controller, or manually. Valves depicted in FIG. 2 include flow control valve 106, supply/return control valve 108, check valve 129, retract control valve 136, and retraction restricting valves 138 and 140. Alternative arrangements can be utilized where a different hydraulic structure or other technology (*e.g.*, electro-mechanical jacks) is employed.

[0040] The form of the invention shown in FIGS. 1 and 2, in which the pairs of jacks 12 and 16 operate in parallel, can be referred to as a pseudo four-leg vehicle leveling system. However, it will be appreciated that, actuating jacks in pairs or individually, any number of jacks can be utilized.

[0041] FIG. 3 illustrates a flow chart depicting a methodology of securing a power-leveled structure. Methodology 300 begins at 302 and proceeds to 304 where a security prompt is provided. The security prompt can be provided on a dedicated user interface or control panel (*e.g.*, leveling interface for controlling hydraulic or electro-mechanical leveling apparatus in structure), a shared user interface or control panel (*e.g.*, a vehicle dashboard or onboard computer for structure to be leveled), or a third-party device capable of use as an interface (*e.g.*, mobile device or computer with app for communicating with controller and/or six-axis digital sensor installed).

[0042] At 304, a determination is made as to whether the security prompt is satisfied. If the prompt is satisfied (*e.g.*, correct password, PIN, code, pattern, biometric input), methodology 300 proceeds to 314 where access is granted to the controls. At 314, the user can view or modify controls in accordance with the permissions and/or controller capabilities. In embodiments, there can be two or more permission levels, such as where a first response to a security prompt at 304 permits the user to view jack or level status, but not transmit controls to modify jack operation or

level status. A second security level can permit viewing and modification. After use of the controls is complete subsequent to access being granted at 314, methodology 300 ends at 316.

[0043] If the security prompt at 306 is not satisfied, methodology 300 proceeds to 308 where a determination is made as to whether this is a final failure. A final failure may be a first wrong security attempt in more secure systems, or a subsequent wrong security attempt in less secure systems that permit users multiple attempts before lockout. If the determination at 308 returns that the failure to satisfy the security prompt at 304/306 was not a final failure, methodology 300 recycles to 304 where the security prompt is re-presented.

[0044] If 308 returns a final failure, methodology 300 advances to 310 where a lock out occurs. The lock out can prevent one or more of viewing of structure level information, modifying structure level status through interaction with the controller, or other aspects. In an embodiment, automatic control can continue (*e.g.*, controller re-levels structure due to settling) without permitting any user access to information or control of such.

[0045] After lock out at 310, a determination is made at 312 if the lock out should end (*e.g.*, expiration of timer, keys inserted in ignition, manual override, other condition). If the determination at 312 returns positive, methodology 300 may recycle to 304 (or any other step such as 312). However, if the lock out has not ended, methodology 300 can remain at 310, or alternatively proceed to 316 and end in a lock out condition. In this way, structure tampering, theft, and other unauthorized activities can be discouraged or prevented.

[0046] Referring now to FIG. 4, the present invention in one embodiment relates to a vehicle 420 comprising a vehicle body 422 (or base unit or first module). In embodiments such as that shown, vehicle body 420 includes one or more room slideout units (or second modules) 424 that is horizontally reciprocable relative to the vehicle body 422 between a retracted (or first) position and an extended (or second) position. The vehicle 420 can be a motor home, a fifth wheel trailer or a travel trailer. The slideout unit 424, when extended, affords more room or space to the interior of the vehicle, but can impact the center of gravity or leveling of the vehicle. An actuation system or drive mechanism (or force transmitting mechanism) can be provided for reciprocation of the slideout unit 424. This first slideout unit (room slideout unit or space-

expanding slideout unit) 424 and the drive mechanism for reciprocating the slideout unit 424 together form a slidable room assembly.

[0047] The vehicle 420 may alternatively or further comprise one or more reciprocable storage slideout units 426, which may serve as storage compartments. This second or storage slideout unit 426, shown in closed (or retracted) position, is shown as disposed in a lower portion of a side wall of vehicle body 422. The actuating system or drive mechanism for reciprocating the storage slideout unit 426 may be similar to that used to reciprocate room slideout unit 424, but may be smaller and less powerful (since a storage slideout unit 426 is commonly much lighter than a room slideout unit 424) and may be positioned differently.

[0048] A vehicle 420 may have either any number of room slideout units 424, or storage slideout units 426, or both. Thus, a vehicle 420 may have storage slideout units 426 but no room slideout unit 424 if desired. Also, a vehicle may have either slideout units 424 but no storage slideout unit 426 if desired. As noted, movement of such components can cause shifting of the vehicle's mass, and accordingly its balance or leveling, after stopping.

[0049] The vehicle 420 may be a self-powered vehicle, such as a recreational vehicle, or may be a trailer that is adapted to be towed, e.g. by an automobile or a truck. The vehicle may be one that is designed for living (as a house trailer) or may be a work vehicle (e.g. a mobile library).

[0050] Continuing, vehicle 420 comprises a vehicle body 422 having a plurality of exterior walls, e.g., a roof, a front wall, side walls, and a rear wall. The interior of vehicle body 422 also has a floor. Beneath the floor is an underframe (not shown) for supporting the vehicle body 422; the underframe may be conventional. At least one of the exterior walls, here shown as the left side wall 430, has an opening therein for receiving the first reciprocable slideout unit 424. The opening in the left side 430 of vehicle body 422 is preferably rectangular, as shown, and has a perimeter that includes horizontal top and bottom edges and vertical side edges. Each of the side walls 430 (only the left side wall is shown) may have a lower portion or skirt 436, which is disposed below the floor of vehicle 420 and which terminates in a lower edge 437. One or both side walls 430 may have an opening 438, which is preferably rectangular, for receiving a storage slideout 426. There may be any number of such openings 438 equal to the number of

storage slideout units 426. These openings 438 may be in any location. Opening 438 preferably extends to the lower edge 437 of the side wall 430.

[0051] The room slideout unit 424 generally has the same cross-sectional shape as the opening in the vehicle body 422, i.e., rectangular in the embodiment shown. The slide out unit 424 may comprise a floor, a ceiling, left and right side walls, and a forward or outside wall 448. The forward or outside wall of the slideout unit 424 is substantially coincident with (and spaced slightly outwardly from) the left side wall 430 of the vehicle body 422 when the slideout unit 424 is retracted, and is parallel to and spaced outwardly from the vehicle body side wall 430 when the slideout unit 424 is extended. As described, the right side wall of the slideout unit 424 is disposed in a rearward direction of the vehicle body 422, and the left side wall of the slideout unit 424 is disposed in a forward direction of the vehicle body. The spacing between opposite side walls is just slightly less than the width of the opening in the vehicle body 422, to afford enough clearance for sliding movement of the slideout unit 424 while minimizing the intrusion of the elements such as wind and rain. The size of the forward or outer wall can be just slightly greater than the size of the vehicle body opening. In this manner, the edges of the forward wall overlie the vehicle body 422 as an aid in maintaining a good seal when the slideout unit is retracted. Seals extending around the perimeter of opening 422 may be provided.

[0052] The room slideout unit 424 may be provided with windows in the forward and side walls, as shown, particularly when the vehicle is used as a recreational vehicle or house trailer. Opening and closing movements of either the first or second slideout units or compartments 424 and 426 can be accomplished with a power assist. In certain embodiments (e.g., when manual operation or servicing is desired), handles 450 may be provided on the front wall of the slideout unit 424, so that the slideout unit can be opened and closed manually. A lock 452 for room slideout unit 424 may be provided. Such lock may be provided in addition to the functioning of the drive mechanism that locks the slideout unit 424 in position when it is at rest (whether retracted, extended or in between). Similarly, the storage slideout unit 426 may be provided with a handle 454 for manual operation and a lock 456.

[0053] One or more than one space-expanding slideout unit 424 may be provided in a vehicle 420 in accordance with this invention. A horizontally reciprocable room slideout unit

424 may be provided in any of the exterior walls of vehicle 420, e.g. the left side wall 430 as shown, the right side wall, and/or the rear wall of vehicle 420. Also in accordance with this invention, one may provide a vertically reciprocable slideout unit in order to expand interior space in a vertical direction. The drive mechanism in all cases may be as described in the figures.

[0054] In embodiments, force is transmitted evenly to upper and lower portions and to both sides of the slideout unit, resulting in smooth, even application of force, so that the slideout unit reciprocates smoothly along its predetermined axis and in a predetermined plane with no tendency to twist or bind, and with minimum power input required, considering the appreciable weight of a typical slideout unit for a vehicle. The force transmission systems (or drive mechanisms) may be on-board systems, which are shown as mounted on the slideout unit 424. By mounting the entire drive mechanism on the slideout unit 424, and not on fixed frame or any other member that is part of the vehicle body 422, one can manufacture the slideout unit 424 and its drive mechanism as a modular unit and ship the modular unit to another site for assembly with or installation in a vehicle body 422 having a slideout opening of the required size. However, drive mechanisms provided independent of the slideout unit and requires connection to the slideout unit upon installation are contemplated. A drive mechanism can be attached to a bottom frame member via a motor bracket. Drive mechanisms which are either a self-locking worm drive or a planetary gear motor with an electric brake are two types qualified for use with this invention. The drive mechanism can be operatively installed at any position around the slideout frame. This can be desirable to mask the drive mechanism from view, depending on the exact configuration of the vehicle and/or slideout unit. A chain or direct drive units are appropriate for use herewith.

[0055] Vehicle 420 can include one or more jacks 490 for leveling at least a portion of vehicle 420. Jacks 490 can be separate components attached to portions of the structure of vehicle 420 (*e.g.*, standalone jacks attached to a vehicle chassis) or embedded within other components (*e.g.*, built into suspension or movable portions of axles of vehicle 420). Jacks 490 can be powered by one or more techniques (*e.g.*, hydraulic, electro-mechanical). Jacks 490 need not be identical, and may be arranged in asymmetrical manners (*e.g.*, to support slideout unit 424 when extended). Jacks 490 are actuated at least in part by a controller which receives feedback

from a six-axis digital sensor to assist with the leveling and stability of vehicle 420 when vehicle 420 is parked.

[0056] While principles and modes of operation have been explained and illustrated with regard to particular embodiments, it must be understood, however, that this may be practiced otherwise than as specifically explained and illustrated without departing from its spirit or scope.

CLAIMS

1. An assembly for correcting the attitude of at least a selected portion of a structure, the assembly comprising:

a controller operatively coupled with one or more jacks operable to change the attitude of a structure; and

a 6-axis digital sensor operatively coupled with the controller,

the 6-axis digital sensor provides digital signals to the controller describing the angular orientation of at least the selected portion of the structure,

the controller moves a selected portion of the structure into a desired attitude by transmitting jack control signals to extend and retract the one or more jacks, the control signals based on the digital signals.

2. A method for analyzing the attitude of a structure relative, the method comprising:

analyzing the current angular orientation of the structure using a 6-axis digital sensor to produce data related to the current angular orientation of the structure;

transmitting the data related to the current angular orientation of the structure to a controller operatively coupled to one or more jacks for moving the structure from the current angular orientation of the structure to a desired angular orientation of the structure; and

comparing the data related to the current angular orientation of the structure to the desired angular orientation of the structure.

ABSTRACT

Aspects herein relate to using a 6-axis digital sensor for feedback for controlling the extension or retraction of jacks for control of the angular orientation of a structure, or other means for accomplishing the same.

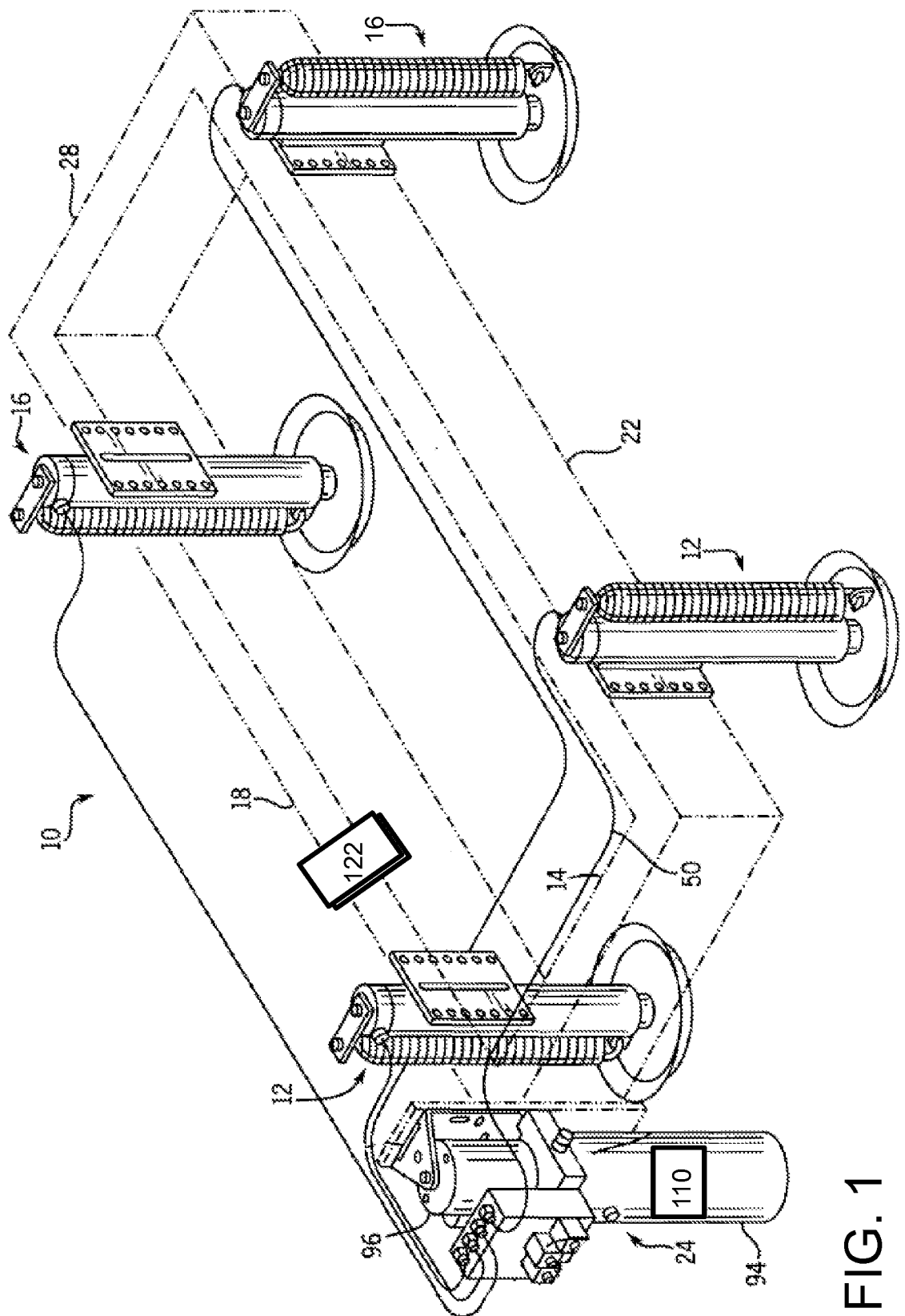


FIG. 1



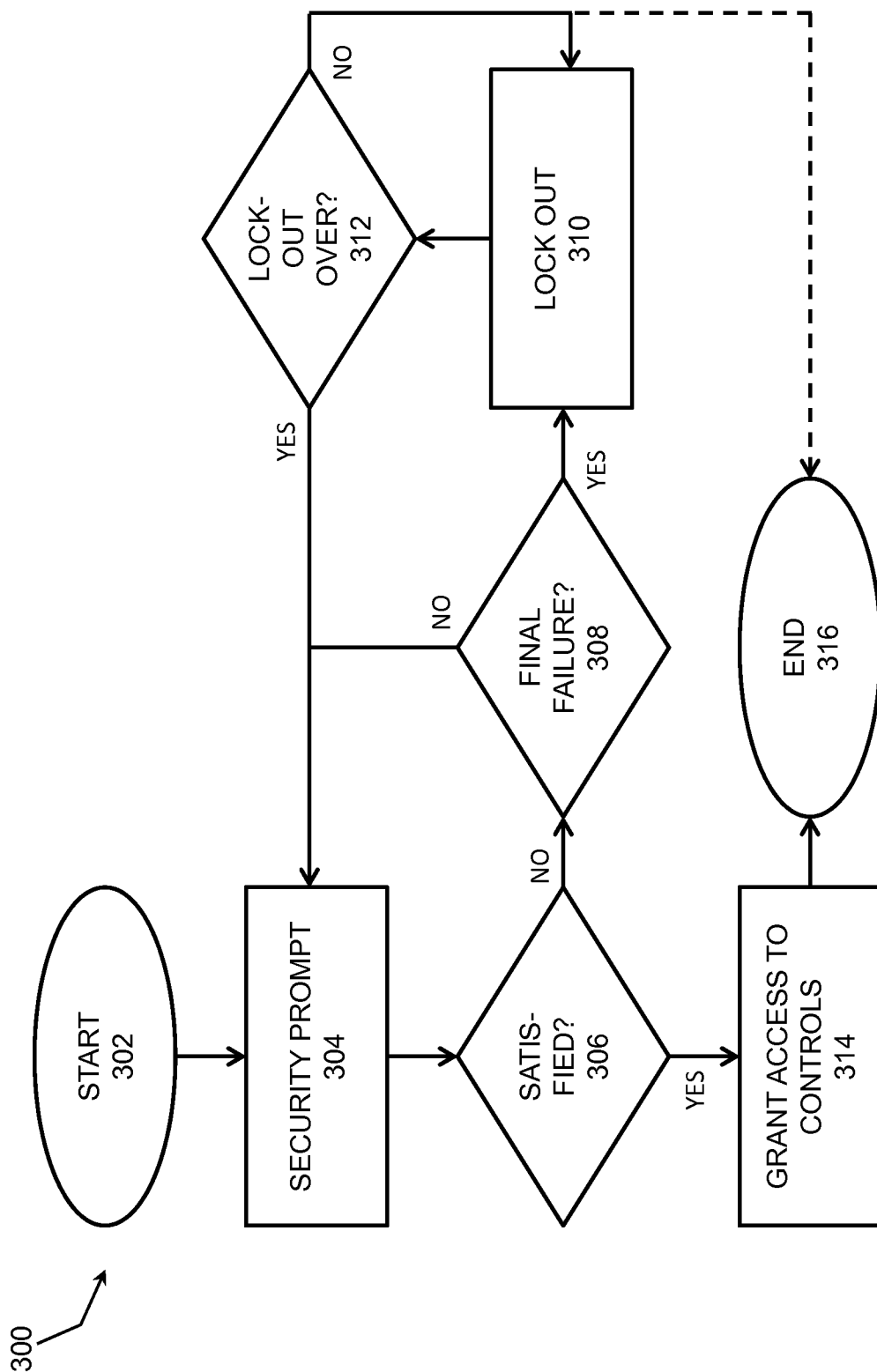


FIG. 3

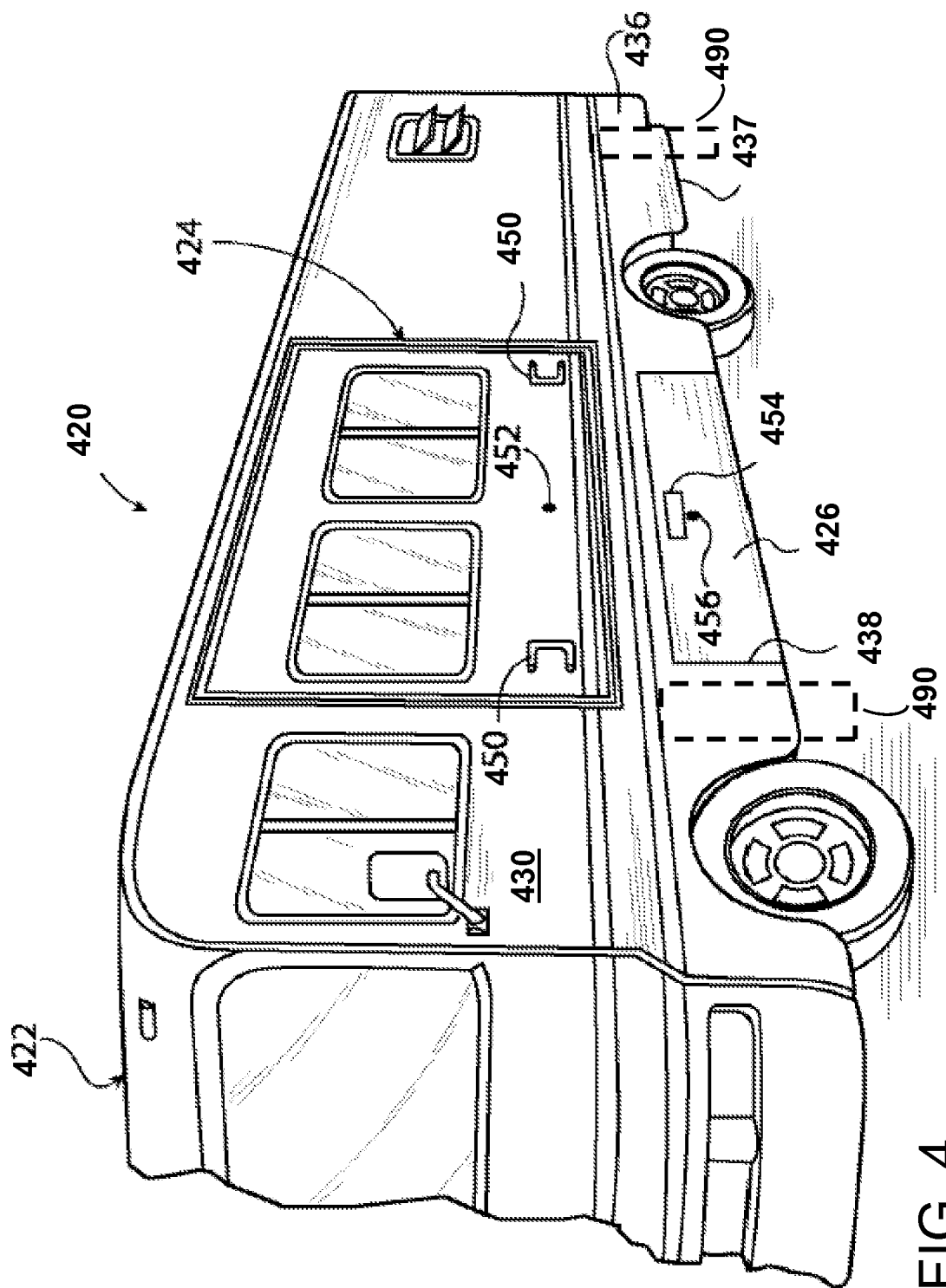


FIG. 4

Electronic Patent Application Fee Transmittal

Application Number:

Filing Date:

Title of Invention:

VEHICLE LEVELING ASSEMBLY WITH DIGITAL SENSOR

First Named Inventor/Applicant Name:

BERNARD F. GARCEAU

Filer:

Brendan Edward Clark

Attorney Docket Number:

116523.

Filed as Small Entity

Provisional Filing Fees

Description

Fee Code

Quantity

Amount

**Sub-Total in
USD(\$)**

Basic Filing:

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2005

1

130

130

Pages:

Claims:

Miscellaneous-Filing:

Petition:

Patent-Appeals-and-Interference:

Post-Allowance-and-Post-Issuance:

Extension-of-Time:

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Description	Fee Code	Quantity	Amount	Sub-Total in USD(\$)
Miscellaneous:				
Total in USD (\$)				130

Electronic Acknowledgement Receipt

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International Application Number:	
Confirmation Number:	4632
Title of Invention:	VEHICLE LEVELING ASSEMBLY WITH DIGITAL SENSOR
First Named Inventor/Applicant Name:	BERNARD F. GARCEAU
Customer Number:	21324
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Application Type:	Provisional

Payment information:

Submitted with Payment	yes
Payment Type	Deposit Account
Payment was successfully received in RAM	\$ 130
RAM confirmation Number	4781
Deposit Account	150450
Authorized User	

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	ETN# 1008 Part / 34 of 35 Pages (if appl.)
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1	Application Data Sheet	116523_aia0014.pdf	1561086 9dda97c1aa673888d9959aa7f8918f27b6c8dc30	no	7
Warnings:					
Information:					
2	Specification	NorcoSpec20140915a.pdf	157609 a886f471fe3853f8f53755a2240f42ca2d244278	no	17
Warnings:					
Information:					
3	Drawings-only black and white line drawings	Norco20140915a.pdf	167430 b9cd0250c4998e8dc4e82d7fb61925801319cc93	no	4
Warnings:					
Information:					
4	Fee Worksheet (SB06)	fee-info.pdf	29746 7013479b00cbde47c69704adbb4d8c065f4ca172	no	2
Warnings:					
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Total Files Size (in bytes):			1915871		
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