

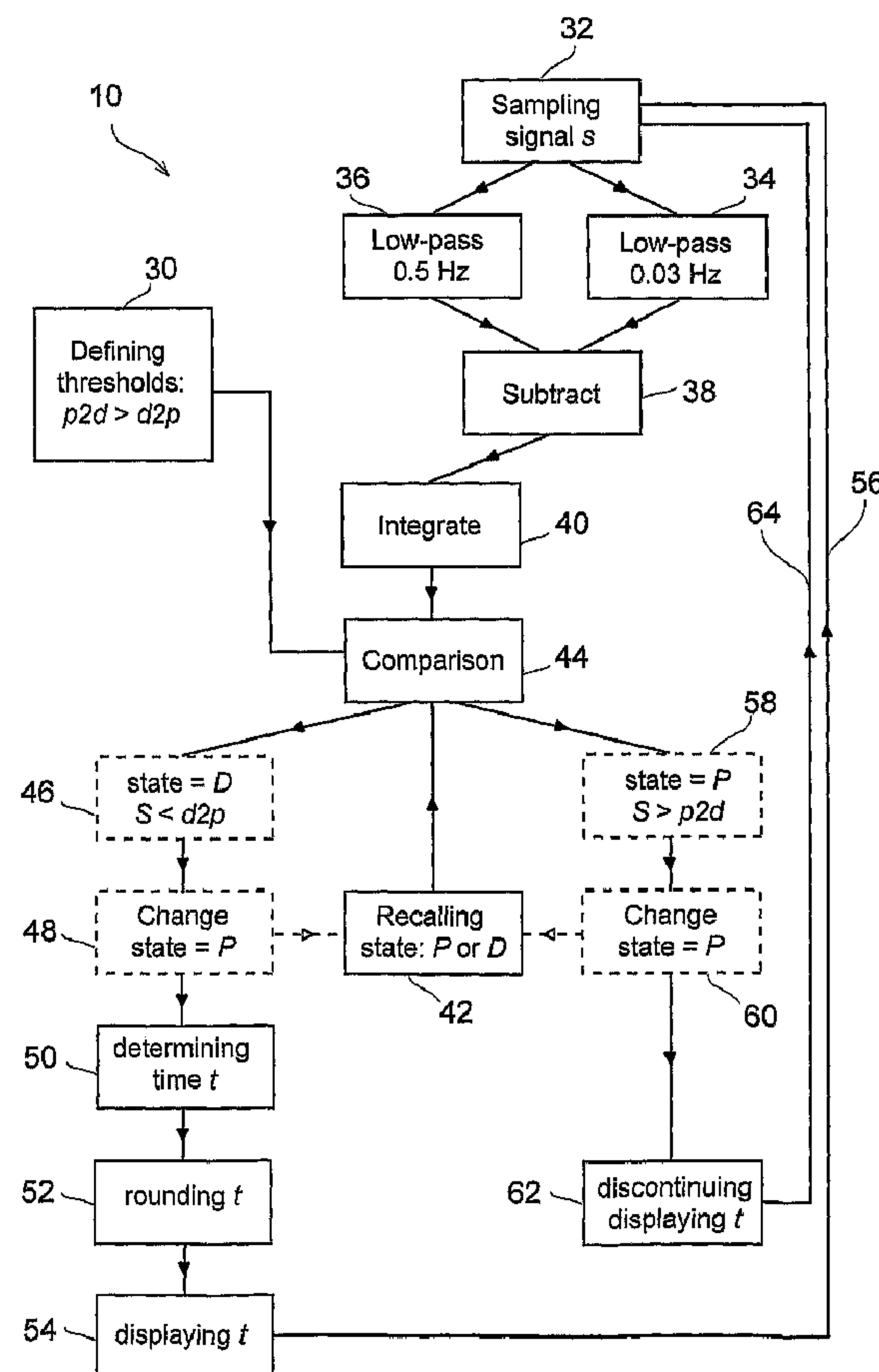


(86) **Date de dépôt PCT/PCT Filing Date:** 2009/05/12
(87) **Date publication PCT/PCT Publication Date:** 2010/11/18
(45) **Date de délivrance/Issue Date:** 2015/07/14
(85) **Entrée phase nationale/National Entry:** 2011/11/01
(86) **N° demande PCT/PCT Application No.:** IB 2009/005565
(87) **N° publication PCT/PCT Publication No.:** 2010/131059

(51) **Cl.Int./Int.Cl.** *G07C 1/30* (2006.01)
(72) **Inventeur/Inventor:**
LARSEN, KLAUS, DK
(73) **Propriétaire/Owner:**
NEEDIT APS, DK
(74) **Agent:** FETHERSTONHAUGH & CO.

(54) **Titre : DISQUE DE STATIONNEMENT AUTOMATIQUE**

(54) **Title: AUTOMATIC PARKING DISC**



(57) **Abrégé/Abstract:**

A method for determining changes between states of a land vehicle is disclosed. The method involves the initial steps of sampling a signal having a signal parameter representing the driving motions of said land vehicle, defining a lower threshold and an upper



(57) Abrégé(suite)/Abstract(continued):

threshold for said signal parameter. The method further involves the subsequent steps of determining a change from parked to driving if the present state is parked and if said signal parameter is greater than said upper threshold, or alternatively determining a change from driving to parked if the present state is driving and if said signal parameter is smaller than said lower threshold. An automatic parking disc performing the method is also disclosed.

(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau



(43) International Publication Date
18 November 2010 (18.11.2010)

(10) International Publication Number
WO 2010/131059 A1

(51) International Patent Classification:
G07C 1/30 (2006.01)

(21) International Application Number:
PCT/IB2009/005565

(22) International Filing Date:
12 May 2009 (12.05.2009)

(25) Filing Language: English

(26) Publication Language: English

(71) Applicant (for all designated States except US): **NEDIT APS** [DK/DK]; Store Strandstraede 21, 3rd r., DK-1255 Copenhagen (DK).

(72) Inventor; and

(75) Inventor/Applicant (for US only): **LARSEN, Klaus** [DK/DK]; Pilevej 1, DK-2970 Hoersholm (DK).

(74) Agent: **BUDDE SCHOU A/S**; Vester Sogade 10, DK-1601 Copenhagen V (DK).

(81) Designated States (unless otherwise indicated, for every kind of national protection available): AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BR, BW, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RS, RU, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) Designated States (unless otherwise indicated, for every kind of regional protection available): ARIPO (BW, GH, GM, KE, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, SE, SI, SK, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

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(54) Title: AUTOMATIC PARKING DISC

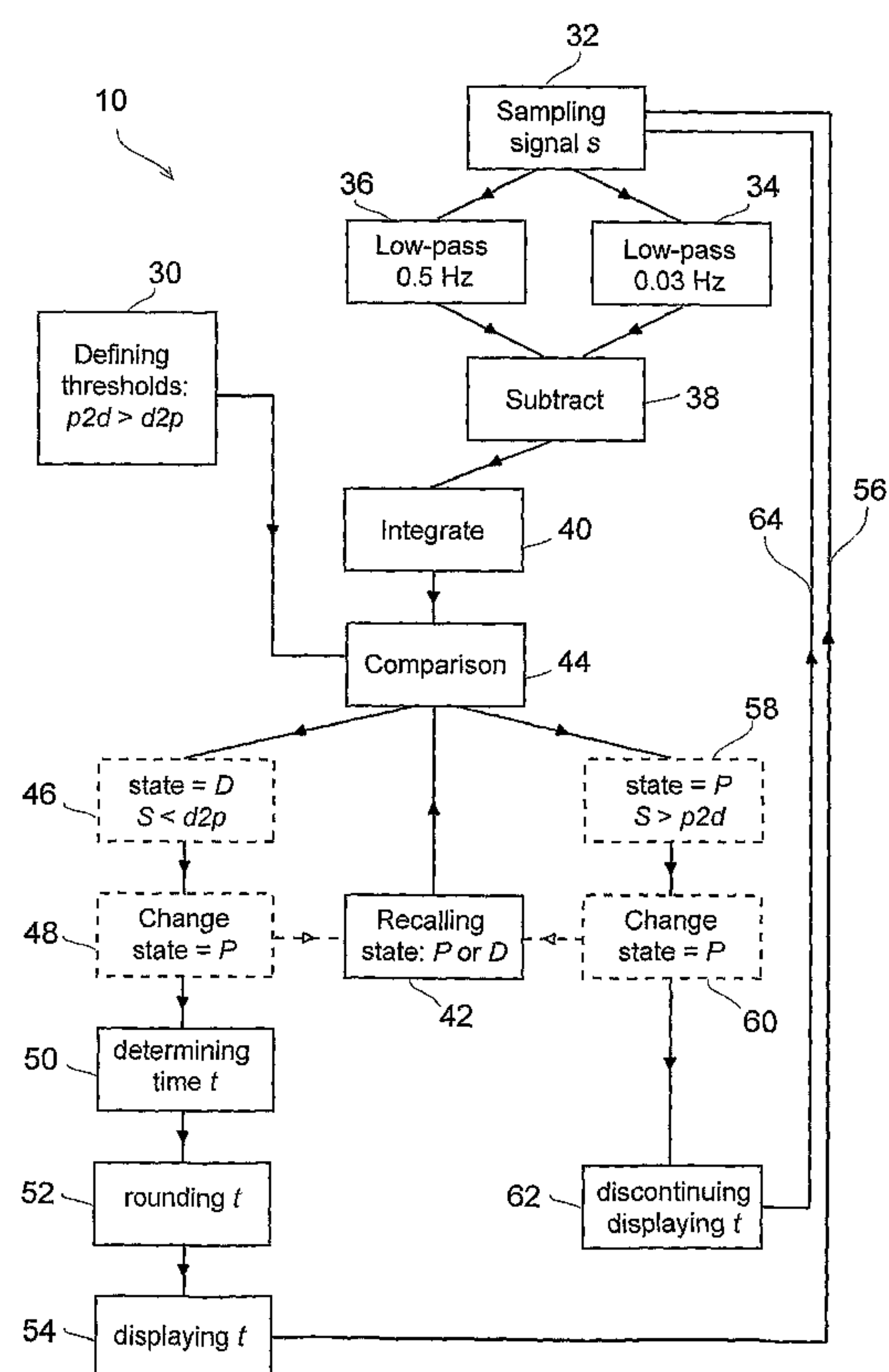


Figure 1

(57) Abstract: A method for determining changes between states of a land vehicle is disclosed. The method involves the initial steps of sampling a signal having a signal parameter representing the driving motions of said land vehicle, defining a lower threshold and an upper threshold for said signal parameter. The method further involves the subsequent steps of determining a change from parked to driving if the present state is parked and if said signal parameter is greater than said upper threshold, or alternatively determining a change from driving to parked if the present state is driving and if said signal parameter is smaller than said lower threshold. An automatic parking disc performing the method is also disclosed.

WO 2010/131059 A1



Published:

— *with international search report (Art. 21(3))*

AUTOMATIC PARKING DISC

Field of the invention

The present invention generally relates to a method for accurately determining
5 the state of a vehicle, and in particular to an automatic parking disc. More specifically, the present invention relates to an autonomous parking disc without any direct couplings to the electronics of the vehicle it is placed in.

Related art

10 In disc parking the parking disc shows the arrival time, which is set to the next full hour, half hour, or quarter hour mark on a clock face. For example, if a parking sign indicates a one hour maximum parking time, then the effective maximum parking time is at least 61 to 75 minutes, because of the setting of the clock forward in time.

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Parking discs are commonly placed inside a vehicle so that the arrival time can be read from the outside of the vehicle through the windshield or through one of the side-windows at the front. Typically, a parking disc has a traditional clock face with time marks positioned in a circle. A mechanical time indicator or arrow
20 is rotationally connected to the centre of the circle and can be set manually relative to the clock face to indicate the arrival time. The manually operable parking discs are commonly sheet-like objects that can easily be stowed away when not in use. However, there are also parking discs that are bulky, or parking discs that are releasably or permanently attached to the windscreen.

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There are also parking discs that automatically indicate the arrival time. In EP1221676A2 and EP1231572 acceleration sensors are suggested as sensors for determining whether a vehicle is in a driving state or a parked state. These kinds of parking discs are associated with the problem that they are not reliable
30 in determining the state of the vehicle, or in determining the transition between states.

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Another kind of parking discs is revealed in DE4305266A1, in which it is physically coupled to the electrical system, or more specifically to the ignition, of a vehicle.

These parking discs are generally reliable in determining the state of a vehicle.

However, they are associated with costly installment procedures and are also

5 susceptible to manipulation via the physical coupling to the electrical system.

WO 2004/114225 discloses an automatic parking disc, wherein a state transition from parked to driving is based on whether an estimate of the acceleration along a single uniform direction exceeds a minimum value.

Another parking disc also employing an accelerometer for the determination of

10 whether a land vehicle is driving or parked is disclosed in EP 1 221 676.

Object of the invention

It is an object of some embodiments of the present invention to provide a reliable determination of changes between states of a vehicle, i.e. whether the state is changed from parked to driving or from driving to parked, by an automatic parking

15 disc. A particular feature of the present invention is that the parking disc is autonomous with respect to the vehicle, for example it is not coupled to the electrical system the vehicle for power or for receiving information about the state of the vehicle. An advantage with some embodiments of the present invention is an automatic and accurate parking disc that can be easily be transferred between and
20 used in different vehicles.

General description

The above object, the above advantage and the above feature together with numerous other objects, advantages and features will be evident from the detailed descriptions given below of preferred embodiments according to the present

25 invention. The objects, advantages and features may be obtained according to a first aspect of the present invention by a method for determining changes between states

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of a land vehicle from parked to driving and from driving to parked comprising the steps of: sampling a signal having a signal parameter representing the driving motions of the land vehicle, defining a lower threshold and an upper threshold for the signal parameter, determining a change from parked to driving if the present state is parked and if the signal parameter is greater than the upper threshold, or alternatively
5 determining a change from driving to parked if the present state is driving and if the signal parameter is smaller than the lower threshold.

Here, the states in question are parked or driving. Further, the land vehicle may be any vehicle capable of travelling on land, such as road vehicles and off-road vehicles.
10 Examples of road vehicles are cars, buses, trucks and vans. Examples of off-road vehicles are tractors, forklifts, cranes, bulldozers and Golf carts. The land vehicle may be wheeled, tracked, railed, or skied.

The driving motions of the land vehicle are primarily a result from the movement of the land vehicle across land, e.g. due to accelerations, decelerations, direction
15 changes of the land vehicle, e.g. turns. Uneven road surfaces may also result in driving motions, e.g. due to bumps or hollows in the roads. Hence, the signal parameter may essentially represent the changes in velocities and directions relative to the surroundings. For example, the signal parameter may be considered as having the unit of meters per seconds squared. Naturally, the value of the signal parameter
20 changes over time when the land vehicle is in the state of driving.

The method for determining a change of state of a land vehicle may further comprise the steps of determining an arrival time from a reference time if the change from driving to parked is determined, and displaying the arrival time. These features may provide the advantages of easier setting of the arrival time in an automatic parking
25 disc and that they enable the arrival time to be viewed at a later point in time. The method for determining a change of state of a land vehicle may further comprise the step of rounding the arrival time to the next full quarter of an hour. If the arrival time is

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indicated with hands on a clock face, this has the advantage of clearer indication than if every minute is indicated.

The method for determining a change of state of a land vehicle may further comprise the step of discontinuing the displaying of the arrival time if the change from parked to driving is determined. This feature may provide the advantage of an easier resetting
5 of the arrival time in an automatic parking disc and also the advantage that it enables the parking time to be displayed during whole time in the parked state.

The method for determining a change of state of a land vehicle may further comprise the step of filtering the signal to suppress the signal outside a frequency window. This
10 feature may provide the advantage of a more accurate determination of a change between states. For example, motions induced by the wind on a parked land vehicle may be filtered out at the lower frequencies, while engine vibrations may be filtered out at the higher frequencies for a land vehicle in a driving state. The frequency window may have its lower cut-off frequency and its upper cut-off frequency within
15 approximately 0.01Hz and approximately 1Hz. More specifically, the frequency window may have its lower cut-off frequency at approximately 0.03Hz and its upper cut-off frequencies at approximately 0.5 Hz. It has been show that with these particular cut-off frequencies the changes between states can be accurately determined, where the signal primarily represents changes in velocities and
20 directions relative to the surroundings. A particular advantage of the proposed cut-off frequencies may be that the method for determining a change of state of a land vehicle does not depend on combustion engines to function, which means that it also works for vehicles having electrical motors.

Additionally or alternatively, the motions of the land vehicle may be approximately
25 vertical, approximately parallel to the primary driving direction of the land vehicle, or a combination thereof. Due to the suspensions of many land vehicles, which usually allow for significant sideways rocking, by leaving out perpendicular or sideways

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motions, the accuracy in determining a change between states is made more accurate.

The sampling frequency in the step of sampling the signal may be in the range between approximately 0.1 second and approximately 30 seconds. The method for
5 determining a change of state of a land vehicle may further comprise the step of lowering the time-resolution of the signal parameter. The lowering of the time-resolution may be achieved through an integration of the signal parameter over a time interval. The length of the time interval may be in the range of approximately
10 10 seconds to approximately 100 seconds. All of these features and steps may provide the advantage that they increase the accuracy in determining a change between states of the more common land vehicles.

The objects, advantages and features may be obtained according to a second aspect of the present invention by an automatic parking disc having a front face for being viewed from the outside of a land vehicle and a back face for being viewed from the
15 inside of the land vehicle. The automatic parking disc comprises one or more processors for performing the method of determining a change of state of a land vehicle according to the first aspect of the present invention, an accelerometer coupled to the processor to provide the signal, a chronometer to provide the reference time to the processor, and an autonomous power source to provide the
20 automatic parking disc with electrical power.

The accelerometer typically measures its acceleration or change in velocity relative to the surroundings. It may be a single- or multi-axis model, i.e. the accelerometer may measure velocity changes in a single direction, or in several directions simultaneously. The chronometer may comprise any type of electronic or electro-
25 mechanical oscillator, e.g. a quartz oscillator having a base resonance frequency of 32768 Hz. Naturally, the chronometer may have to be calibrated in order to provide an appropriate reference time. The autonomous power source may be an electrical battery, or it may be a solar or photovoltaic cell storing some of its power in an

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electrical battery or capacitor. Autonomous should here be understood as not depending on external power from the vehicle.

- The automatic parking disc may further comprise a first indicator on the front face to display the arrival time. This may provide the advantage that, if the parking disc is
- 5 attached to the windscreen, or for that matter on any window of a vehicle, the arrival time can be seen from the outside of the vehicle. The first indicator may comprise a clock face on the front face having twelve hour differentiating marks in a closed loop, a thirty-minutes differentiating mark between each pair of neighboring hour
- 10 differentiating marks, and a fifteen-minutes differentiating mark between each neighboring thirty-minutes and hour differentiating marks. The automatic parking disc may further comprise a liquid-crystal-display to display the arrival time by a pointer to any of the hour, thirty-minutes, and fifteen-minutes differentiating marks. All these technical features may provide the advantage of improving the displaying of the arrival time.
- 15 The chronometer may further provide a reference date, and the automatic parking disc may further comprise a second indicator on the back face to display the reference time and the reference date. Naturally, the chronometer may have to be calibrated in order to provide an appropriate reference time and reference date. Hence, the automatic parking disc may further comprise a first manual input to
- 20 manually set the reference time and/or the reference date. This may provide the advantage that the reference time can be adjusted to any Coordinated Universal Time or UTC, i.e. the parking disc can easily be used in two different time-zones by a simple recalibration of the chronometer.

- The automatic parking disc may further comprise a second manual input to manually
- 25 set the arrival time. This may provide the advantage that if the time-limited parking starts at a particular time that is later than the present time, the arrival time can be set to the later particular time. This way, it is not necessary to go back to a parked vehicle to set the arrival time when the time-limited parking starts.

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The automatic parking disc may further comprise a support to releasably attach the automatic parking disc to a windshield with the front face facing the windshield. This may provide the advantage that the arrival time can be seen from the outside when the land vehicle is in a parked state.

- 5 According to one aspect of the present invention, there is provided an automatic parking disc having a front face for being viewed from the outside of a land vehicle and a back face for being viewed from the inside of said land vehicle, said automatic parking disc comprising: a processor, an accelerometer coupled to said processor to provide a signal, a chronometer to provide a reference time to said processor, and an
- 10 autonomous power source to provide said automatic parking disc with electrical power, the processor being configured for determining changes between states of the land vehicle from parked to driving and from driving to parked, sampling the signal provided by the accelerometer, said signal having a signal parameter representing driving motions of said land vehicle, the accelerometer being a multi-axis
- 15 accelerometer measuring velocity changes in several directions simultaneously, wherein the processor is configured for: filtering said sampled signal to suppress said signal outside a frequency window, integrating the filtered signal over a time interval in order to provide an integrated signal parameter, and determining a change from parked to driving if a present state is parked and if said integrated signal parameter is
- 20 greater than an upper threshold, or determining a change from driving to parked if the present state is driving and if said integrated signal parameter is smaller than a lower threshold.

Brief description of the figures

Additional objects and features according to the present invention will be more readily apparent from the following detailed description of a preferred embodiment presented in conjunction with the figures:

Figure 1 is a schematic block diagram illustrating the method for determining a change of state of a land vehicle.

Figure 2 is a graph illustrating in the frequency domain a low-pass filtering of the sampled signal.

Figure 3 is a graph illustrating in the frequency domain another low-pass filtering of the sampled signal, where the cut-off frequency is lower than in Figure 2.

Figure 4 is a graph illustrating in the frequency domain the subtraction of the signal after passing the low-pass filtering of Figure 3 from the signal after passing the low-pass filtering of Figure 2, thus effectively representing a band-pass filtering.

Figure 5 is a phase diagram illustrating the hysteresis of the method for determining a change of state of a land vehicle.

Figure 6 is a block diagram illustrating the principal electronic components of an automatic parking disc.

Figure 7 is a front view of an automatic parking disc.

Figure 8 is a side view of an automatic parking disc.

Figure 9 is a back view of an automatic parking disc.

Detailed description

Figure 1 is a schematic block diagram 10 illustrating a preferred embodiment of the method for determining a change of state of a land vehicle. Two thresholds $p2d$ and $d2p$ are defined 30, where the former is higher than the latter. The signal s is sampled 32 at a sampling frequency of 16 Hz and subjected to a low-pass filter 36 having a cut-off frequency at approximately 0.5 Hz, giving a first filtered signal. The sampled signal s is also subjected to another low-pass filter 34 having a cut-off frequency at approximately 0.03 Hz, giving a second filtered signal. The second filtered signal is subtracted 38 from the first filtered signal to. The signal is then integrated 40 over a time window of 16 s, thereby giving the signal parameter S .

The thresholds $p2d$ and $d2p$ are set by calibration with respect to the properties of the signal parameter S in the state of parked and in the state of driving for a car on a road surface.

The signal parameter S is compared 44 with the thresholds $p2d$ and $d2p$ and the present state, either parked P or driving D , is recalled 42. If the present state is driving D and the signal parameter S is smaller than $d2p$ 46, then the present state is changed 48 to parked P , which is stored to be recalled later 42. Next, an arrival time t is determined 50 from a reference time and rounded to the closest future quarter of an hour. The rounded arrival time is then displayed 54. Subsequently, the sampling 32 of a new signal s is performed iteratively 56. If the present state is parked P and the signal parameter S is larger than $p2d$ 58, then the present state is changed 60 to driving D , which is stored to be recalled later 42. Next, the displaying of the arrival time t is discontinued 62. Subsequently, the sampling 32 of a new signal s is performed iteratively 64.

Figure 2 is a graph 12 illustrating in the frequency domain a low-pass filtering of the sampled signal 84. The ordinate 80 shows the changes in velocities a being normalized to a single gravity g , i.e. having the unit of meters per seconds squared, while the abscissa 82 shows the frequency f in the unit of Hertz. An

example of a signal is represented by a dashed line 84. A low pass filter, having the cut-off frequency f_1 that is less than half of the sampling frequency f_{sample} is shown as a solid line 86. Figure 3 is a graph 14 illustrating in the frequency domain a low-pass filtering of the same sampled signal 84 as in Figure 2. Here, the ordinate 92 also shows the changes in velocities a being normalized to a single gravity g , while the abscissa 94 shows the frequency f in the unit of Hertz. A low pass filter, having the cut-off frequency f_2 that is less than the cut-off frequency f_1 of Figure 2 is shown as a solid line 98.

Figure 4 is a graph 16 illustrating in the frequency domain the subtraction of the signal after passing the low-pass filter of Figure 3 from the signal after passing the low-pass filter of Figure 2. Thus, the filtered and subtracted signal 106 is effectively within the upper cut-off frequency f_1 and the lower cut-off frequency f_2 . As in the previous Figures 2 and 3, the ordinate 102 shows the changes in velocities a being normalized to a single gravity g , while the abscissa 104 shows the frequency f in the unit of Hertz. The same scales on the corresponding coordinate axis of Figures 2 to 4 have been used.

Figure 5 is a phase or state diagram 18 illustrating the hysteresis of the method for determining a change of state of a land vehicle. The ordinate 100 shows the values of the signal parameter S , while the abscissa 112 shows to the state of the land vehicle. The hysteresis curve 114 is shown as a solid line, where the dashed arrows 124 indicate the direction of changes between states. The transition from parked P 120 to driving D 122 requires the signal parameter S to be larger than the threshold $p2d$ 116, while the transition from driving D 120 to parked P 120 requires the signal parameter S to be smaller than the threshold $d2p$ 118, where the threshold $p2d$ 116 is higher than the threshold $d2p$ 118.

Figure 6 is a block diagram 20 illustrating the principal electronic components of a preferred embodiment of the automatic parking disc. An Accelerometer 130 samples an analog signal at least partly representing the driving motions of a vehicle. The Accelerometer 130 is set to primarily measure driving motion along in a vertical direction and in the driving direction of the vehicle. Naturally,

this may require that the Accelerometer 130 is placed in the appropriate orientation for this to be achieved. The analog signal is sent to an Analog-to-Digital converter 132 converting it to a digital signal. The digital signal is sent via a Control/Data bus 134 to a Processor 136 in connection with a quartz Oscillator 138 having a base resonance frequency of 32768 Hz. The Processor 136 and the quartz oscillator 138 together define a chronometer for providing a reference time and a reference date. A Temperature sensor 140 also sends an analog temperature signal to the Analog-to-Digital converter 132 to give a digital temperature signal, which is sent via the Control/Data bus 134 to the Processor 136. The digital temperature signal is employed for correcting or partly compensating for temperature induced shifts in the resonance frequency of the quartz oscillator 138.

The Processor performs the method described in conjunction with Figures 1 to 5. Naturally, the Processor 136 comprises a memory unit for storing the corresponding algorithms and the present state of the vehicle.

If the change of state from driving to parked is determined, the Processor 136 sends a signal to the Display controller 144 via the Control/Data bus 134, which in turn sends a display signal via the Display bus 146 to the Front face indicator 148 to display the arrival time. If the change of state from parked to driving is determined, the Processor 136 sends a signal to the display controller 144 via the Control/Data bus 134 to stop display the arrival time on the Front face indicator 148. The processor 136 also sends a signal to the display controller 144 via the Control/Data bus 134 to continuously display the reference time and reference date on the Back face indicator 150.

A key Input 152 enables a time recalibration signal to be sent to the Processor 136 via a Digital In-/Output and the Control/Data bus 134 to manually set the reference time. Another key input 154 enables a date recalibration signal to be sent to the Processor 136 via a Digital In-/Output and the Control/Data bus 134 to manually set the reference date. Similarly, a key input 156 enables an ar-

rival-time recalibration signal to be sent to the Processor 136 via a Digital In-/Output and the Control/Data bus 134 to manually set the arrival time.

5 The electronic components of the parking disc are provided with power via an electrical battery 142. The output power of the battery is monitored by the Processor 136 via the Analog-to-Digital converter 132 and the Control/Data bus 134.

10 Figure 7 is a front view of a preferred embodiment of the automatic parking disc 22. The cylindrical automatic parking disc 22 has a front face 184 with a clock face 170. The clock face 170 is provided with twelve hour differentiating marks 178 in a closed loop and a thirty-minute differentiating mark 180 between each pair of neighboring hour differentiating marks 178. Further, the clock face 170 is also provided with a fifteen-minutes differentiating mark 182 between each
15 neighboring thirty-minutes 180 and hour 178 differentiating mark. On the inside of the clock face 170 is a liquid-crystal-display 174 showing an arrow 176 indicating the arrival time when the state is changed from driving to parked. The arrow 176 points either at an hour differentiating mark, a thirty-minutes differentiating mark, or a fifteen-minutes differentiating mark.

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Figure 8 is a side view of a preferred embodiment of the automatic parking disc 22. The depth of the side 188 of the cylindrical parking disc 22 is significantly smaller than the diameter of its front 184 or back 172 faces, thereby giving it a flat profile. The front face is provided with a transparent suction ring 186 on the
25 clock face 170 to enable a releasable attachment of the parking disc onto the inside of a windshield with the front face 184 facing outwards from the vehicle. The transparent cover 202 of a battery indicator lamp, which is turned on at low battery energy levels, protrudes from the back face 172.

30 Figure 9 is a back view of a preferred embodiment of the automatic parking disc 22. The cylindrical automatic parking disc 22 has a back face 172 provided with a liquid-crystal-display 192 for indicating the reference time and reference date. The parking disc 22 is also provided with an autonomous power source in

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the form of a battery housed behind a battery lid 200. The back face 172 is also provided with a manual key input 196 for setting the reference time, a manual key input 198 for setting the reference date, and manual key input 194 for setting the arriving time.

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CLAIMS:

1. An automatic parking disc having a front face for being viewed from the outside of a land vehicle and a back face for being viewed from the inside of said land vehicle, said automatic parking disc comprising:
 - 5 a processor,
an accelerometer coupled to said processor to provide a signal,
a chronometer to provide a reference time to said processor, and
an autonomous power source to provide said automatic parking disc with electrical power,
 - 10 the processor being configured for determining changes between states of the land vehicle from parked to driving and from driving to parked, sampling the signal provided by the accelerometer, said signal having a signal parameter representing driving motions of said land vehicle, the accelerometer being a multi-axis accelerometer measuring velocity changes in several directions simultaneously,
 - 15 wherein the processor is configured for:
 - filtering said sampled signal to suppress said signal outside a frequency window,
 - integrating the filtered signal over a time interval in order to provide an integrated signal parameter, and
 - 20 determining a change from parked to driving if a present state is parked and if said integrated signal parameter is greater than an upper threshold, or
determining a change from driving to parked if the present state is driving and if said integrated signal parameter is smaller than a lower threshold.

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2. The automatic parking disc according to claim 1, wherein the processor is further being configured for determining an arrival time from the reference time if said change from driving to parked is determined, and

5 displaying said arrival time in a first indicator on said front face of the automatic parking disc.

3. The automatic parking disc according to claim 2, wherein the processor is further being configured for rounding said arrival time to a next full quarter of an hour.

10 4. The automatic parking disc according to claim 2 or 3, wherein the processor is further being configured for discontinuing the displaying of said arrival time if said change from parked to driving is determined.

5. The automatic parking disc according to claim 1, wherein the frequency window has its lower cut-off frequency and its upper cut-off frequency within 0.01Hz and 1Hz.

15 6. The automatic parking disc according to claim 1 or 5, wherein the frequency window has its lower cut-off frequency at 0.03Hz and its upper cut-off frequencies at 0.5 Hz.

7. The automatic parking disc according to any one of claims 1-6, wherein the length of said time interval is in the range of 10 seconds to 100 seconds.

20 8. The automatic parking disc according to any one of claims 1-7, wherein said first indicator comprises a clock face on said front face having:

twelve hour differentiating marks in a closed loop,

a thirty-minutes differentiating mark between each pair of neighboring hour differentiating marks, and

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a fifteen-minutes differentiating mark between each neighboring thirty-minutes and hour differentiating marks.

9. The automatic parking disc according to any one of claims 1 to 8, wherein said first indicator further comprises: a liquid-crystal-display to display said arrival time by a pointer to any of said hour, thirty-minutes, and fifteen-minutes differentiating marks.

10. The automatic parking disc according to any one of claims 1 to 9, wherein said chronometer further provides a reference date, and said automatic parking disc further comprising: a second indicator on said back face to display said reference time and said reference date.

11. The automatic parking disc according to any one of claims 1 to 10 further comprising: a first manual input to manually set said reference time and/or said reference date.

12. The automatic parking disc according to any one of claims 1 to 11 further comprising: a second manual input to manually set said arrival time.

13. The automatic parking disc according to any one of claims 1 to 12 further comprising: a support to releasably attach said automatic parking disc to a windshield with said front face facing said windshield.

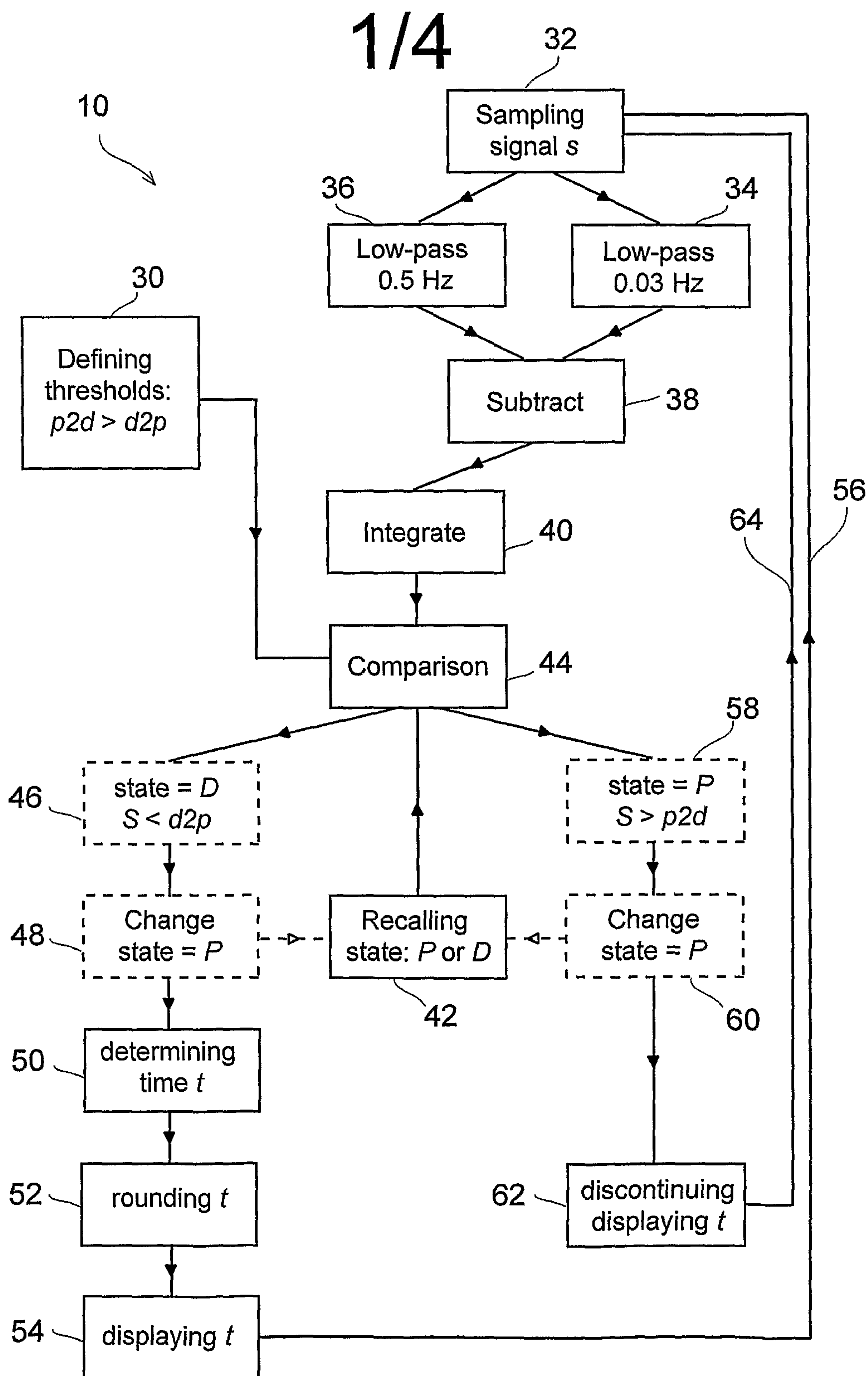


Figure 1

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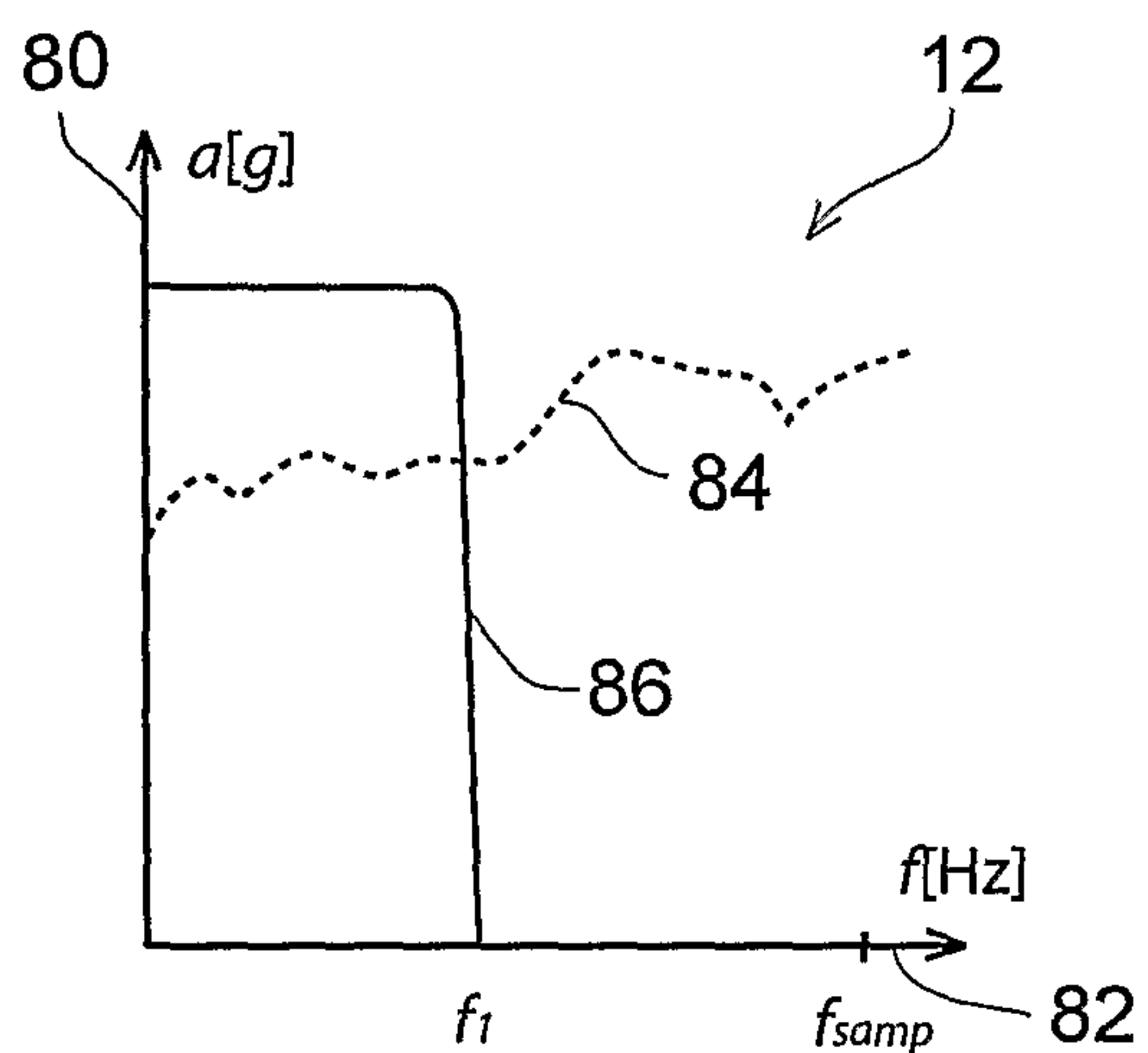


Figure 2

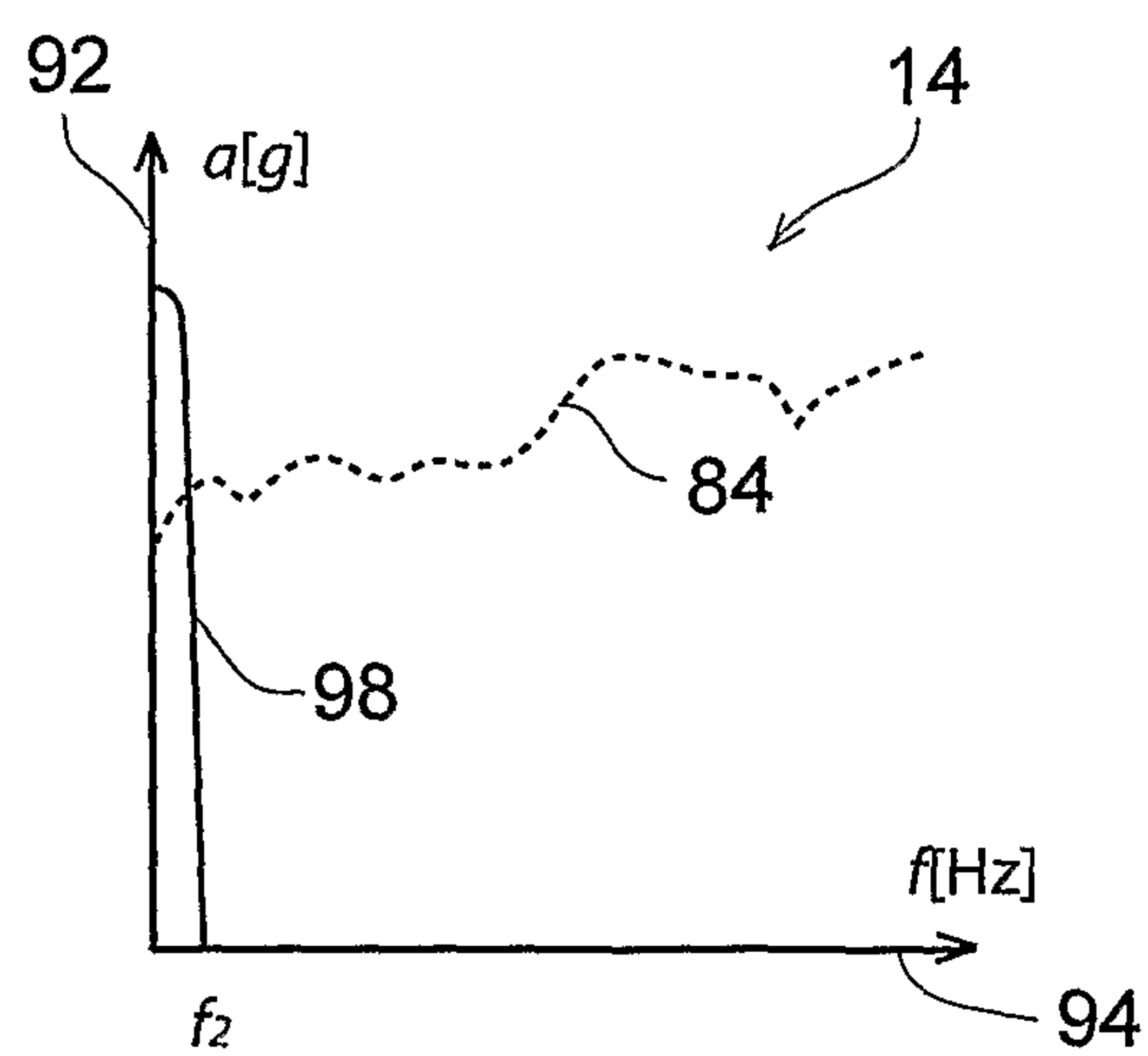


Figure 3

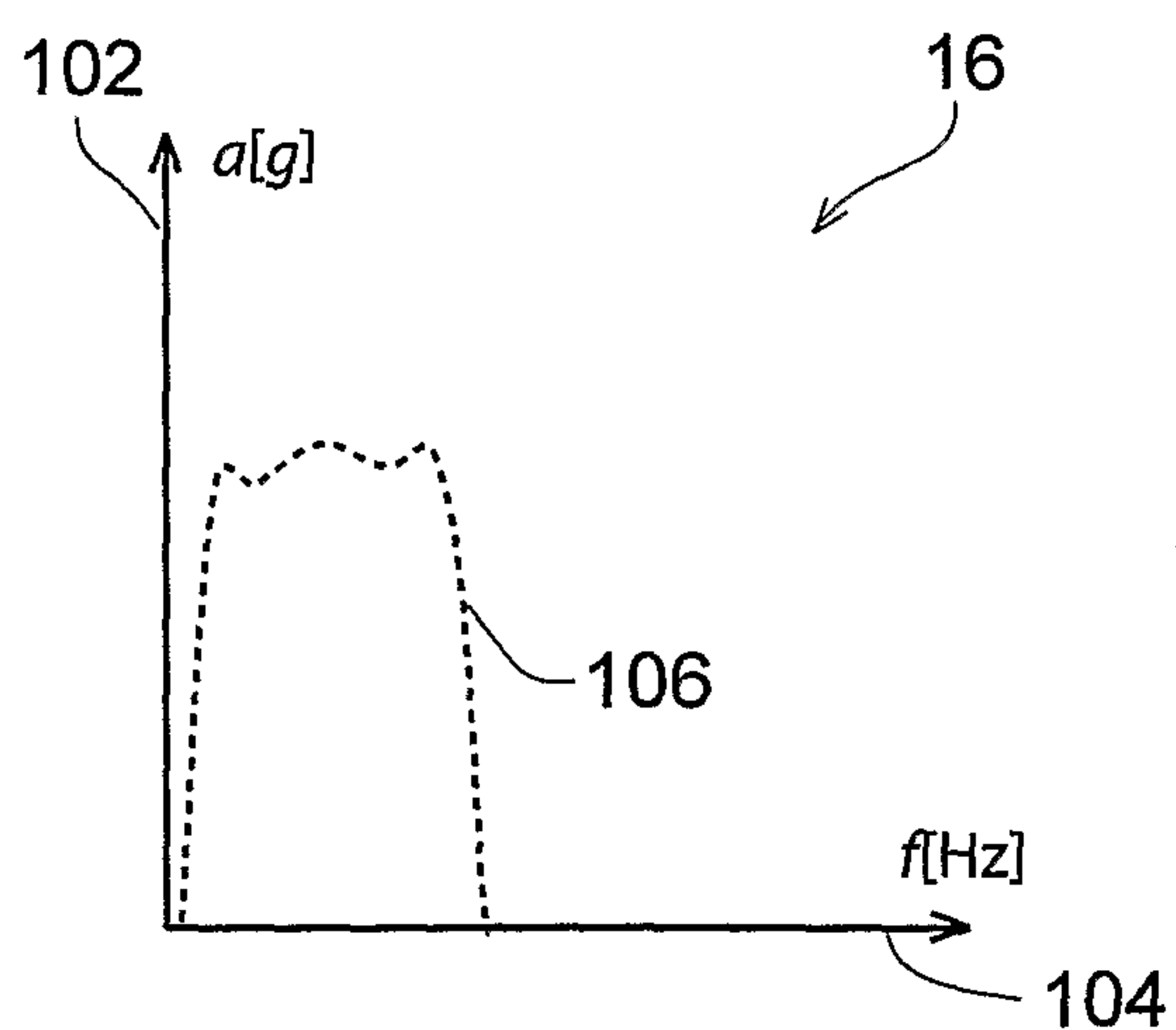


Figure 4

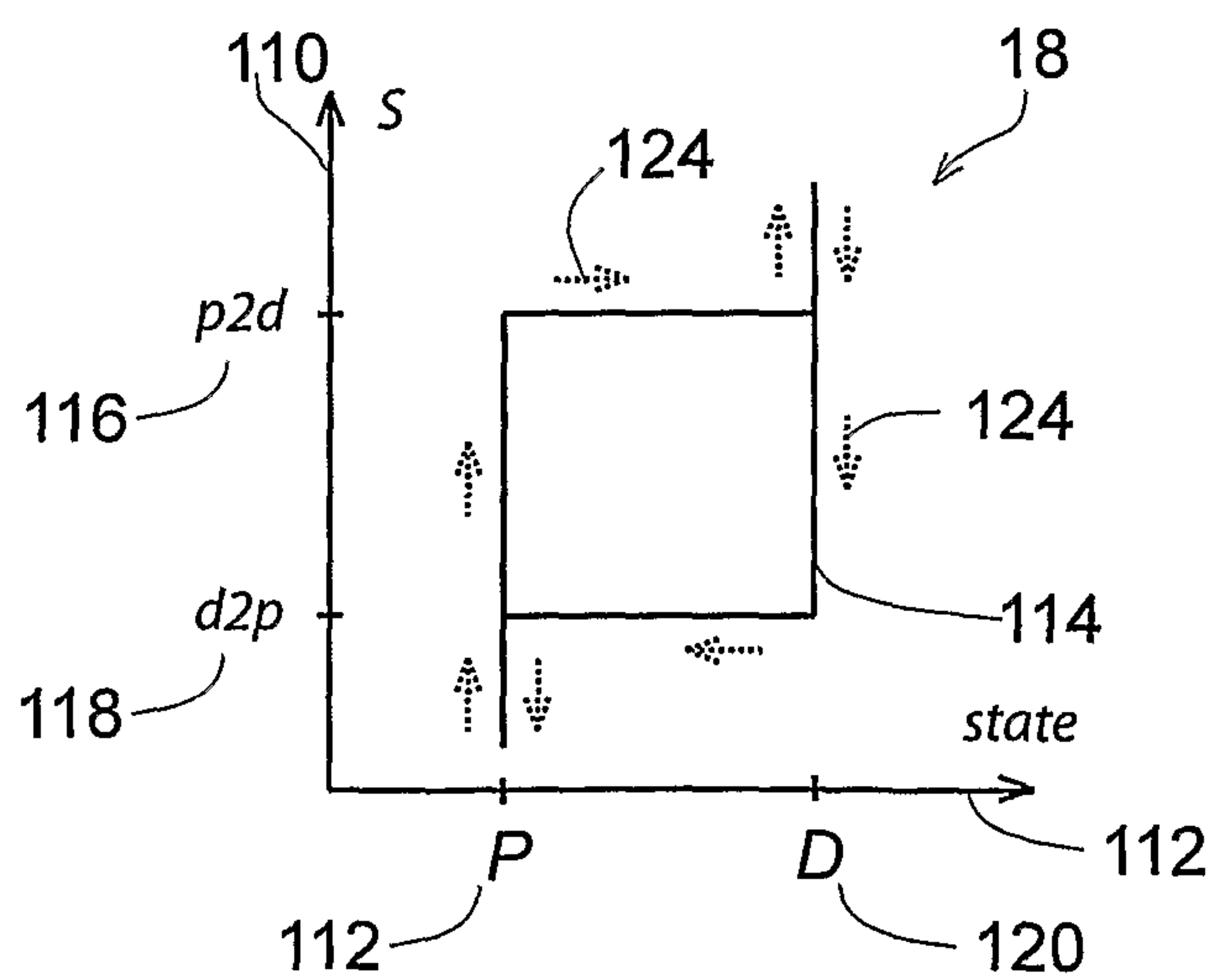


Figure 5

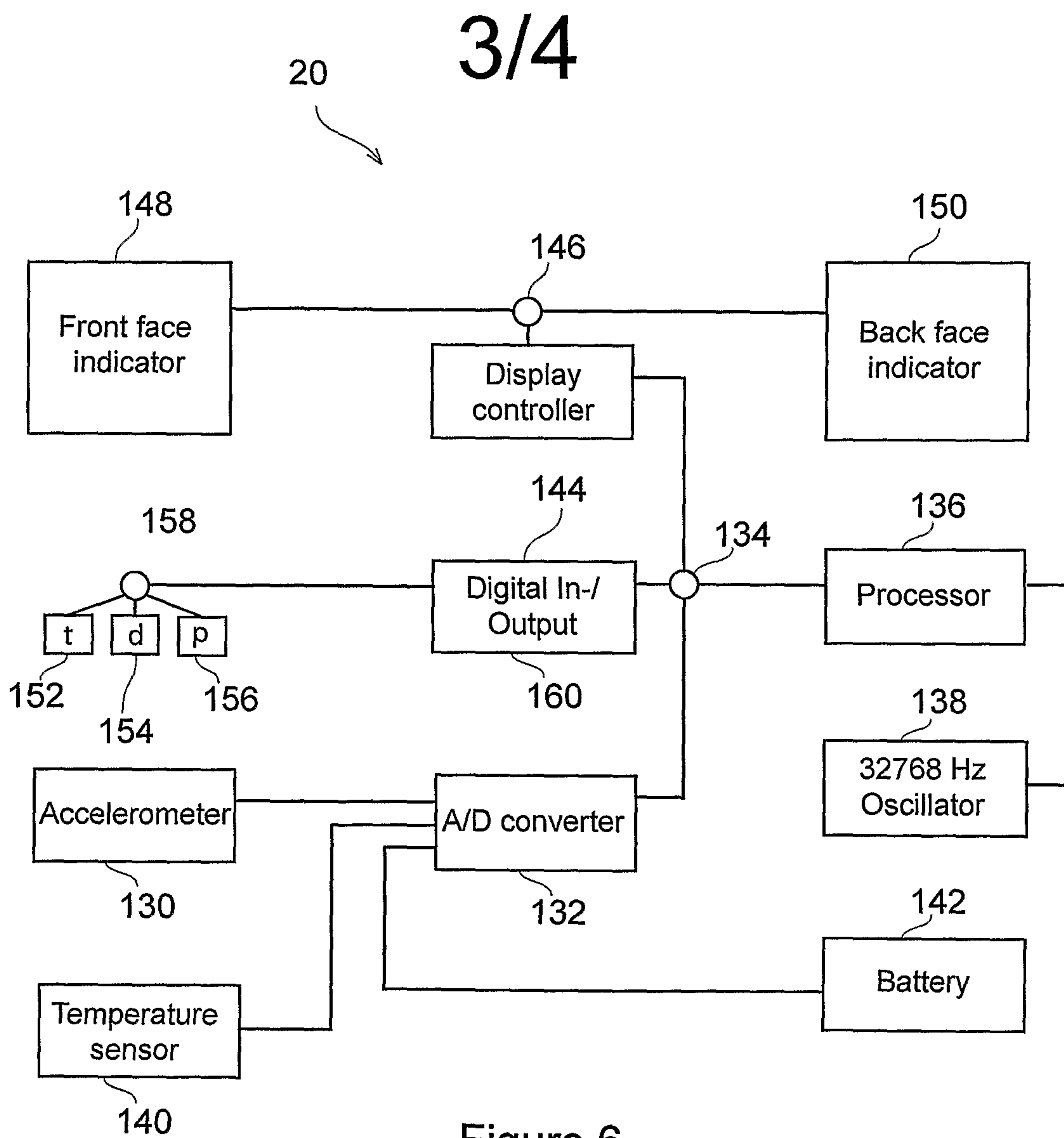


Figure 6

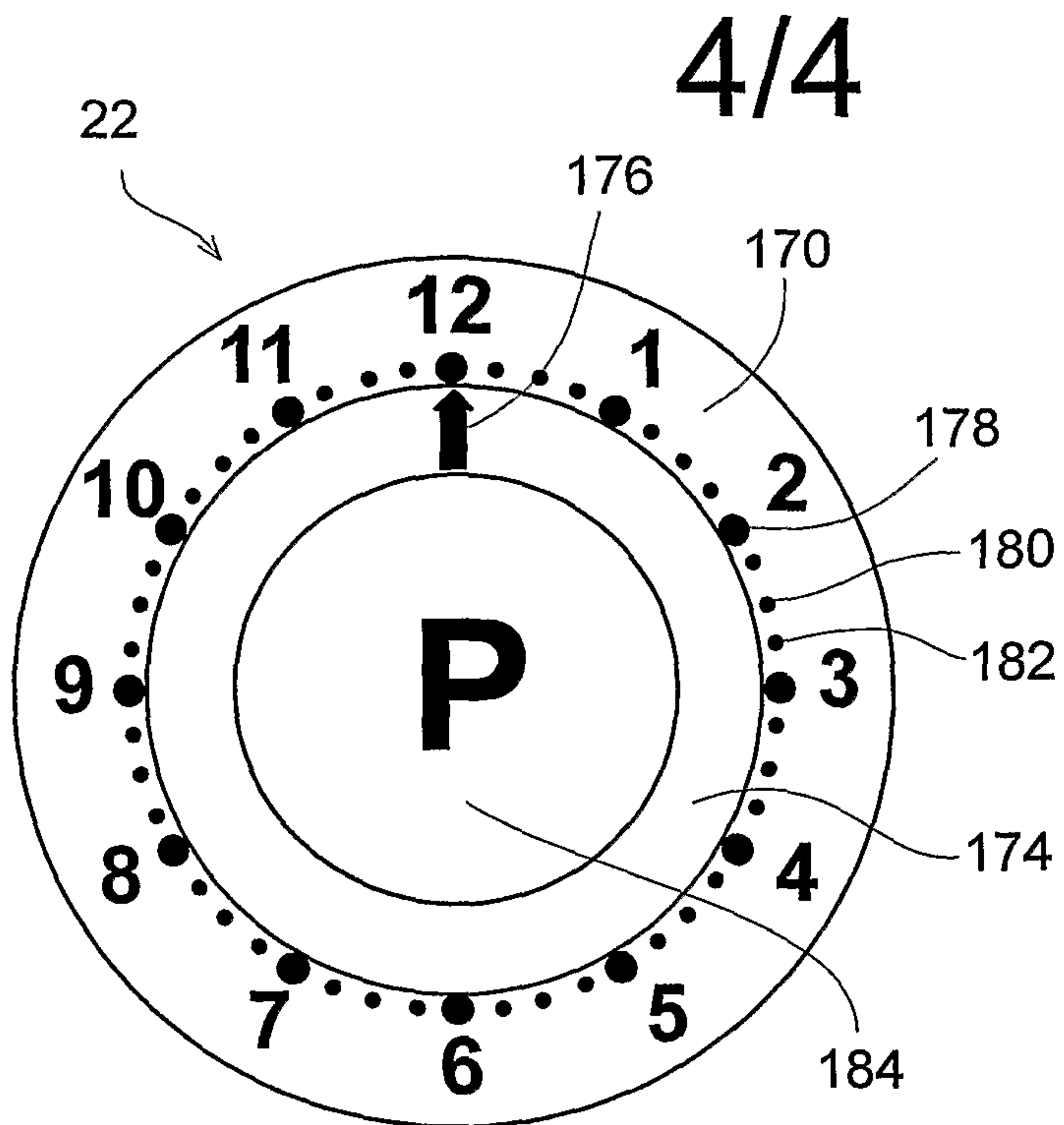


Figure 7

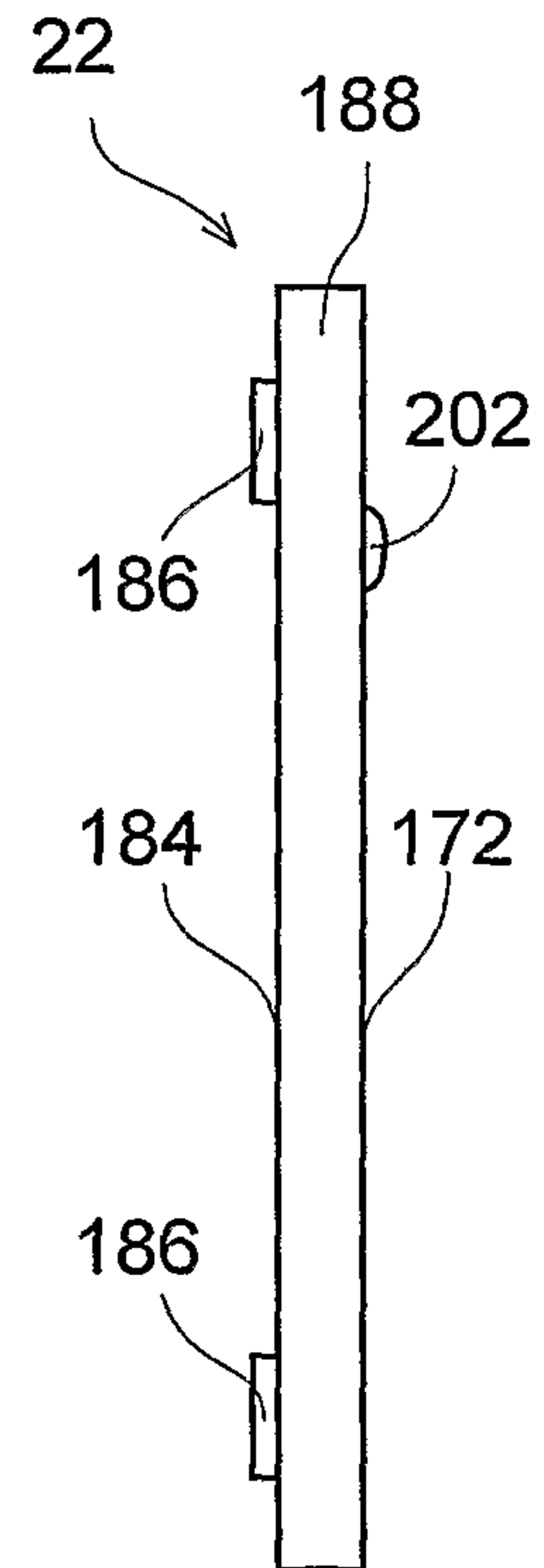


Figure 8

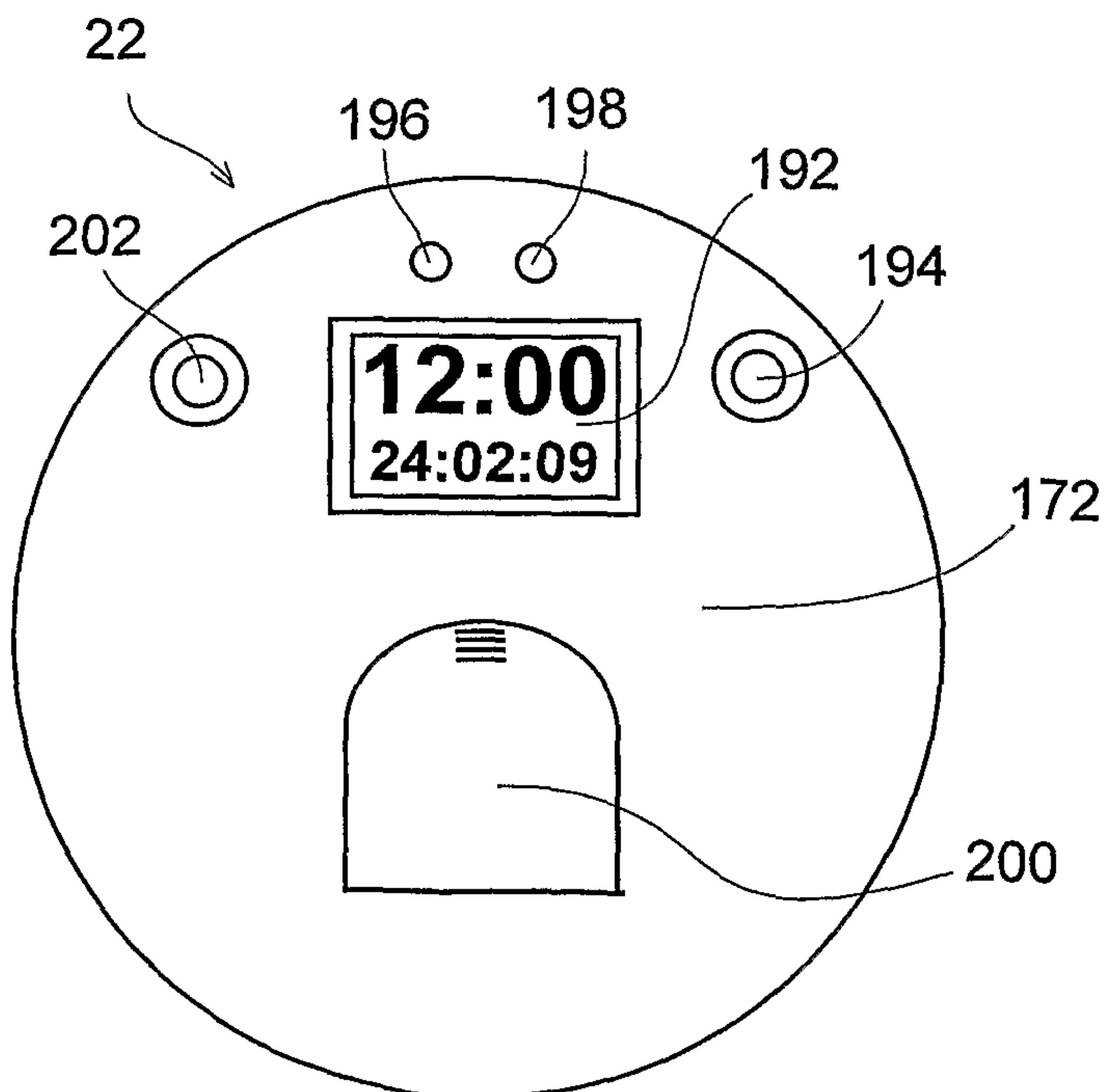


Figure 9

