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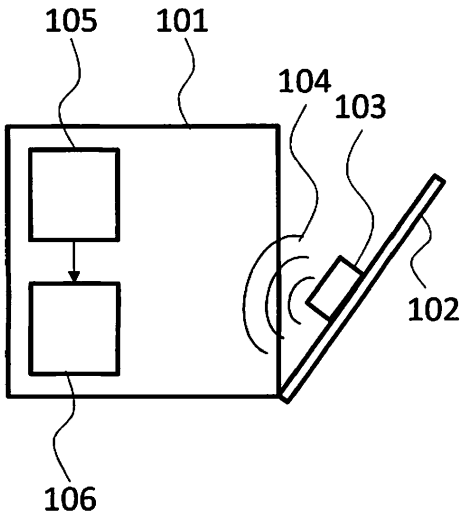
(54) ELECTRICAL DEVICE AND METHOD FOR OPERATING AN ELECTRICAL DEVICE

(57) The present invention provides an electrical device (100, 200, 300, 400) comprising a main housing (101, 201, 301), a door (102, 202, 302, 402, 407) arranged on the main housing (101, 201, 301), wherein the door (102, 202, 302, 402, 407) is openable and closable by a user, a vibrator (103, 403, 408) arranged on the main housing (101, 201, 301) and/or the door (102, 202, 302, 402, 407) and configured to produce vibrations (104) during a movement of the door (102, 202, 302, 402, 407), a vibration detector (105) arranged in the housing and configured to detect the vibrations (104) generated by the vibrator (103, 403, 408), and a vibration evaluation device (106) coupled to the vibration detector (105) and configured to determine when the door (102, 202, 302, 402, 407) moves based on the detected vibrations (104).



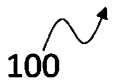


Fig. 1

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Description

TECHNICAL FIELD

[0001] The invention relates to an electrical device and a method for operating such an electrical device.

BACKGROUND

[0002] Although applicable to any electrical device, the present invention will mainly be described in conjunction with white goods, like e.g. refrigerators, washing machines, dishwashers, ovens and the like.

[0003] Usually, electrical devices for use in a household, like e.g. refrigerators, washing machines, dishwashers, ovens comprise a door that may be operated by a user, e.g. to insert or remove goods or objects from the respective device.

[0004] In modern electrical devices the door is usually monitored to detect the state of the door. The information about the state of the door may then be used to control the electrical device. In case of a refrigerator for example, an alarm may be activated if the door is open for a period longer than a predefined period. In case of an oven, heating may be stopped if the door is detected to be open, and the like.

[0005] Usually, to detect the state of the door a sensor is installed in the electrical device. Such a sensor may e.g. be a switch or a contactless sensor, like e.g. a hall sensor or the like. In any case, the sensor must be provided near the door to detect the state of the door. Since usually, the control unit of an electronic device is not provided near the door, the sensor is usually coupled to the control via respective cabling.

[0006] Such a traditional arrangement may, however, cause electrical and mechanical problems. First, a mechanical structure to hold the sensor and the cabling in the electrical device must be provided, thereby increasing complexity and mounting effort for the electrical device. Further, the cabling may cause problems in EMC tests (electro-magnetic compliance tests) or require an increased shielding effort.

[0007] Accordingly, there is a need for an improved state detection for doors of electrical devices.

SUMMARY OF THE INVENTION

[0008] The above stated problem is solved by the features of the independent claims. It is understood, that independent claims of a claim category may be formed in analogy to the dependent claims of another claim category.

[0009] Accordingly, it is provided:

An electrical device comprising a main housing, a door arranged on the main housing, wherein the door is openable and closable by a user, a vibrator arranged on the main housing and/or the door and configured to produce vibrations during a movement of the door, a vibration detector arranged in the housing and configured to detect the vibrations generated by the vibrator, and a vibration evaluation device coupled to the vibration detector and configured to determine when the door moves based on the detected vibrations.

[0010] Further, it is provided:

A method for operating an electrical device with a main housing, and a door arranged on the main housing, wherein the door is openable and closable by a user, the method being provided especially for monitoring a door of the electrical device, the method comprising producing vibrations during a movement of the door with a vibrator arranged on the main housing and/or the door, detecting the vibrations generated by the vibrator with a vibration detector arranged in the main housing, and determining when the door moves based on the detected vibrations.

[0011] The present invention is based on the finding that local sensors for detecting the state of a door of an electrical device will always increase the complexity of the respective device.

[0012] The present invention therefore provides an electrical device that comprises a wireless state detection mechanism that allows detecting whether the door is open or closed without the need to provide in the main housing a cabling to the door and a dedicated sensor near the door.

[0013] To this end, the electrical device comprises a vibrator that is arranged on the main housing and/or the door and that produces vibrations during movement of the door.

[0014] The term vibrations may in this context refer to any type of audible and non-audible vibrations, like e.g. mechanical vibrations below the audible frequency spectrum, i.e. below 16 Hz, or vibrations that propagate as sound waves, especially as air-born or structure-born sound waves, or vibrations that propagate as sound waves, especially as air-born or structure-born sound waves, with a frequency above the audible frequency spectrum, i.e. above about 16 kHz.

[0015] It is understood, that the vibrator may be any kind of device, that is capable of generating any kind of the above-mentioned types of vibrations when the door is moved by a user. Further, it is understood, that the vibration detector may be any kind of sensor that is capable of detecting and/or recording the respective vibrations or the sound waves generated through the vibrations either as air-born or structure-born sound waves.

[0016] The vibration detector may electrically be coupled to the vibration evaluation device. This means that the

vibration detector may be arranged where appropriate in the main housing. The vibration detector may e.g. be arranged with the vibration evaluation device in a single electronic circuit or unit. As alternative, the vibration detector may also be provided as dedicated device that may e.g. be coupled via a cable or a connector with the vibration evaluation device. It is understood, that in case that a cable is used to couple the vibration detector with the vibration evaluation device, the vibration detector may be provided in the main housing such that the cable is as short as possible.

[0017] The vibration evaluation device may e.g. be provided as a dedicated circuit, e.g. as a band-pass filter or any other adequate filter that outputs a detection signal, if a vibration with a respective frequency is detected. It is understood, that a control unit of the electrical device may determine if the door is open or closed based on counting the number of signals generated by the vibration evaluation device. The first signal may e.g. indicate the door being opened, the second signal may indicate the door being closed, etc.

[0018] As alternative, the vibration evaluation device may be implemented in the control unit of the electrical device, e.g. as a function or part of a computer program product, e.g. a firmware of the control unit.

[0019] With the features of the electrical device, monitoring of the state of the door of the device is easily possible without the need to install complex wirings from the door to the control unit of the electrical device. Therefore, with the present invention, the electrical device is simplified and may be produced with less effort.

[0020] Further embodiments of the present invention are subject of the further dependent claims and of the following description, referring to the drawings.

[0021] In an embodiment, the vibrator may comprise a first mechanical part arranged on the main housing and a second mechanical part arranged on the door. The first mechanical part and the second mechanical part may be configured to move relatively to each other during movement of the door and generate the vibrations based on the relative movement.

[0022] The first and the second mechanical parts may comprise surfaces facing each other that engage with each other and comprise a respective pattern. When the mechanical parts are moved relative to each other the respective patterns may move relative to each other and produce the vibrations.

[0023] One of the patterns may e.g. comprise a kind of bit or finger or multiple bits or fingers extending from the mechanical part and the second pattern may comprise multiple protrusions. When the mechanical parts move relative to each other the protrusions will periodically engage with the bit or finger, deform the bit or finger and slide over the bit or finger, which when released will produce vibrations that may be detected by the vibration detector. It is understood, that the vibrations may propagate as audible or inaudible sound waves, as structure-born or air-born sound waves that may be received or detected with a respective microphone or vibration sensor.

[0024] It is understood, that any other pattern is also possible. Instead of providing dedicated bits or fingers, it is also possible to provide rough or coarse surfaces that when rubbing over each other generate respective vibrations. It is understood, that the grain size of the rough or coarse surfaces may be adapted to generate vibrations with a specific frequency. The surfaces may e.g. be coated with a respective coating. For example, a coating may be used that generates ultrasound or vibrations that result in ultrasonic waves being propagated.

[0025] Especially, if the vibrator is adapted to generate non-audible sound waves, the detection of the state of the door may be performed with minimal impact on the user.

[0026] In a further embodiment, the electrical device may comprise a hinge coupling the door with the main housing. The first mechanical part may be arranged on a part of the hinge that is coupled to the main housing and the second mechanical part may be arranged on a part of the hinge that is coupled to the door.

[0027] The hinge may provide a rotational movement for the door. Therefore, the two mechanical parts may e.g. be provided as (semi-) circular parts that are arranged opposite to each other on the respective parts of the hinge. Every movement of the hinge will therefore also provide a relative movement of the two mechanical parts to each other and generate the respective sound.

[0028] Arranging the mechanical parts on the hinge allows easily providing the vibrations along the full range of movement of the door. In contrast, providing the mechanical parts e.g. on the frame of the door either only allows providing the vibrations while the door is almost closed, with small mechanical parts, or requires larger mechanical parts that engage with each other over the full range of movement of the door, which is also possible in another embodiment.

[0029] It is understood, that if the hinge is for example provided only as a rod that connects a hole in the doorframe with a hole in the main housing, the surfaces around the holes may be seen as the parts of the hinge to which the mechanical parts may be coupled.

[0030] In another embodiment, the electrical device may comprise a sliding mechanism coupling the door with the main housing. The first mechanical part may be arranged on a part of the sliding mechanism that is coupled to the main housing and the second mechanical part may be arranged on a part of the sliding mechanism that is coupled to the door.

[0031] A sliding mechanism may e.g. be provided on kitchen ovens, but also on any other electrical device. With such a sliding mechanism the door is not opened by a rotational movement but by a translational movement. Usually, an adequate sliding mechanism comprises parts fixed to the door and parts fixed to the main housing that engage with each other throughout the complete range of movement. These parts are therefore perfectly suited to provide the

mechanical parts of the vibrator.

[0032] It is understood, that the mechanical parts may also be provided on sections of the door and the main housing that move relative to each other with any sliding movement of the door.

[0033] It is understood, that the arrangements discussed in here with reference to the door may also be applied to any other element of an electrical device, like e.g. to drawers. Such drawers may e.g. be provided in a dish washer, in a refrigerator or the like. Therefore, everything disclosed herein with regard to the door may also be applied to drawers. The vibrator may therefore be arranged to generate vibrations when the respective drawer is moved. In case of a mechanical vibrator consisting of multiple parts, the parts may be arranged on the main housing and on the drawer or the respective sliding mechanism.

[0034] In a further embodiment, the vibrator may comprise an electrically actuated vibration device.

[0035] The electrically actuated vibration device may e.g. be an electrically powered device that detects when the door starts moving and then generates respective vibrations. To this end, the electrically actuated vibration device may be mounted on the door. This also allows the electrically actuated vibration device to detect in which direction the door is moved, e.g. by using acceleration sensors. If acceleration sensors are provided in the electrically actuated vibration device, a kind of dead reckoning may be performed for the door based on the measured acceleration values. This would also allow determining the opening angle of the door. Such information may e.g. be transmitted by respective coding or modulation of the vibrations.

[0036] It is understood, that the electrically actuated vibration device may also be provided in the main housing, as alternative. Such an electrically actuated vibration device may comprise respective sensors to detect the presence of the door.

[0037] It is understood, that the electrically actuated vibration device may e.g. be battery powered. As alternative or in addition, the electrically actuated vibration device may comprise an energy harvesting unit that provides electrical power to energize the electrically actuated vibration device. Further, the above-said regarding the types of vibrations that may be generated also applies to the electrically actuated vibration device.

[0038] With the electrically actuated vibration device it is possible to generate vibrations very flexibly and at the same time save the cabling that is used for traditional sensors for detecting door states.

[0039] It is understood, that the electrically actuated vibration device may be used on any type of door and with any type of connection between the door and te main housing, like e.g. the hinge or the sliding mechanism mentioned above.

[0040] In another embodiment, the vibrator may be configured to generate a predefined vibration pattern.

[0041] For example, every vibrator may be configured to produce a unique vibration pattern or a vibration pattern that comprises a unique identifier, e.g. at the end or the beginning. In this context the term "unique" does not necessarily require the pattern or identifier to be globally unique. Instead, a predefined number of patterns or identifiers may be provided that allow differentiating electrical devices with a sufficient probability.

[0042] Especially, in case of an electrically actuated vibration device the vibration device may also comprise a vibration detector and may detect if a vibration device is present in the vicinity that creates the same vibration pattern as the respective electrically actuated vibration device. In this case, the electrically actuated vibration device may change the vibration pattern. A special pattern may be provided to the vibration evaluation device to inform the vibration evaluation device about the change of the vibration pattern.

[0043] If the principle of the present invention is not only applied to a single door, but to multiple doors or also to drawers or the like of the electrical device, a unique vibration pattern may be provided for every element that is monitored. The vibration evaluation device may then identify the respective element based on the different vibration patterns.

[0044] In a further embodiment, the predefined vibration pattern may comprise a directional dependency.

[0045] The vibration pattern comprising a directional dependency refers to the vibration pattern being different when the door is opened then when the door is closed. The vibration pattern may for example comprise a frequency ramp or a frequency modulation that is different when reproduced forwards or backwards.

[0046] With the directional dependency of the vibration pattern it is possible to identify in the vibration evaluation device if the door of the electrical device is opened or closed. It is therefore not necessary to store the current state of the door in the vibration evaluation device or in a control unit of the electrical device.

[0047] Further, the vibration pattern comprising a directional dependency may also allow determining the position of the door between the open and closed state. To this end, the vibration pattern may be designed such that it comprises identifiable sections, i.e. as within the frequency ramp mentioned above. By evaluating the frequency of the currently detected vibrations, the vibration evaluation device or a respective control unit may determine the position of the door.

[0048] Since the frequency of the generated vibrations, at least with a purely mechanical vibrator, may depend on the speed of movement of the door, the vibrations may be normalized when they are received or detected. To this end, for example, specific marks or markers of a known frequency may be transmitted in the vibration pattern.

BRIEF DESCRIPTION OF THE DRAWINGS

[0049] For a more complete understanding of the present invention and advantages thereof, reference is now made to the following description taken in conjunction with the accompanying drawings. The invention is explained in more detail below using exemplary embodiments which are specified in the schematic figures of the drawings, in which:

Fig. 1 shows a block diagram of a possible embodiment of an electrical device according to the present invention;

Fig. 2 shows a block diagram of another possible embodiment of an electrical device according to the present invention;

Fig. 3 shows a block diagram of another possible embodiment of an electrical device according to the present invention;

Fig. 4 shows a block diagram of another possible embodiment of an electrical device according to the present invention; and

Fig. 5 shows a flow diagram of a possible embodiment of a method according to the present invention.

[0050] In the figures like reference signs denote like elements unless stated otherwise.

DETAILED DESCRIPTION OF THE DRAWINGS

[0051] Fig. 1 shows a block diagram of an electrical device 100. The electrical device 100 comprises a main housing 101. A door 102 is attached to the main housing 101. It is understood, that the door 102 may be opened and closed by a user, either manually or by interaction with respective inputs on the electrical device 100. In Fig. 1 the door 102 is rotatably opened and is shown half open. It is understood, that any other type of door fixation, e.g. with slides, is also possible.

[0052] In the electrical device 100 a vibrator 103 is arranged on the door 102. It is understood, that the vibrator 103 is just exemplarily shown as a single unit on the door 102 and that other arrangement are possible, as will e.g. be shown in Figs. 2 and 3. The vibrator 103 produces vibrations 104 during a movement of the door 102.

[0053] As a kind of counterpart to the vibrator 103 a vibration detector 105 is arranged in the main housing 101. The vibration detector 105 may be a kind of transducer that detects the vibrations 104 that are generated by the vibrator 103. The vibration detector 105 provides a vibration evaluation device 106 with a respective signal to determine when the door 102 moves based on the detected vibrations 104.

[0054] It is understood, that the vibration detector 105 and the vibration evaluation device 106 may be provided as a single unit, e.g. a control unit with a respective sensor or the like.

[0055] In the electrical device 100 the vibrator 103 may generate a predefined vibration pattern. The term "vibration pattern" refers to any sequence of vibrations of e.g. different frequencies and/or amplitudes. Such a vibration pattern may therefore be identified when it is received by the vibration detector 105 and the vibration evaluation device 106. It is understood, that the predefined vibration pattern may also comprises a directional dependency. This means that the vibration pattern is different when played from one direction or from the other. This allows determining if the door is opened or closed by analyzing the vibration pattern.

[0056] Fig. 2 shows a partial block diagram of an electrical device 200. Emphasis is put on the hinge 210 that couples the door 202 to the main housing 201. In the electrical device 200 the vibrator is not provided as a single unit. Instead, the movement in the hinge 210 when the door 202 is opened or closed is used to generate the vibrations.

[0057] To this end, a first mechanical part 211 is arranged on the main housing 201, i.e. on a part of the hinge 210 that is coupled to the main housing 201. A second mechanical part 213 is arranged on the door 202, i.e. on a part of the hinge 210 that is coupled to the door 202.

[0058] The first mechanical part 211 and the second mechanical part 213 are therefore arrange such that they move relatively to each other during movement of the door 202 and generate the vibrations 104 based on the relative movement.

[0059] In the electrical device 200 the first mechanical part 211 and the second mechanical part 213 engage radially. It is understood, that the electrical device 200 the first mechanical part 211 may also engage axially in an embodiment.

[0060] The first mechanical part 211 comprises a pin 212 that may be actuated, e.g. bent, like a leaf spring or the like that produces a vibration when it is released. To actuate the pin 212, the second mechanical part 213 comprises a plurality of protrusions 214 that rotate with the movement of the door and engage with the pin 212 during the movement. It is understood, that by arranging the protrusions 214 accordingly, a vibration pattern may be generated.

[0061] Fig. 3 shows a block diagram of an electrical device 300. In Fig. 3 emphasis is put on a sliding mechanism 320 that couples the door 302 to the main housing 301 and the generation of the vibration pattern during movement of the door 302.

[0062] In the electrical device 300, a first mechanical part 321 is arranged on the main housing 301, i.e. on a part of the sliding mechanism 320 that is coupled to the main housing 301. A second mechanical part 323 is arranged on the door 302, i.e. on a part of the sliding mechanism 320 that is coupled to the door 302 and moves together with the door 302.

[0063] As in the electrical device 200, the first mechanical part 321 comprises a pin 322 that may be actuated, e.g. bent, like a leaf spring or the like, that produces a vibration when it is released.

[0064] To actuate the pin 322, the second mechanical part 323 comprises a plurality of protrusions 324 that move laterally along the pin 322 with the lateral movement of the door 302. The protrusions 324 engage with the pin 322 during the movement. It is understood, that by arranging the protrusions 324 accordingly, a vibration pattern may be generated.

[0065] It is understood, that the pin-arrangement shown with electrical devices 200 and 300 may also be substituted by other arrangements. For example, specifically coated surfaces may be provided that slide or rub over each other to generate vibrations. Such coatings may be chosen such that high frequencies are produced, especially in a frequency range that cannot be heard by the human ear. By different coatings along the respective mechanical parts, different frequencies and therefore vibration patterns may be generated.

[0066] Fig. 4 shows a block diagram of an electrical device 400. In contrast to the electrical devices 200 and 300, the electrical device 400 comprises two vibrators 403, 408 that electrically generate the vibrations and are each installed on one of the doors 402, 407. The electrical device 400 with the two doors 402, 407 therefore comprises an arrangement that is typical for e.g. refrigerators.

[0067] The electrically actuated vibration devices 403, 408 of the electrical device 400 may e.g. comprise vibration motors that are supplied with electrical energy when the door 402 or the door 407 moves. To detect such a movement of the doors 402, 407 for example the electrically actuated vibration devices 403, 408 may e.g. comprise respective sensors. Further, it is understood, that the electrically actuated vibration devices 403, 408 may comprise respective energy sources, like e.g. batteries, solar cells and/or other energy harvesting units.

[0068] The arrangement of the electrical device 400 provides an alternative solution to the mechanical vibration generation. With the electrically actuated vibration devices 403, 408 the generation of the vibrations may e.g. be performed more independently of the speed of movement of the respective door 402, 407. Further, higher or lower frequencies may e.g. be used for the vibrations that cannot be heard by the human ear.

[0069] For sake of clarity in the following description of the method-based Fig. 5 the reference signs used above in the description of apparatus-based Figs. 1 - 4 will be maintained.

[0070] Fig. 5 shows a flow diagram of a possible embodiment of a method for operating an electrical device 100, 200, 300, 400 with a main housing 101, 201, 301, and a door 102, 202, 302, 402, 407 arranged on the main housing 101, 201, 301, wherein the door 102, 202, 302, 402, 407 is openable and closable by a user.

[0071] The method comprises producing S1 vibrations 104 during a movement of the door 102, 202, 302, 402, 407 with a vibrator 103, 403, 408 arranged on the main housing 101, 201, 301 and/or the door 102, 202, 302, 402, 407. In a second step S2 the vibrations 104 generated by the vibrator 103, 403, 408 are detected with a vibration detector 105 arranged in the main housing 101, 201, 301. It is then determined based on the detected vibrations 104 in step S3 when the door 102, 202, 302, 402, 407 moves.

[0072] Producing vibrations 104 may for example be performed with a first mechanical part 211, 321 arranged on the main housing 101, 201, 301 and a second mechanical part 213, 323 arranged on the door 102, 202, 302, 402, 407. The first mechanical part 211, 321 and the second mechanical part 213, 323 may move relatively to each other during movement of the door 102, 202, 302, 402, 407 and generate the vibrations 104 based on the relative movement.

[0073] For example, the door 102, 202, 302, 402, 407 may be coupled with the main housing 101, 201, 301 via a hinge 210. With such an arrangement the first mechanical part 211 may be arranged on a part of the hinge 210 that is coupled to the main housing 101, 201, 301 and the second mechanical part 213 may be arranged on a part of the hinge 210 that is coupled to the door 102, 202, 302, 402, 407, as explained e.g. with regard to Fig. 2.

[0074] In another example, the door 102, 202, 302, 402, 407 may be coupled with the main housing 101, 201, 301 via a sliding mechanism 320. With such an arrangement the first mechanical part 321 may be arranged on a part of the sliding mechanism 320 that is coupled to the main housing 101, 201, 301 and the second mechanical part 323 may be arranged on a part of the sliding mechanism 320 that is coupled to the door 102, 202, 302, 402, 407, as explained e.g. with regard to Fig. 3.

[0075] As alternative to the vibrations 104 that are mechanically generated, an electrically actuated vibration device 403, 408 may also be used.

[0076] When producing vibrations 104, a predefined vibration pattern may be generated that may be identified after detecting the vibrations 104. It is understood, that the predefined vibration pattern may be generated with a directional dependency.

[0077] Although specific embodiments have been illustrated and described herein, it will be appreciated by those of ordinary skill in the art that a variety of alternate and/or equivalent implementations exist. It should be appreciated that the exemplary embodiment or exemplary embodiments are only examples, and are not intended to limit the scope, applicability, or configuration in any way. Rather, the foregoing summary and detailed description will provide those

skilled in the art with a convenient road map for implementing at least one exemplary embodiment, it being understood that various changes may be made in the function and arrangement of elements described in an exemplary embodiment without departing from the scope as set forth in the appended claims and their legal equivalents. Generally, this application is intended to cover any adaptations or variations of the specific embodiments discussed herein.

[0078] The present invention discloses an electrical device comprising a main housing, a door arranged on the main housing, wherein the door is openable and closable by a user, a vibrator arranged on the main housing and/or the door and configured to produce vibrations during a movement of the door, a vibration detector arranged in the housing and configured to detect the vibrations generated by the vibrator, and a vibration evaluation device coupled to the vibration detector and configured to determine when the door moves based on the detected vibrations.

List of reference signs

[0079]

100, 200, 300, 400	electrical device
101, 201, 301	main housing
102, 202, 302, 402, 407	door
103,403,408	vibrator
104	vibrations
105	vibration detector
106	vibration evaluation device
210	hinge
211	first mechanical part
212	pin
213	second mechanical part
214	protrusion
320	sliding mechanism
321	first mechanical part
322	pin
323	second mechanical part
324	protrusion
S1, S2, S3	method steps

Claims

1. Electrical device (100, 200, 300, 400) comprising:

a main housing (101, 201, 301),
a door (102, 202, 302, 402, 407) arranged on the main housing (101, 201, 301), wherein the door (102, 202, 302, 402, 407) is openable and closable by a user,
a vibrator (103, 403, 408) arranged on the main housing (101, 201, 301) and/or the door (102, 202, 302, 402, 407) and configured to produce vibrations (104) during a movement of the door (102, 202, 302, 402, 407),
a vibration detector (105) arranged in the main housing (101, 201, 301) and configured to detect the vibrations (104) generated by the vibrator (103, 403, 408), and
a vibration evaluation device (106) coupled to the vibration detector (105) and configured to determine when the door (102, 202, 302, 402, 407) moves based on the detected vibrations (104).

2. Electrical device (100, 200, 300, 400) according to claim 1, wherein the vibrator (103, 403, 408) comprises a first mechanical part (211, 321) arranged on the main housing (101, 201, 301) and a second mechanical part (213, 323) arranged on the door (102, 202, 302, 402, 407), wherein the first mechanical part (211, 321) and the second mechanical part (213, 323) are configured to move relatively to each other during movement of the door (102, 202, 302, 402, 407) and generate the vibrations (104) based on the relative movement.

3. Electrical device (100, 200, 300, 400) according to claim 2, comprising a hinge (210) coupling the door (102, 202,

302, 402, 407) with the main housing (101, 201, 301), wherein the first mechanical part (211) is arranged on a part of the hinge (210) that is coupled to the main housing (101, 201, 301) and wherein the second mechanical part (213) is arranged on a part of the hinge (210) that is coupled to the door (102, 202, 302, 402, 407).

4. Electrical device (100, 200, 300, 400) according to claim 2, comprising a sliding mechanism (320) coupling the door (102, 202, 302, 402, 407) with the main housing (101, 201, 301), wherein the first mechanical part (321) is arranged on a part of the sliding mechanism (320) that is coupled to the main housing (101, 201, 301) and wherein the second mechanical part (323) is arranged on a part of the sliding mechanism (320) that is coupled to the door (102, 202, 302, 402, 407).

5. Electrical device (100, 200, 300, 400) according to claim 1, wherein the vibrator (103, 403, 408) comprises an electrically actuated vibration device (403, 408).

6. Electrical device (100, 200, 300, 400) according to any one of the preceding claims, wherein the vibrator (103, 403, 408) is configured to generate a predefined vibration pattern.

7. Electrical device (100, 200, 300, 400) according to claim 6, wherein the predefined vibration pattern comprises a directional dependency.

8. Method for operating an electrical device (100, 200, 300, 400) with a main housing (101, 201, 301), and a door (102, 202, 302, 402, 407) arranged on the main housing (101, 201, 301), wherein the door (102, 202, 302, 402, 407) is openable and closable by a user, the method comprising:

producing (S1) vibrations (104) during a movement of the door (102, 202, 302, 402, 407) with a vibrator (103, 403, 408) arranged on the main housing (101, 201, 301) and/or the door (102, 202, 302, 402, 407),
detecting (S2) the vibrations (104) generated by the vibrator (103, 403, 408) with a vibration detector (105) arranged in the main housing (101, 201, 301), and
determining (S3) when the door (102, 202, 302, 402, 407) moves based on the detected vibrations (104).

9. Method according to claim 8, wherein producing vibrations (104) is performed with a first mechanical part (211, 321) arranged on the main housing (101, 201, 301) and a second mechanical part (213, 323) arranged on the door (102, 202, 302, 402, 407), wherein the first mechanical part (211, 321) and the second mechanical part (213, 323) move relatively to each other during movement of the door (102, 202, 302, 402, 407) and generate the vibrations (104) based on the relative movement.

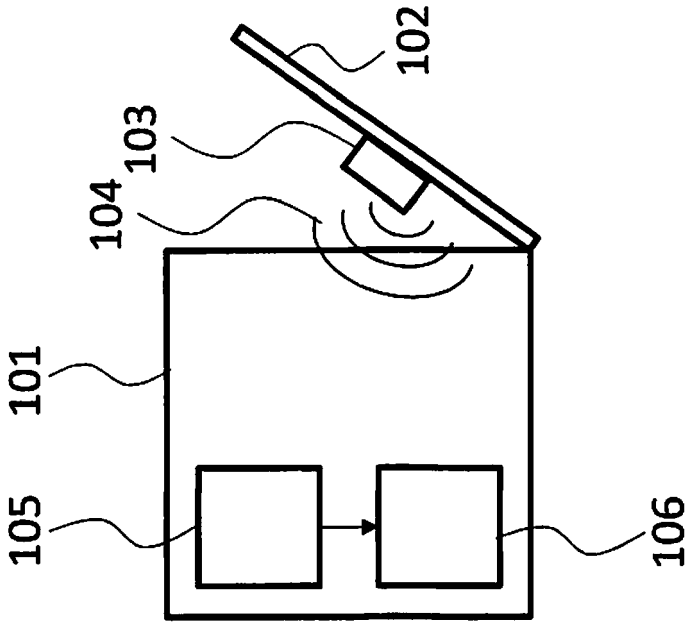
10. Method according to claim 9, wherein the door (102, 202, 302, 402, 407) is coupled with the main housing (101, 201, 301) via a hinge (210), wherein the first mechanical part (211) is arranged on a part of the hinge (210) that is coupled to the main housing (101, 201, 301) and wherein the second mechanical part (213) is arranged on a part of the hinge (210) that is coupled to the door (102, 202, 302, 402, 407).

11. Method according to claim 9, wherein the door (102, 202, 302, 402, 407) is coupled with the main housing (101, 201, 301) via a sliding mechanism (320), wherein the first mechanical part (321) is arranged on a part of the sliding mechanism (320) that is coupled to the main housing (101, 201, 301) and wherein the second mechanical part (323) is arranged on a part of the sliding mechanism (320) that is coupled to the door (102, 202, 302, 402, 407).

12. Method according to claim 8, wherein the vibrations (104) are generated with an electrically actuated vibration device (403, 408).

13. Method according to any one of the preceding method-related claims, wherein when producing vibrations (104), a predefined vibration pattern is generated.

14. Method according to claim 13, wherein the predefined vibration pattern is generated with a directional dependency.



100

Fig. 1

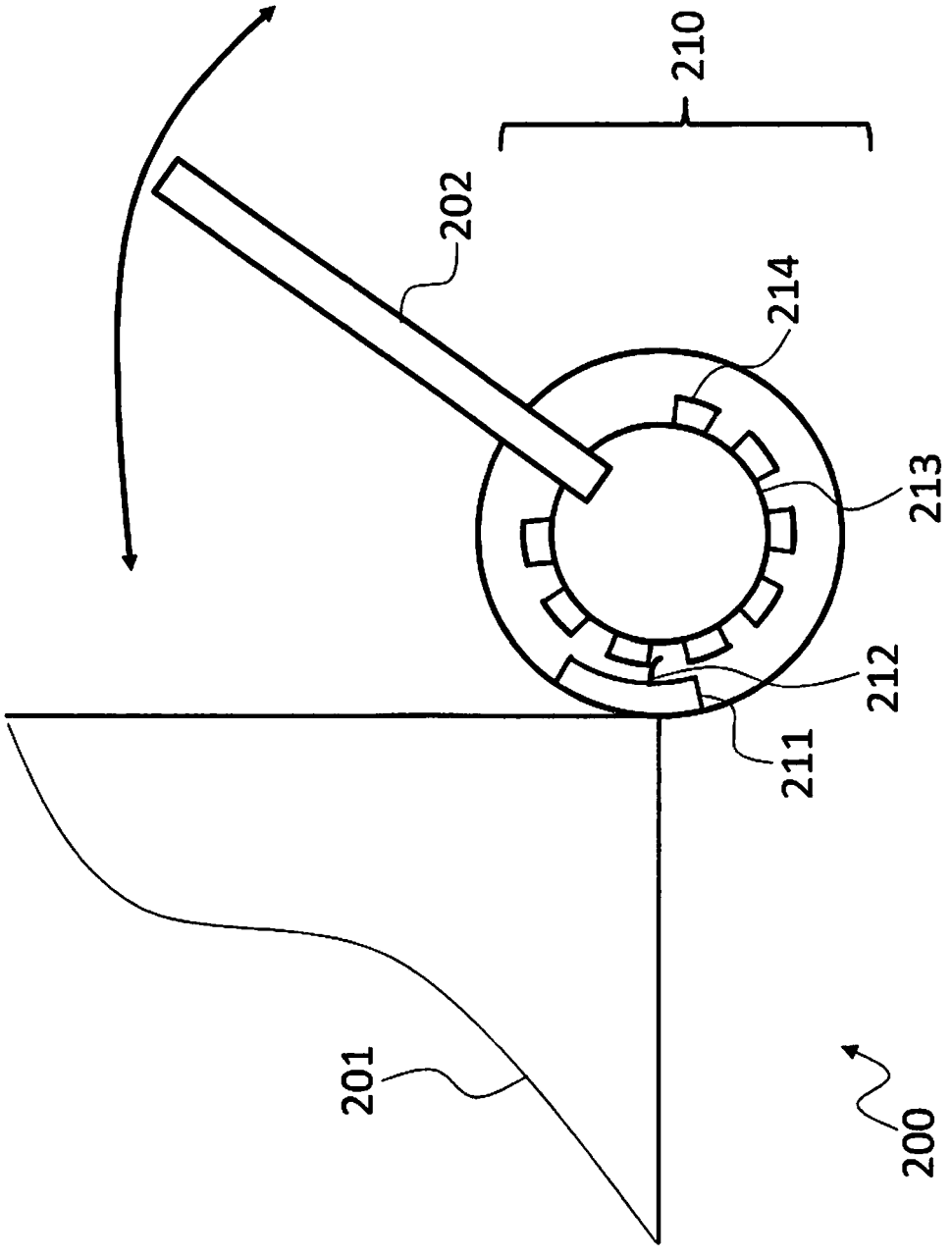


Fig. 2

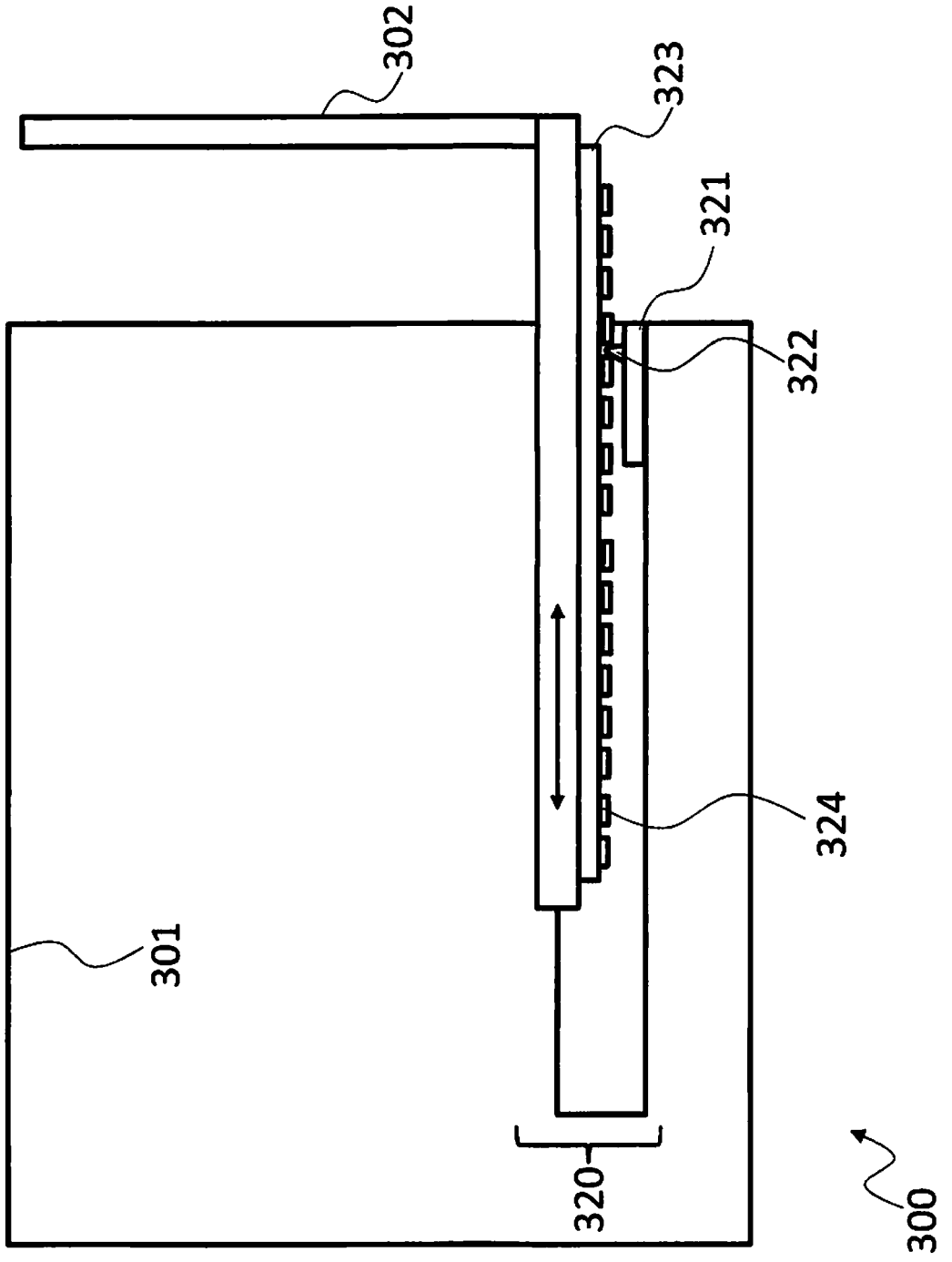
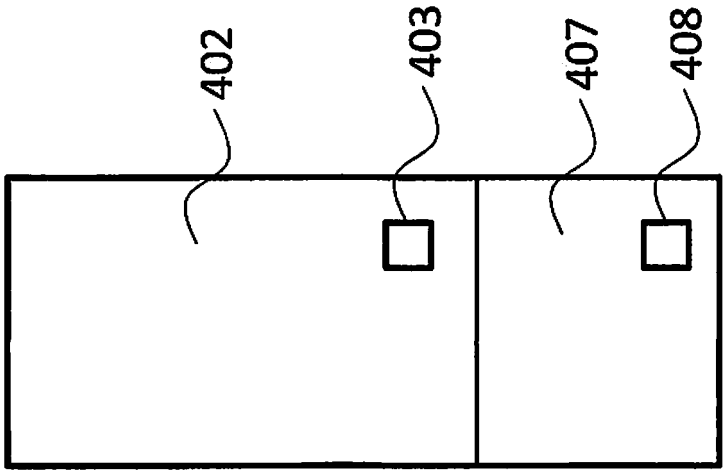


Fig. 3



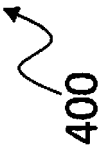


Fig. 4

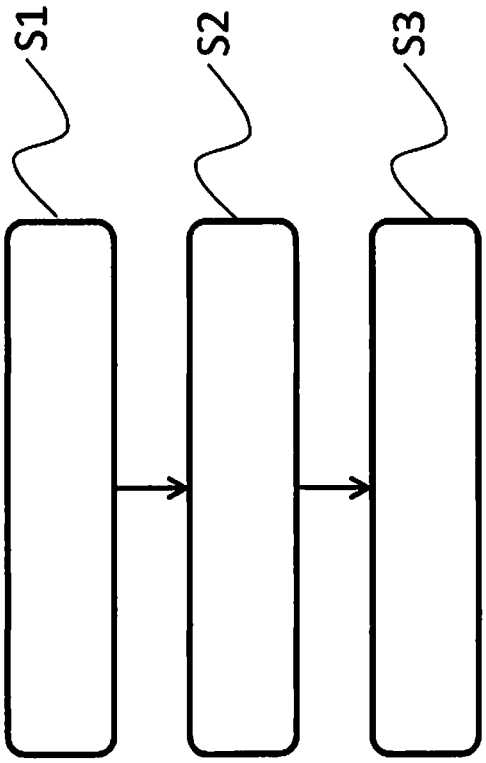


Fig. 5

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EUROPEAN SEARCH REPORT

Application Number
EP 19 21 4509

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Place of search	Date of completion of the search	Examiner
Munich	26 June 2020	Lodato, Alessandra

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