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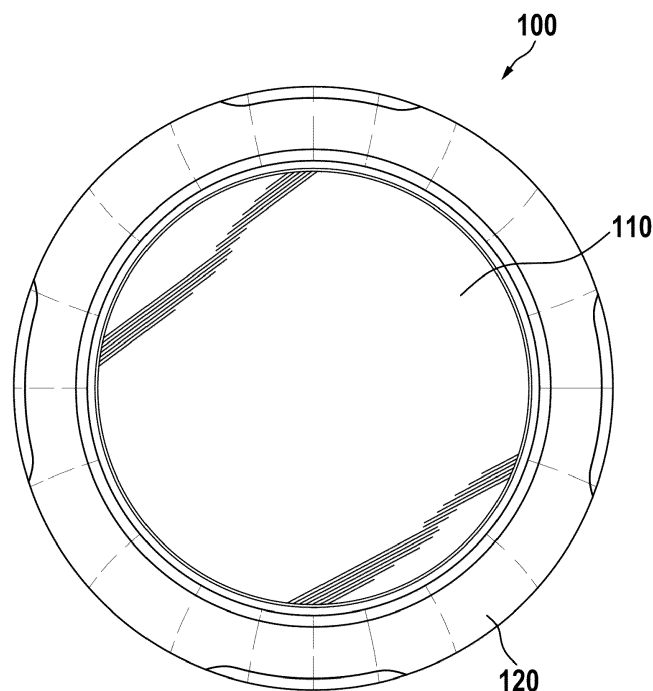
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(54) **DOOR-OPENING SENSOR-BUTTON WITH RF INTERFACE**

(57) A sensor button for a public transport vehicle comprises a sensor electrode coupled to a sensor circuit and a RF communication circuit configured to communicate with at least one user device e.g. a cell phone or a RFID token. The sensor button further includes a com-

munication bus interface configured to communicate with a public transport vehicle controller wherein the sensor button is configured to forward data between the at least one user device and the public transport vehicle controller.

Fig. 1



Description

Field of the invention

[0001] The invention relates to sensor buttons for public transport systems.

Description of the related art

[0002] A person who wants to ride a bus or a train approaches its door and touches a button at the door or in proximity of the door to open the door. Then the person enters the vehicle and may purchase a ticket from the driver or validate a ticket by a stamping machine. This system does not provide a reliable access control, a reliable validation of tickets and a presence control of persons in the vehicle.

[0003] A door for a public transport system is disclosed in DE 10 2015 212 129 A1. The door has a sensor button which may be operated from the inside and the outside of the door to request opening of the door.

Summary of the invention

[0004] The problem to be solved by the invention is to provide a system for public transport, like bus or train systems, which provides at least one an access control, a ticket validation, and a presence detection.

[0005] Solutions of the problem are described in the independent claims. The dependent claims relate to further improvements of the invention.

[0006] A sensor button which is mounted at a vehicle or at least one door of a vehicle or a public transport provides further communication means to communicate with a personal device of the persons entering and/or using the vehicle. The sensor button may further include a communication bus interface, which is configured to communicate with a controller of the public transport vehicle.

[0007] The sensor button may exchange information or authentication data with a public transport vehicle controller or door controller and with a user device of a user approaching the button. Further, an authentication data exchange may be with the public transport vehicle or door controller. In an embodiment, a user device requests access to the public transport vehicle by communicating with the sensor button. The sensor button may forward this request to the public transport vehicle or door controller which may issue an authentication request. This authentication request may be received by the sensor button and be forwarded to the user device. The user device may respond with an authentication code, which may be received by the sensor button and be forwarded to the public transport vehicle or door controller. In an abbreviated version, a user device may immediately forward an authentication code to the sensor button which communicates this code to the public transport vehicle or door controller.

[0008] In another embodiment, a user device may transmit an access code to the sensor button, which may be a priority access code or a request for special handling, like a handicapped access, to the sensor button which further forwards this code to the public transport vehicle or door controller.

[0009] In an embodiment, there may be a ticket validation or a ride authorization by means of a communication similar to the communications mentioned above to validate an electronic ticket, to purchase an electronic ticket, or to charge the person's account or credit card or a similar payment device for the ride.

[0010] In an embodiment, there may be a simple user identification, for example in a school bus, to identify the students and to verify that all have entered the bus.

[0011] In an embodiment, there is a first communication between a user device, the sensor button and the public transport vehicle or door controller to count the number of people entering the public transport vehicle. Further, the persons leaving the public transport vehicle may be counted. From these counts, it can be calculated how many people are in the transport vehicle and it can be identified whether the transport vehicle is empty or not.

[0012] In an embodiment, there may be a plurality of sensor buttons communicating with the public transport vehicle or door controller, for example if there is a plurality of doors. Sensor buttons at internal doors or compartment separators may identify persons moving between departments like cars of a train, such that for example access to first class or second class seats may be checked.

[0013] In a further embodiment, at least one sensor button is at an entrance door and at least a further sensor button is at an exit door.

[0014] The sensor button may also be mounted at a handrail, an interior wall or an exterior wall of a bus or public transport.

[0015] In an embodiment, the sensor button is a communication gateway between the user device and the public transport vehicle controller.

[0016] The integration of a communication interface with a user device and a communication interface with the public transport vehicle controller in the sensor button provides several benefits. First, the sensor button is the first point of access for a person which wants to enter a public transport vehicle, because everybody is used to press the sensor button or to interact with the sensor button to open the door. Therefore, it would not be unusual to bring a personal device like a cell phone or PDA or laptop or even a transponder in proximity to the sensor button to get access. Further, using the sensor button for communication is cheaper and requires less maintenance than providing separate communication interfaces or communication access points in addition to the sensor buttons. It would be difficult to understand for a user to manually operate a sensor button and to hold the mobile device to a different position, e.g. outside of the door, for authentication. This combined solution also provides a

simplified cabling, because only the sensor button must be provided with cables to the public transport vehicle controller. In a further embodiment, the sensor button may be configured by a personal device. Before exchanging configuration data an authentication of the user and/or device who wants to configure the sensor button may be required.

[0017] In another embodiment, the sensor button may act as a beacon which may be localized by a user device. The sensor button may identify a certain public transport vehicle and/or a specific door. Therefore, the sensor button may emit a certain signal or code for identification. The sensor button may emit a specific identification code which may either be assigned to the switch or which may be received from a public transport vehicle or door controller.

[0018] In an embodiment, a sensor button for a public transport vehicle may include at least a sensor electrode coupled to a sensor circuit. The sensor circuit is configured to generate a signal, when at least one of a person or an object approaches and/or touches the sensor button. A signal may be generated, if at a person or an object is within a predetermined minimum distance to the sensor electrode.

[0019] The sensor button further includes a RF communication circuit which is configured to communicate with at least one user device, and it includes further a communication bus interface configured to communicate with a public transport vehicle controller. A user device may be at least one of a cell phone, a handheld device, a laptop, a smartwatch, a wearable, and an RFID device, which a user of the public transport vehicle and/or the switch may bring with him/her. The public transport vehicle controller may be a controller or computer off/in the public transport vehicle. It may handle passenger data, tickets, etc. The sensor button is further configured to forward data between the at least one user device and the public transport vehicle controller.

[0020] In an embodiment, the sensor button includes a Bluetooth interface or a Bluetooth low energy (BLE) interface. Accordingly, the RF communication circuit is configured to communicate by using at least a Bluetooth or a Bluetooth low energy protocol. Such a Bluetooth or a Bluetooth low energy interface may be configured to emit Bluetooth beacon signals or to establish a full communication which may be required for example for user identification or authentication.

[0021] In another embodiment, the sensor button includes an NFC (Near Field Communication) interface. Here, the RF communication circuit is configured to communicate by using at least an NFC protocol. This may also be combined with a Bluetooth and/or BLE interface.

[0022] The sensor button may be configured to

a) localize a person for

guiding a person to a desired door of a public transport vehicle and/or public building. This

may avoid entering a wrong public transport vehicle and therefore waste of time.

assigning passengers to public transports and therefore to control the passenger load over public transports and time.

identifying the absolute position of approach which may be done by using additional position or localization information, for example by using GPS. This allows further routing of passengers in a larger extent or e.g. in bus terminals. For these localization services, it is preferred if the provider of the public transport system provides an App or a program or a software for these services to the user.

b) identifying a specific sensor button or door. This may specifically provide for a handicapped or blind person a guidance to locate a specific entrance of the public transport vehicle. This may further be controlled by voice control.

c) remotely controlling and opening to door without touching, which may increase a protection of infection. This may further be used to automatically open the door upon approach or only to open the door after authorization or payment.

d) Configuration the sensor button by a user device and/or reading of configuration and/or use data of the sensor button, e.g. for predictive maintenance.

Change of use scenario of the public transport, for example from a local bus to school bus system.

Reading of the number of operations to get data for active exchange due to high wear or to get an idea of the use of bus stops or trains stops.

e) There may further be a wireless connection, e.g. a Bluetooth connection between multiple sensor buttons as mentioned herein, such that these can communicate together. This may allow a precise control of passengers like moving of passengers within the public transport where more space is available. A further application may be estimating present passengers by counting the Bluetooth connections.

f) Communication of operation of the switch to the public transport vehicle or door controller. This may be used instead of a wired bus connection.

[0023] Some of these applications may require establishing Bluetooth connection between a user device and the switch.

[0024] Another application may be payment with a mo-

bile payment system for use of the public transport over a certain time or distance as long as there is a connection between the user device and the switch.

[0025] In an embodiment, the sensor button is configured for an entrance door and/or a wall of a public building. It may be configured to operate in the same or in a similar way as in a public transport vehicle and as outlined above.

[0026] In an embodiment, the sensor button may have a mechanical sensor like contact or a force sensor, which may have a piezo, capacitive, or inductive transducer. The preferred embodiments relate to a sensor button having a capacitive proximity sensor.

[0027] In an embodiment, the sensor button may include a capacitive proximity sensor. In another embodiment, the sensor button includes at least one of an optical feedback means, an acoustic feedback means, and a tactile feedback means. An optical feedback means may be a light source like a LED or a lamp. An acoustic feedback means may be a speaker or other sound source. A tactile feedback means may be a vibration generator, which may in addition be an acoustic feedback means. The sensor button may by its feedback means provide feedback to a user, for example on a positive communication or to signal a specific vehicle, entrance, etc... The sensor button may also forward a command to a user device like a cell phone to take a signaling action. Such a signaling action may be a sound, a tactile signal, like a vibration, or a display, e.g. an entry request or a direction indication.

[0028] In an embodiment, the sensor button may include an antenna, which may be part of a RF communication circuit. The Antenna may be included into the sensor surface. It may be a cutout in the sensor surface. The antenna may also be a separate component within the sensor button. The antenna may also be the side wall of the sensor button or a part thereof.

Description of Drawings

[0029] In the following the invention will be described by way of example, without limitation of the general inventive concept, on examples of embodiment with reference to the drawings.

Figure 1 shows a sensor button.

Figure 2 shows a bus with a sensor button.

Figure 3 shows a block diagram of an embodiment.

Figure 4 shows a sensor button with an antenna.

[0030] In Figure 1, a sensor button 100 which may be configured to be used in public transport system is shown. The sensor button 100 includes a sensor surface 110 which may be touched or approached by a person to generate a sensor signal. There may be a side wall for

mounting the sensor button to the door or somewhere else in a public transport.

[0031] In Figure 2, a bus (public transport vehicle 200) is shown. It includes a door 250 which further has a sensor button 100.

[0032] In Figure 3, a block diagram of an embodiment is shown. The sensor button 100 includes a sensor electrode 150 which may be behind the sensor surface 110 or part of the sensor surface 110 as shown in Figure 1.

[0033] It further includes a sensor circuit 160 which may be connected to the sensor electrode to receive and evaluate signals from the sensor electrode to detect a presence of a person or a part of a person close to the sensor surface. An RF communication circuit 170 may be provided in the sensor button to communicate wirelessly by an RF communication 230 with a user device 300. Further, a communication bus interface 180 may be provided to communicate by a communication bus 220 with a public transport vehicle controller 210. Communication with the public transport vehicle controller 210 may also be established wirelessly, e.g. by using the RF communication circuit 170.

[0034] Figure 4 shows a sensor button with an antenna 112. The RF communication circuit 170 may have an antenna 112 which may be coupled to or be part of the sensor surface 110. Here, the antenna is a cutout in surface of the sensor electrode. The cutout may be a slot or a strip of conductive material, which may have $\frac{1}{2}$, $\frac{1}{4}$ or $\frac{1}{8}$ of a wavelength to be transmitted/received. It may also be a separate component within the sensor button. The antenna may also be the side wall 120 or part thereof.

List of reference numerals

[0035]

100	sensor button
110	sensor surface
112	antenna
120	sidewall
150	sensor electrode
160	sensor circuit
170	RF communication circuit
180	communication bus interface
200	public transport vehicle
210	public transport vehicle controller
220	communication bus
250	public transport door
300	user device
320	Rf communication

Claims

1. A sensor button (100) for a public transport vehicle (200), the sensor button (100) including at least a sensor electrode (150) coupled to a sensor circuit (160)

characterized in, that

the sensor button (100) further includes
 a RF communication circuit (170) configured to com-
 municate with at least one user device (300) and
 a communication bus interface (180) configured to
 communicate with a public transport vehicle control-
 ler (210),
 wherein the sensor button (100) is configured to for-
 ward data between the at least one user device (300)
 and the public transport vehicle controller (210).

2. A sensor button (100) according to claim 1,
characterized in, that

the sensor button (100) is configured to exchange
 user identification data with the at least one user de-
 vice (300) and with the public transport vehicle con-
 troller (210).

3. A sensor button (100) according to any of the previ-
 ous claims, **characterized in, that**
 the sensor button (100) is configured to exchange
 authentication data with the at least one user device
 (300) and with the public transport vehicle controller
 (210).

4. A sensor button (100) according to any of the previ-
 ous claims, **characterized in, that**
 the sensor button (100) is configured to exchange
 payment data with the at least one user device (300)
 and with the public transport vehicle controller (210).

5. A sensor button (100) according to any of the previ-
 ous claims, **characterized in, that**
 the sensor button (100) is configured to exchange
 electronic ticket validation data with the at least one
 user device (300) and with the public transport ve-
 hicle controller (210).

6. A sensor button (100) for a public transport vehicle
 (200), the sensor button (100) including at least a
 sensor electrode (150) coupled to a sensor circuit
 (160),

characterized in, that

the sensor button (100) further includes
 a RF communication circuit (170) configured to
 transmit an identification code for identification of the
 public transport vehicle (200) and/or for identification
 of a door (250) of the public transport vehicle (200),
 wherein the identification code is configured to be
 received by at least one user device (300).

7. A sensor button (100) according to the previous
 claim,
characterized in, that
 the sensor button (100) is coupled to receive the
 identification code from the public transport vehicle
 controller (210).

8. A sensor button (100) according to any of the previ-
 ous claims, **characterized in, that**
 the sensor button (100) includes at least one of a
 capacitive proximity sensor, a piezo sensor, and a
 mechanical contact.

9. A sensor button (100) according to any of the previ-
 ous claims, **characterized in, that**
 the sensor button (100) includes at least one of an
 optical feedback means, an acoustic feedback
 means, and a tactile feedback means.

10. A sensor button (100) according to any of the previ-
 ous claims, **characterized in, that**
 the sensor button (100) includes an antenna (112),
 which may be part of a RF communication circuit
 and/or
 the sensor button (100) includes an antenna (112),
 which is included into the sensor surface and may
 be a cutout in the sensor surface.

11. A sensor button (100) according to any of the previ-
 ous claims, **characterized in, that**
 the at least one user device (300) is at least one of
 a cell phone, a handheld device, a laptop, a headset,
 a smartwatch, a wearable, and a RFID device.

12. A sensor button (100) according to any of the previ-
 ous claims, **characterized in, that**
 the RF communication circuit (170) is configured to
 communicate by at least one of Bluetooth, Bluetooth
 Low Energy, and NFC protocol.

13. A public transport vehicle (200) including at least one
 sensor button (100) according to any of the previous
 claims,
characterized in, that
 the at least one sensor button (100) is provided in,
 at or close to a door (250) of the public transport
 vehicle (200).

14. A public transport vehicle (200) according to the pre-
 vious claim, **characterized in, that**
 at least one sensor button (100) is provided in, at or
 close to an entrance door (250) of the public transport
 vehicle (200) and
 at least one sensor button (100) is provided in, at or
 close to an exit door (250) of the public transport
 vehicle (200).

15. A public transport vehicle (200) according to the pre-
 vious claim, **characterized in, that**
 a counter is provided for counting the people entering
 and the people leaving the public transport vehicle
 (200).

Fig. 1

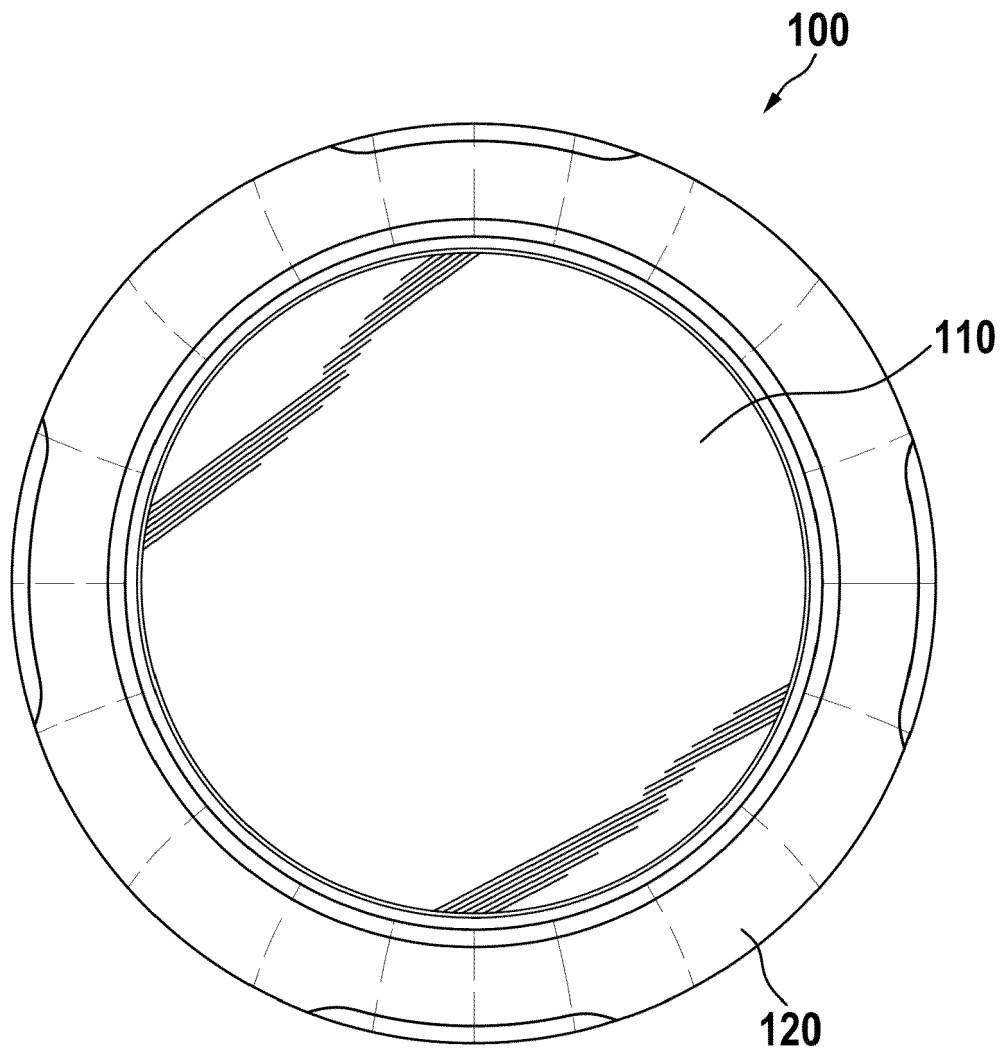


Fig. 2

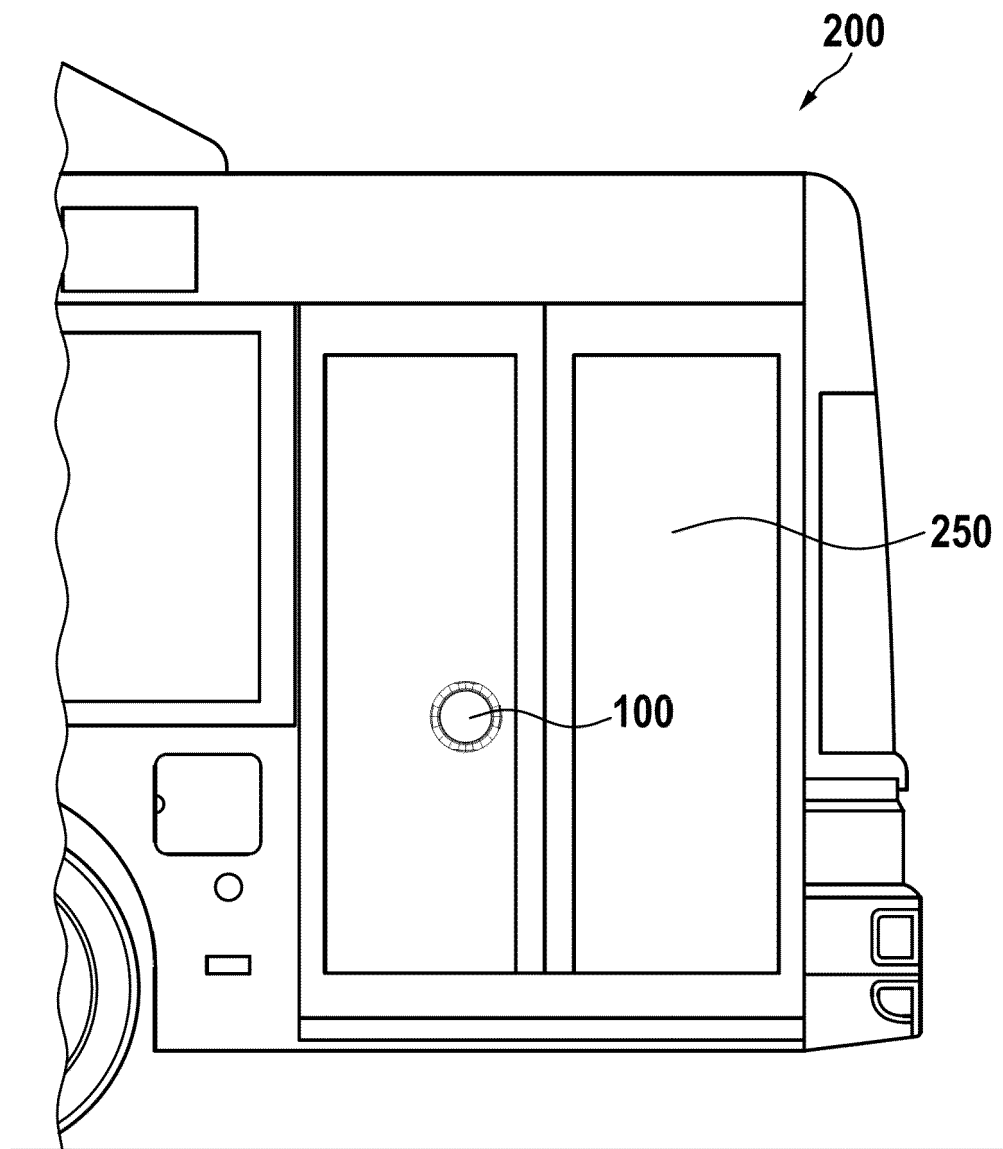


Fig. 3

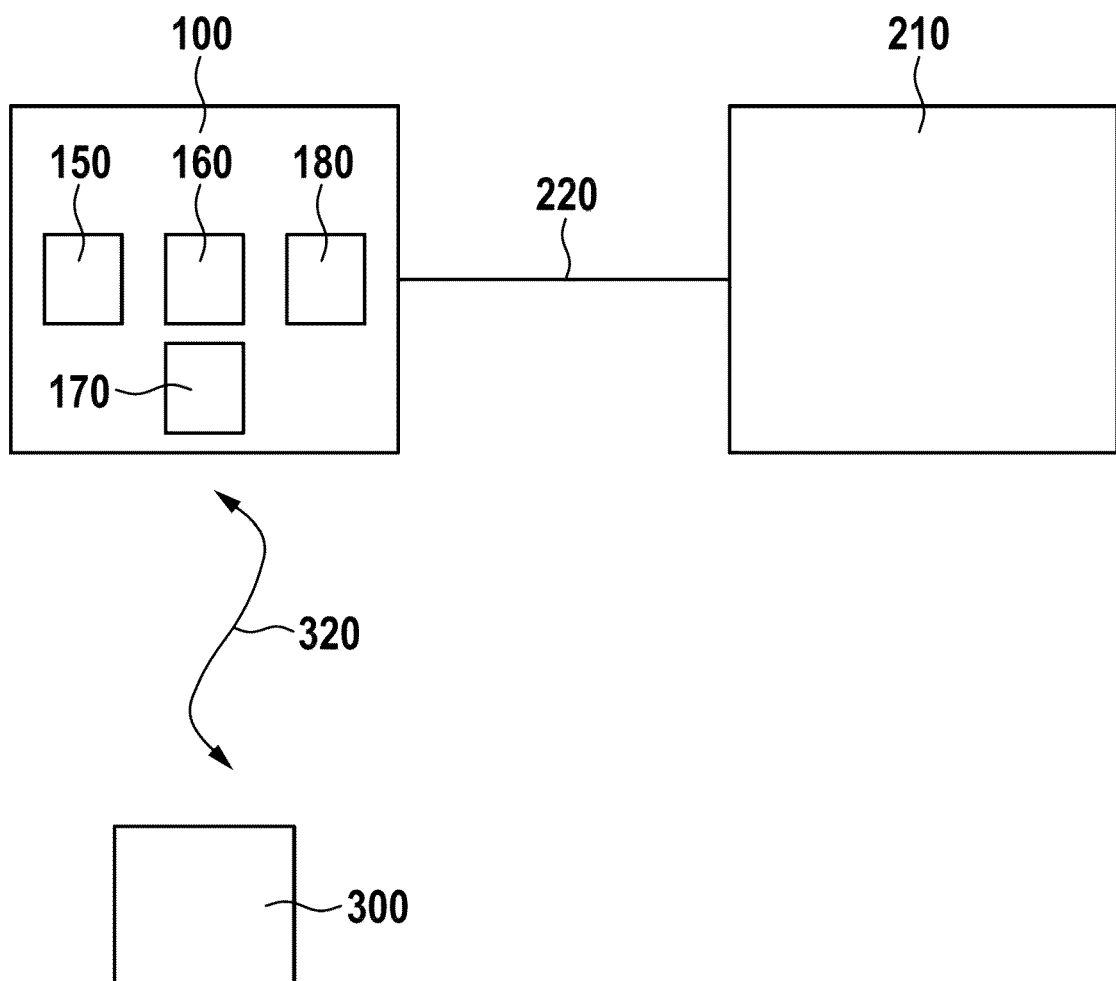
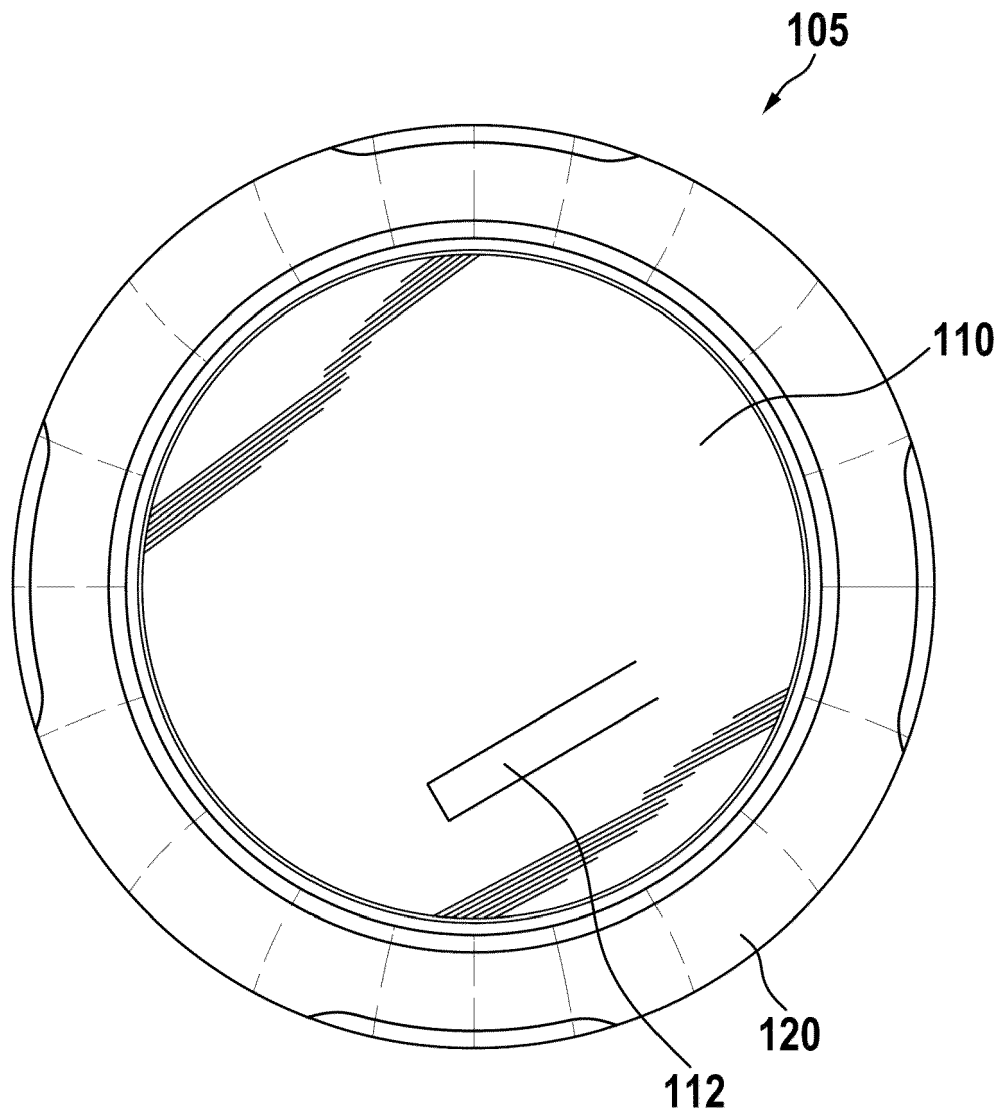


Fig. 4





EUROPEAN SEARCH REPORT

Application Number
EP 20 20 8114

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The present search report has been drawn up for all claims			
Place of search The Hague		Date of completion of the search 26 April 2021	Examiner Pañeda Fernández, J
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

EPO FORM 1503 03.82 (P04C01)

**ANNEX TO THE EUROPEAN SEARCH REPORT
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EP 20 20 8114

5 This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
The members are as contained in the European Patent Office EDP file on
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26-04-2021

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