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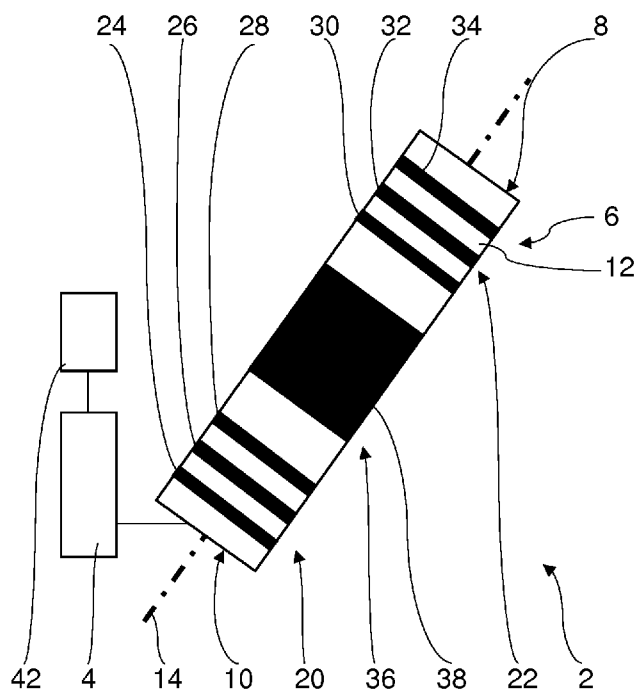


Fig. 1

(57) Abstract: The invention relates to a portable key device (2) for a door locking unit of a vehicle, comprising a control unit (4) housed by a housing (6) and designed and configured to lock and unlock said door locking unit, whereat a memory (42) is designed and configured for storing data for comparing a first output signal of a first input unit (20) and/or a second output signal of a second input unit (22) with said stored data in said control unit (4) for triggering a locking action or an unlocking action of said control unit (4) according to said comparison. In order to provide a portable key device (2) enabling a more intuitive handling of the portable key device (2) it is suggested, that said first input unit (20) and said second input unit (22) each are designed as a touch sensor comprising at least three circular electrodes (24, 26, 28; 30, 32, 34) arranged at a connecting side (12) of a housing (6) in a circular manner around a longitudinal axis (14) of said housing (6) and electrically insulated to each other, whereat said first input unit (20) and said second

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input unit (22) as well as each of said at least three circular electrodes (24, 26, 28; 30, 32, 34) of said first input unit (20) and of said second input unit (22) are spaced apart from each other along said longitudinal axis (14). Furthermore, the invention relates to a method for a portable key device (2).

## **Portable key device and method for a portable key device**

### Description

The present invention relates to a portable key device according to the preamble of claim 1 and a method for a portable key device.

Such portable key devices and methods for such portable key devices are already known in different embodiments.

Known portable key devices for a door locking unit of a vehicle, comprising a control unit housed by a housing and designed and configured to lock and unlock said door locking unit, whereat said housing comprises a top side, a bottom side and at least one connecting side connecting said top side and said bottom side, a first input unit and a second input unit each connected to said control unit in a signal transmitting manner for triggering said control unit for locking or unlocking said door locking unit via radio link by means of a first output signal of said first input unit or a second output signal of said second input unit, and a memory designed and configured for storing data for comparing said first output signal and/or said second output signal with said stored data in said control unit for triggering a locking action or an unlocking action of said control unit according to said comparison.

It is an object of the invention to provide a portable key device and a method for a portable key device with enabling a more intuitive handling of the portable key device.

This object of the invention is solved by a portable key device for a door locking unit of a vehicle according to claim 1, wherein said top side and said bottom side are spaced apart from each other along a longitudinal axis of said housing and said first input unit and said second input unit each are designed as a touch sensor comprising at least three circular electrodes arranged at said connecting side in a circular manner around said longitudinal axis and electrically insulated to each other, whereat said first input

unit and said second input unit as well as each of said at least three circular electrodes of said first input unit and of said second input unit are spaced apart from each other along said longitudinal axis.

Furthermore, this object of the invention is solved by a method for a portable key device according to claim 11, wherein said control unit locks or unlocks said door locking unit according to a comparison of said first output signal and/or said second output signal transmitted to said control unit with data stored in said memory during an operation mode of the portable key device, whereat before said operation mode of the portable key device is executed a determination mode of the portable key device for determining a spatial orientation of the portable key device with respect to a hand of a user the portable key device is held with is executed, and whereat the portable key device is automatically transferred from said determination mode into said operation mode.

A main advantage of the portable key device and the method for a portable key device according to the invention is, that a more intuitive handling of the inventive portable key device is possible. There is no longer a need for looking at the portable key device trying to hit the right button for locking or unlocking a locking unit of a vehicle by using the inventive portable key device and the inventive method for a portable key device. Instead of that, the spatial orientation and the relative position of the inventive portable key device is detected while a user of the portable key device is handling it and is used for automatically finding out what kind of action said user keeps in mind while operating the inventive portable key device. Thus, locking or unlocking of doors of a vehicle by using the inventive portable key device is more user-friendly. Even at nighttime or under bad lighting conditions, locking or unlocking of the doors of a vehicle by using the inventive portable key device is possible without any further action. Therefore, a user can keep being focused on the overall situation in the vicinity and do not have to quit watching the traffic situation because of operating a portable key device in order to lock or unlock doors of a vehicle. The doors of the vehicle can be of any kind. Thus, a door of a vehicle could be a trunk or a hood of a vehicle, too.

Further advantageous developments of the inventive portable key device and the inventive method for a portable key device are apparent from the sub-claims as well as from the following description of exemplary embodiments of the portable key device and the method for a portable key device according to the invention by means of the attached Figures.

Basically, the design of the portable key device according to the invention can be of any suitable shape, material, dimension and arrangement. This is also true for said at least one connecting side of said housing. For example, said housing can be designed as a cuboid. That means, that the at least one connecting side is designed as in total four rectangular sides. In other embodiments, said at least one connecting side could be designed in order to follow an oval border of said top side and said bottom side. That way, said at least one connecting side is designed as only one single connecting side. Thus, the meaning of the wording "circular" is quite general and is not limited to circles. Advantageously, said housing is designed as a cylinder, whereat said connecting side is designed as a lateral area of said cylinder. Hereby, the handling of said housing and therefore of the inventive portable key device is simplified.

Another preferable development of the portable key device according to the invention is, that between said first input unit and said second input unit a third input unit is arranged at said connecting side, whereat said third input unit is designed as a touch sensor comprising at least one circular electrode arranged at said connecting side in a circular manner around said longitudinal axis, and whereat said at least one circular electrode is electrically insulated from said first input unit and said second input unit and connected to said control unit in a signal transmitting manner for transmitting a third output signal to said control unit. Thus, the third input unit can be used for enlarging a surface of said first input unit or said second input unit during certain operating conditions of the inventive portable key device in order to increase said first output signal of said first input unit or said second output signal of said second input unit. For example, said electrodes of said first input unit and said electrodes of said second input unit can be interconnected with said at least one electrode of said third input unit

via multiplexing in order to enlarge a surface of said first input unit or said second input unit. Said interconnection can be done by using a switching matrix, also known as switching array.

As mentioned above, the inventive portable key device can be of any useful and suitable design. This is true for the first, second and third input unit, too.

A preferable development of the inventive portable key device according to the aforementioned embodiment is, that said third input unit comprises multiple circular electrodes arranged at said connecting side in a circular manner around said longitudinal axis and electrically insulated to each other. Hereby, the resolution of the third input unit can be enhanced.

A particular preferable development of the portable key device according to the invention is, that each of said circular electrodes of said first input unit and/or of said second input unit and/or of said third input unit comprises at least two segments, whereat said segments are spaced apart in a circular direction and electrically insulated from each other. That way, the resolution of said first and/or said second and/or said third input unit can be enhanced in circular direction, too. For example, it is possible to find out about specific segments of said first or said second input unit being in contact with a palm of a hand of a user, the portable key device is handled with.

Another preferable development of the portable key device according to the invention is, that said first input unit and/or said second input unit and/or said third input unit are/is comprising a non-mechanical sensor. Hereby, the design of said first and/or said second and/or said third input unit and thus of the inventive portable key device according to this embodiment is simplified. Furthermore, said first and/or said second input unit is quite robust against detrimental environmental influences like dirt and humidity.

An advantageous development of the portable key device according to the aforementioned embodiment of the invention is, that each of said first input unit and said second

input unit or each of said first input unit, said second input unit and said third input unit are designed as a capacitive sensor. Capacitive sensors are advantageous in several ways. For example, capacitive sensors are quite energy saving. Capacitive sensors are also quite simple in design, highly sensitive and show less idleness.

Another preferable development of the portable key device according to the invention is, that said portable key device comprises at least one position sensor housed by said housing and connected to said control unit in a signal transmitting manner for detecting a spatial orientation of the portable key device, preferable designed as a micro-electro-mechanical-system, abbreviated as MEMS. For example, by means of said position sensor the portable key device can be driven in different modes of energy consumption, whereat said position sensor can be used for automatically transferring the portable key device from a mode of low energy consumption to a regular mode of function with a higher energy consumption. Using MEMS means, that said position sensor can be realized with less space needed for its implantation in said housing of the inventive portable key device according to this embodiment.

A particular preferable development of the portable key device according to the aforementioned embodiment is, that said position sensor is designed as a single 3-axes-acceleration-sensor. Thus, said at least one position sensor is realized with a minimum number of components.

Another preferable development of the portable key device according to the invention is, that said first input unit and said second input unit are designed and configured to trigger said control unit for a locking action or an unlocking action according to a single action of a user of the portable key device detected by said first input unit while a user of the portable key device is holding it with one hand at said second input unit or said second input unit while a user of the portable key device is holding it with one hand at said first input unit. Hereby, the operation of the inventive portable key device is further simplified. A user of the inventive portable key device just has to execute a single movement which can be detected by said first input unit or said second input unit in order to trigger a locking action or an unlocking action of said control unit of the portable

key device. Thus, no complicated input action of a user is necessary for operating the portable key device according to this embodiment.

This is although true for a preferable development of the method according to the invention corresponding to the aforementioned embodiment of the inventive portable key device, wherein a single action of a user of the portable key device detected by said first input unit while a user of the portable key device is holding it with one hand at said second input unit or said second input unit while a user of the portable key device is holding it with one hand at said first input unit triggers said control unit for a locking action or an unlocking action.

A further advantageous development of the portable key device according to the invention is, that said control unit and said at least three circular electrodes of said first input unit and/or of said second input unit and/or said at least one circular electrode of said third input unit are designed and configured that way, that said at least three circular electrodes of said first input unit and/or of said second input unit and/or said at least one circular electrode of said third input unit can be interconnected to each other at least partly during a determination mode of the portable key device for determining a spatial orientation of the portable key device with respect to a hand of a user the portable key device is held with. Hereby, said spatial orientation of the portable key device can be detected more easily. For example, during said determination mode said electrodes of said first input unit and said electrodes of said second input unit can be interconnected with said at least one electrode of said third input unit via multiplexing in order to enlarge a surface of said first input unit or said second input unit. Said interconnection can be done by using a switching matrix, also known as switching array.

Another preferable development of the portable key device according to the invention is, that said control unit, said at least three circular electrodes of said first input unit and/or of said second input unit and/or said at least one circular electrode of said third input unit and/or said position sensor are designed and configured to be operated in a regular mode, like a determination mode or an operation mode, and in an idle mode of

the portable key device, whereat said determination mode is for determining a spatial orientation of the portable key device with respect to a hand of a user the portable key device is held with, said operation mode is for locking or unlocking said door locking unit by means of said first input unit and/or said second input unit, and said idle mode is for energy saving, and whereat the portable key device is automatically transferable from said idle mode into said determination mode according to an output signal of said position sensor and/or said first output signal of said first input unit and/or said second output signal of said second input unit and/or said third output signal of said third input unit. Thus, the inventive portable key device can be driven in a regular mode with a higher energy consumption and in an idle mode with a lower energy consumption.

An advantageous development of the method according to the invention is, that the portable key device is automatically transferred from said determination mode or said operation mode to an idle mode of the portable key device according to a time interval defined before with said output signal of said position sensor and/or said first output signal of said first input unit and/or said second output signal of said second input unit and/or said third output signal of said third input unit are/is not matching data stored in said memory for the portable key device being in said determination mode or said operation mode. Hereby, the energy consumption of the inventive portable key device can be reduced.

A preferable development of the aforementioned embodiment of the inventive method is, that the portable key device is automatically transferred from said idle mode into said determination mode according to an output signal of said position sensor and/or said first output signal of said first input unit and/or said second output signal of said second input unit and/or said third output signal of said third input unit are/is matching data stored in said memory for the portable key device being in said determination mode. That way, the inventive portable key device can be waked up automatically in order to function in a regular mode, thus to function in said determination mode or said operation mode mentioned above.

The Figures are a schematic illustration of a portable key device for a vehicle according to the invention, wherein only the details necessary for the understanding of the invention are shown.

It is shown by the Figures:

- Fig. 1 an exemplary embodiment of the portable key device according to the invention in a side view and.
- Fig. 2 a sectional view of the portable key device according to Fig. 1 perpendicular to a longitudinal axis of the portable key device.

Fig. 1 displays an exemplary embodiment of the portable key device according to the invention. The portable key device 2 for a door locking unit of a vehicle comprises a control unit 4 housed by a housing 6 and designed and configured to lock and unlock said door locking unit of said vehicle, whereat said housing 6 comprises a top side 8, a bottom side 10 and a single connecting side 12 connecting said top side 8 and said bottom side 10. Said vehicle with said door locking unit is not displayed in Fig. 1. Said housing 6 is designed as a right circular cylinder and said connecting side 12 is designed as a lateral surface of said right circular cylinder 6. Thus, said top side 8 and said bottom side 10 are spaced apart from each other by said connecting side 12 along a longitudinal axis 14 of said housing 6. See Fig. 1.

A first input unit 20 and a second input unit 22 of said portable key device 2 are each connected to said control unit 4 in a signal transmitting manner for triggering said control unit 4 for locking or unlocking said door locking unit via radio link by means of a first output signal of said first input unit 20 and/or a second output signal of said second input unit 22. Said first input unit 20 and said second input unit 22 are each designed as a touch sensor comprising three circular electrodes (24, 26, 28; 30, 32, 34) arranged at said connecting side 12 in a circular manner around said longitudinal axis 14 and electrically insulated to each other, whereat said first input unit 20 and said

second input unit 22 as well as each of said three circular electrodes 24, 26, 28 of said first input unit 20 and each of said three circular electrodes 30, 32, 34 of said second input unit 22 are spaced apart from each other along said longitudinal axis 14.

Between said first input unit 20 and said second input unit 22 a third input unit 36 is arranged at said connecting side 12, whereat said third input unit 36 is designed as a touch sensor comprising a single circular electrode 38 arranged at said connecting side 12 in a circular manner around said longitudinal axis 14, and whereat said at least one circular electrode 38 is electrically insulated from said first input unit 20 and said second input unit 22 and connected to said control unit 4 in a signal transmitting manner in order to transfer third output signals of said third input unit 36 to said control unit 4.

Said first input unit 20, said second input unit 22 and said third input unit 36 each is designed as a non-mechanical sensor, too. Said first, second and third input unit 20, 22, 36 each is designed as a capacitive sensor.

Furthermore, each of said circular electrodes 24, 26, 28 of said first input unit 20 and each of said circular electrodes 30, 32, 34 of said second input unit 22 comprises eight segments 40, whereat said segments 40 are spaced apart in a circular direction and electrically insulated from each other. See Fig. 2, in which said segments 40 of said circular electrode 24 of said first input unit 20 are displayed. Said electrodes 26, 28 of said first input unit 20 as well as said electrodes 30, 32, 34 of said second input unit 22 are segmented in the same way. Said electrode 38 of said third input unit 36 is not segmented at all, thus said electrode 38 is closed in circular direction.

A memory 42 is designed and configured for storing data for comparing said first output signals of said first input unit 20, said second output signals of said second input unit 22 and said third output signals of said third input unit 36 with said stored data in said control unit 4, and said control unit 4 is designed and configured to lock or unlock said door locking unit according to a comparison of said first output signals of said first

input unit 20 and/or said second output signals of said second input unit 22 transferred to said control unit 4 with data stored in said memory 42.

Said memory 42 for storing said aforementioned data for comparing said first output signals and/or said second output signals with said stored data in said control unit 4 for triggering a locking action or an unlocking action of said control unit 4 according to said aforementioned comparisons is housed in said housing 6 of said portable key device 2, too.

In order to simplify the handling of the portable key device 2 according to this embodiment, said first input unit 20 and said second input unit 22 are designed and configured to trigger said control unit 4 for a locking action or an unlocking action according to a single action of a user of the portable key device 2 detected by said first input unit 20 while a user of the portable key device 2 is holding it with one hand at said second input unit 22 or said second input unit 22 while a user of the portable key device 2 is holding it with one hand at said first input unit 20. Said user is not displayed, too.

Said control unit 4 and said three circular electrodes 24, 26, 28 of said first input unit 20, said three electrodes 30, 32, 34 of said second input unit 22 and said single circular electrode 38 of said third input unit 36 are designed and configured that way, that said three circular electrodes 24, 26, 28 of said first input unit 20 and/or said three circular electrodes 30, 32, 34 of said second input unit 22 and/or said one circular electrode 38 of said third input unit 36 can be interconnected to each other at least partly during a determination mode of the portable key device 2 for determining a spatial orientation of the portable key device 2 with respect to a hand of a user the portable key device 2 is held with.

Furthermore, said control unit 4, said three circular electrodes 24, 26, 28 of said first input unit 20, said three circular electrodes 30, 32, 34 of said second input unit 22 and said single circular electrode 38 of said third input unit 36 are designed and configured to be operated in a regular mode, like said determination mode or an operation mode, and in an idle mode of the portable key device 2, whereat said operation mode is for

locking or unlocking said door locking unit by means of said first input unit 20 and/or said second input unit 22, and said idle mode is for energy saving, and whereat the portable key device 2 is automatically transferable from said idle mode into said determination mode according to said first output signal of said first input unit 20 or said second output signal of said second input unit 22 or said third output signal of said third input unit 36.

In the following, the function of the inventive portable key device as well as the inventive method for the inventive portable key device according to the embodiment are explained in detail by means of Fig. 1 and 2.

Said portable key device 2 is in said idle mode of said portable key device 2, thus in an energy saving mode.

Said user of said portable key device 2 wants to unlock said door locking unit of said vehicle. For that reason, said user takes said portable key device 2 in his right hand, because said user is a right-handed person. Said right hand is not displayed. Said user takes said portable key device 2 that way, that said portable key device 2 is held in his right hand, whereat said first input unit 20 arranged at said connecting side 12 of said housing 6 of said portable key device 2 is in contact with the palm of said right hand of said user. That way, the thump of said right hand can be transferred in contact with said second input unit 22, which is arranged on said connecting side 12 of said housing 6 of said portable key device 2, too.

Thus, said portable key device 2 is automatically transferred from said idle mode into said determination mode according to said first output signal of said first input unit 20 and/or said second output signal of said second input unit 22 and/or said third output signal of said third input unit 36 is matching data stored in said memory 42 for said portable key device 2 being in said determination mode.

Because of said aforementioned handling of said portable key device 2 by said user, the following occurs:

Due to that, that said user took said portable key device 2 with his right hand, said first input unit 20 detects this handling of said portable key device 2 via said electrodes 24, 26, 28 of said first input unit 20. That detection causes said control unit 4 to automatically transfer said portable key device 2 from said idle mode into said determination mode.

In said determination mode of said portable key device 2, said segments 40 of each of said electrodes 24, 26, 28 of said first input unit 20 are sequentially interconnected with said electrode 38 of said third input unit 36 via multiplexing in order to yield higher first output signals of said first input unit 20. Said first output signals of said electrodes 24, 26, 28 as well as said third output signals of said electrode 38 are transferred to said control unit 4 and compared to data stored in said memory 42. Of course, said second output signals of said electrodes 30, 32, 34 of said second input unit 22 are transferred to said control unit 4 for comparison with data stored in said memory 42, too. Said comparison yields, that said portable key device 2 is handled by said user that way, that said first input unit 20 is in contact with said right hand of said user and said second input unit 22 is not in contact with said right hand. Thus, via said determination mode of said portable key device 2 a spatial orientation of said portable key device 2 held with said right hand of said user is determined. Because of said electrodes 24, 26, 28 of said first input unit 20 are segmented into segments 40, said control unit 4 detects via said segments 40, that for example said segments 40 of said first input unit 20 are in contact with said hand, which are displayed in the lower half of Fig. 2 with respect to electrode 24. The same is true for the electrodes 26, 28 not displayed in Fig. 2. Thus, said electrodes 30, 32, 34 of said second input unit 22 during an operation mode can be multiplexed accordingly. This is explained below.

After said determination of said spatial orientation of said portable key device 2 during said determination mode is finished, said portable key device 2 is automatically transferred into said operation mode of said portable key device 2.

During said operation mode of said portable key device 2 said control unit 4 locks or unlocks said door locking unit according to a comparison of said first output signal and/or said second output signal transferred to said control unit 4 with data stored in said memory 42. Because of the fact, that said electrodes 24, 26, 28 of said first input unit 20 are in contact with said right hand of said user, said electrodes 30, 32, 34 of said second input unit 22 are automatically interconnected with said electrode 38 of said third input unit 36 via multiplexing in order to yield higher second output signals of said second input unit 22. Due to the detection, that said segments 40 of said first input unit 20 are in contact with said palm of said hand, which are exemplary displayed in the lower half of Fig. 2 for electrode 24, said segments 40 of said second input unit 22 can be watched by said control unit 4, which are arranged analog to said segments 40 displayed in the upper half of Fig. 2. This is advantageous, because it is clear from the evaluation done before, that the thumb of said right hand of said user has to be in a position for transferring it into contact with said aforementioned segments 40 of said second input unit 22.

According to the embodiment of the invention, a single action of said user of said portable key device 2 detected by said second input unit 22 while said user of said portable key device 2 is holding it with his right hand at said first input unit 20 triggers said control unit 4 for a locking action or an unlocking action.

For example, in the case said user would slide with his right thumb over said electrodes 30, 32, 34 of said second input unit 22, namely over said segments 40 of said electrodes 30, 32, 34 located analog to the upper half of Fig. 2, starting from said third input unit 36 along said longitudinal axis 14 into the direction of said second input unit 22, said comparison of said second output signals transmitted from said electrodes 30, 32, 34 to said control unit 4 with said data stored in said memory 42 triggers said control unit 4 to unlock said door locking unit of said vehicle.

Thus, said user can enter said vehicle by opening one of said doors of said vehicle or can put something into a door of said vehicle designed as a trunk of said vehicle or

can inspect something under a door of said vehicle designed as a hood of said vehicle. Of course, other doors of said vehicle like flaps are possible, too.

In another use case, in which said user wants to lock said door locking unit of said vehicle, said user would slide with his right thumb over said electrodes 30, 32, 34 of said second input unit 22, namely over said segments 40 of said electrodes 30, 32, 34 located analog to the upper half of Fig. 2, starting from said second input unit 22 along said longitudinal axis 14 into the direction of said third input unit 36, said comparison of said second output signals transmitted from said electrodes 30, 32, 34 to said control unit 4 with said data stored in said memory 42 triggers said control unit 4 to lock said door locking unit of said vehicle.

Said portable key device 2 is automatically transferred from said determination mode or said operation mode to said idle mode of said portable key device 2 according to a time interval defined before with said first output signal of said first input unit 20 and/or said second output signal of said second input unit 22 and/or said third output signal of said third input unit 36 are/is not matching data stored in said memory 42 for said portable key device 2 being in said determination mode or said operation mode.

Said portable key device 2 is again in said idle mode of said portable key device 2, thus in an energy saving mode.

In another use case, said user of said portable key device 2 wants again to unlock said door locking unit of said vehicle. For that reason, said user takes said portable key device 2 in his right hand, because said user is a right-handed person. Said right hand is not displayed. In contrast to the first use case mentioned above, said user takes said portable key device 2 that way, that said portable key device 2 is held in his right hand, whereat said second input unit 22 arranged at said connecting side 12 of said housing 6 of said portable key device 2 is in contact with the palm of said right hand of said user. That way, the thump of said right hand can be transferred in contact with said first input unit 20, which is arranged on said connecting side 12 of said housing 6 of said portable key device 2, too.

Because of said aforementioned handling of said portable key device 2 by said user, the following occurs:

Due to that, that said user took said portable key device 2 with his right hand, said second input unit 22 detects this handling of said portable key device 2 via said electrodes 30, 32, 34 of said second input unit 22. That detection causes said control unit 4 to automatically transfer said portable key device 2 from said idle mode into said determination mode.

In said determination mode of said portable key device 2, said segments 40 of each of said electrodes 30, 32, 34 of said second input unit 22 are sequentially interconnected with said electrode 38 of said third input unit 36 via multiplexing. Said second output signals of said electrodes 30, 32, 34 as well as said third output signals of said electrode 38 are transferred to said control unit 4 and compared to data stored in said memory 42. Of course, said first output signals of said electrodes 24, 26, 28 of said first input unit 20 are transferred to said control unit 4 for comparison with data stored in said memory 42, too. Said comparison yields, that said portable key device 2 is handled by said user that way, that said second input unit 22 is in contact with said right hand of said user and said first input unit 20 is not in contact with said right hand. Thus, via said determination mode of said portable key device 2 a spatial orientation of said portable key device 2 held with said right hand of said user is determined. Because of said electrodes 30, 32, 34 of said second input unit 22 are segmented into segments 40, said control unit 4 detects via said segments 40, that, for example, said segments 40 of said first input unit 20 are in contact with said hand, which are arranged analog to said segments 40 displayed in the lower half of Fig. 2. Thus, said electrodes 24, 26, 28 of said first input unit 20 during an operation mode can be multiplexed accordingly. This is explained below.

After said determination of said spatial orientation of said portable key device 2 during said determination mode is finished, said portable key device 2 is automatically transferred into said operation mode of said portable key device 2.

During said operation mode of said portable key device 2 said control unit 4 locks or unlocks said door locking unit according to a comparison of said first output signal and/or said second output signal transferred to said control unit 4 with data stored in said memory 42. Because of the fact, that said electrodes 30, 32, 34 of said second input unit 22 are in contact with said right hand of said user, said electrodes 24, 26, 28 of said first input unit 20 are automatically interconnected with said electrode 38 of said third input unit 36 via multiplexing in order to yield higher first output signals of said first input unit 20. Due to the detection, that said segments 40 of said second input unit 22 are in contact with said palm of said hand, which are arranged analog to said segments 40 displayed in the lower half of Fig. 2, said segments 40 of said first input unit 20 can be watched by said control unit 4, which are arranged analog to said segments 40 displayed in the upper half of Fig. 2.

According to the embodiment of the invention, a single action of said user of said portable key device 2 detected by said first input unit 20 while said user of said portable key device 2 is holding it with his right hand at said second input unit 22 triggers said control unit 4 for a locking action or an unlocking action.

For example, in the case said user would slide with his right thumb over said electrodes 24, 26, 28 of said first input unit 20, namely over said segments 40 of said electrodes 24, 26, 28 located analog to the upper half of Fig. 2, starting from said third input unit 36 along said longitudinal axis 14 into the direction of said first input unit 20, said comparison of said first output signals transmitted from said electrodes 24, 26, 28 to said control unit 4 with said data stored in said memory 42 triggers said control unit 4 to unlock said door locking unit of said vehicle.

In another use case, in which said user would slide with his right thumb over said electrodes 24, 26, 28 of said first input unit 20, namely over said segments 40 of said electrodes 24, 26, 28 located analog to the upper half of Fig. 2, starting from said first input unit 20 along said longitudinal axis 14 into the direction of said third input unit 36, said comparison of said first output signals transmitted from said electrodes 24, 26, 28 to

said control unit 4 with said data stored in said memory 42 triggers said control unit 4 to lock said door locking unit of said vehicle.

Of course, the invention is advantageous for left-handed users of said portable key device 2 explained above, too. The function of said portable key device 2 is analog to the function by right-handed users.

The invention is not limited to the exemplary embodiments of the inventive portable key device and of the inventive method for the inventive portable key device discussed before.

As already mentioned above, the term doors is not limited to doors giving entrance to a user of the vehicle, but covers all types of doors, flaps, hoods and trunks, too.

In contrast to the embodiment explained, said third input unit could comprise multiple circular electrodes arranged at said connecting side in a circular manner around said longitudinal axis and electrically insulated to each other. Thus, said third input unit could be designed analog to said first and said second input unit. Furthermore, said first, second or third input unit does not have to be segmented at all. Thus, said first and second input unit could be designed as said third input unit according to the exemplary embodiment, but with multiple circular electrodes. Of course, other embodiments of the inventive portable key device comprise only a first input unit and a second input unit, but no third input unit. First, second and third input unit can also be merged together to a single input unit, comprising multiple circular electrodes.

Moreover, said portable key device could comprise at least one position sensor housed by said housing and connected to said control unit in a signal transmitting manner for detecting a spatial orientation of the portable key device, preferable designed as a micro-electro-mechanical-system. For example, said position sensor could be used for automatically transferring said portable key device from said idle mode into said determination mode and/or from said determination mode/operation mode to

said idle mode. Said position sensor could be designed as a single 3-axes-acceleration-sensor. Instead of only one single position sensor designed as a 3-axes-acceleration-sensor any useful and suitable type and number of the at least one position sensor is possible.

Said electrodes of said first input unit and said second input unit or of said first input unit, said second input unit and said third input unit can be covered by a cover, for example a waterproof layer. Thus, said first and/or said second and/or said third input unit is quite robust against detrimental environmental influences like dirt and humidity.

Said top side and said bottom side of said housing of the inventive portable key device can be used for portable key device functions, too. For example, switches can be arranged at said bottom side and/or said top side of said housing. Said functions are not limited to functions concerning a door locking unit of a vehicle, but may concern any other useful and suitable function of the inventive portable key device or the vehicle triggered by the inventive portable key device.

## List of reference numbers

|    |                                               |
|----|-----------------------------------------------|
| 2  | Portable key device                           |
| 4  | Control unit                                  |
| 6  | Housing                                       |
| 8  | Top side of housing 6                         |
| 10 | Bottom side of housing 6                      |
| 12 | Connecting side of housing 6                  |
| 14 | Longitudinal axis of housing 6                |
| 20 | First input unit                              |
| 22 | Second input unit                             |
| 24 | Electrode of first input unit 20              |
| 26 | Electrode of first input unit 20              |
| 28 | Electrode of first input unit 20              |
| 30 | Electrode of second input unit 22             |
| 32 | Electrode of second input unit 22             |
| 34 | Electrode of second input unit 22             |
| 36 | Third input unit                              |
| 38 | Electrode of third input unit 36              |
| 40 | Segment of first and second input unit 20, 22 |
| 42 | Memory                                        |

## Portable key device and method for a portable key device

### Claims

1. A portable key device (2) for a door locking unit of a vehicle, comprising a control unit (4) housed by a housing (6) and designed and configured to lock and unlock said door locking unit, whereat said housing (6) comprises a top side (8), a bottom side (10) and at least one connecting side (12) connecting said top side (8) and said bottom side (10), a first input unit (20) and a second input unit (22) each connected to said control unit (4) in a signal transmitting manner for triggering said control unit (4) for locking or unlocking said door locking unit via radio link by means of a first output signal of said first input unit (20) and/or a second output signal of said second input unit (22), and a memory (42) designed and configured for storing data for comparing said first output signal and/or said second output signal with said stored data in said control unit (4) for triggering a locking action or an unlocking action of said control unit (4) according to said comparison, wherein,  
said top side (8) and said bottom side (10) are spaced apart from each other along a longitudinal axis (14) of said housing (6) and said first input unit (20) and said second input unit (22) each are designed as a touch sensor comprising at least three circular electrodes (24, 26, 28; 30, 32, 34) arranged at said connecting side (12) in a circular manner around said longitudinal axis (14) and electrically insulated to each other, whereat said first input unit (20) and said second input unit (22) as well as each of said at least three circular electrodes (24, 26, 28; 30, 32, 34) of said first input unit (20) and of said second input unit (22) are spaced apart from each other along said longitudinal axis (14).
2. Portable key device (2) according to claim 1,  
wherein,

between said first input unit (20) and said second input unit (22) a third input unit (36) is arranged at said connecting side (12), whereat said third input unit (36) is designed as a touch sensor comprising at least one circular electrode (38) arranged at said connecting side (12) in a circular manner around said longitudinal axis (14), and whereat said at least one circular electrode (38) is electrically insulated from said first input unit (20) and said second input unit (22) and connected to said control unit (4) in a signal transmitting manner for transmitting a third output signal to said control unit (4).

3. Portable key device according to claim 2, wherein,  
said third input unit comprises multiple circular electrodes arranged at said connecting side in a circular manner around said longitudinal axis and electrically insulated to each other.
4. Portable key device (2) according to one of the claims 1 to 3, wherein,  
each of said circular electrodes (24, 26, 28; 30, 32, 34) of said first input unit (20) and/or of said second input unit (22) and/or of said third input unit comprises at least two segments (40), whereat said segments (40) are spaced apart in a circular direction and electrically insulated from each other.
5. Portable key device (2) according to one of the claims 1 to 4, wherein,  
each of said first input unit and said second input unit or each of said first input unit (20), said second input unit (22) and said third input unit (36) are designed as a capacitive sensor.
6. Portable key device according to one of the claims 1 to 5, wherein,

said portable key device comprises at least one position sensor housed by said housing and connected to said control unit in a signal transmitting manner for detecting a spatial orientation of the portable key device, preferable designed as a micro-electro-mechanical-system.

7. Portable key device according to claim 6,  
wherein,  
said position sensor is designed as a single 3-axes-acceleration-sensor.
8. Portable key device (2) according to one of the claims 1 to 7,  
wherein,  
said first input unit (20) and said second input unit (22) are designed and configured to trigger said control unit (4) for a locking action or an unlocking action according to a single action of a user of the portable key device (2) detected by said first input unit (20) while a user of the portable key device (2) is holding it with one hand at said second input unit (22) or said second input unit (22) while a user of the portable key device (2) is holding it with one hand at said first input unit (20).
9. Portable key device (2) according to one of the claims 1 to 8,  
wherein,  
said control unit (4) and said at least three circular electrodes (24, 26, 28; 30, 32, 34) of said first input unit (20) and/or of said second input unit (22) and/or said at least one circular electrode (38) of said third input unit (36) are designed and configured that way, that said at least three circular electrodes (24, 26, 28; 30, 32, 34) of said first input unit (20) and/or of said second input unit (22) and/or said at least one circular electrode (38) of said third input unit (36) can be interconnected to each other at least partly during a determination mode of the portable key device (2) for determining a spatial orientation of the portable key device (2) with respect to a hand of a user the portable key device (2) is held with.

10. Portable key device (2) according to one of the claims 1 to 9, wherein,  
said control unit (4), said at least three circular electrodes (24, 26, 28; 30, 32, 34) of said first input unit (20) and/or of said second input unit (22) and/or said at least one circular electrode (38) of said third input unit (36) and/or said position sensor are designed and configured to be operated in a regular mode, like a determination mode or an operation mode, and in an idle mode of the portable key device (2), whereat said determination mode is for determining a spatial orientation of the portable key device (2) with respect to a hand of a user the portable key device (2) is held with, said operation mode is for locking or unlocking said door locking unit by means of said first input unit (20) and/or said second input unit (22), and said idle mode is for energy saving, and whereat the portable key device (2) is automatically transferable from said idle mode into said determination mode according to an output signal of said position sensor and/or said first output signal of said first input unit (20) and/or said second output signal of said second input unit (22) and/or said third output signal of said third input unit (24).
11. Method for a portable key device (2) according to one of the claims 1 to 10, wherein,  
said control unit (4) locks or unlocks said door locking unit according to a comparison of said first output signal and/or said second output signal transmitted to said control unit (4) with data stored in said memory (42) during an operation mode of the portable key device (2), whereat before said operation mode of the portable key device (2) is executed a determination mode of the portable key device (2) for determining a spatial orientation of the portable key device (2) with respect to a hand of a user the portable key device (2) is held with is executed, and whereat the portable key device (2) is automatically transferred from said determination mode into said operation mode.
12. Method according to claim 11, wherein,

the portable key device (2) is automatically transferred from said determination mode or said operation mode to an idle mode of the portable key device (2) according to a time interval defined before with said output signal of said position sensor and/or said first output signal of said first input unit (20) and/or said second output signal of said second input unit (22) and/or said third output signal of said third input unit (36) are/is not matching data stored in said memory (42) for the portable key device (2) being in said determination mode or said operation mode.

13. Method according to claim 12,

wherein,

the portable key device (2) is automatically transferred from said idle mode into said determination mode according to said output signal of said position sensor and/or said first output signal of said first input unit (20) and/or said second output signal of said second input unit (22) and/or said third output signal of said third input unit (36) are/is matching data stored in said memory (42) for the portable key device (2) being in said determination mode.

14. Method according to one of the claims 11 to 13,

wherein,

a single action of a user of the portable key device (2) detected by said first input unit (20) while a user of the portable key device (2) is holding it with one hand at said second input unit (22) or said second input unit (22) while a user of the portable key device (2) is holding it with one hand at said first input unit (20) triggers said control unit (4) for a locking action or an unlocking action.



## INTERNATIONAL SEARCH REPORT

International application No  
PCT/EP2019/055105

## A. CLASSIFICATION OF SUBJECT MATTER

INV. G07C9/00

ADD. G06F3/03 H01H9/02

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

G07C G06F H01H

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPO-Internal, WPI Data

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

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| X         | US 2016/250996 A1 (PARK KI WOONG [KR] ET<br>AL) 1 September 2016 (2016-09-01)<br>figure 17<br>paragraph [0200] - paragraph [0207]<br>-----   | 1-14                  |
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Further documents are listed in the continuation of Box C.



See patent family annex.

## \* Special categories of cited documents :

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"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&amp;" document member of the same patent family

Date of the actual completion of the international search

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## INTERNATIONAL SEARCH REPORT

International application No  
PCT/EP2019/055105

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Information on patent family members

International application No

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