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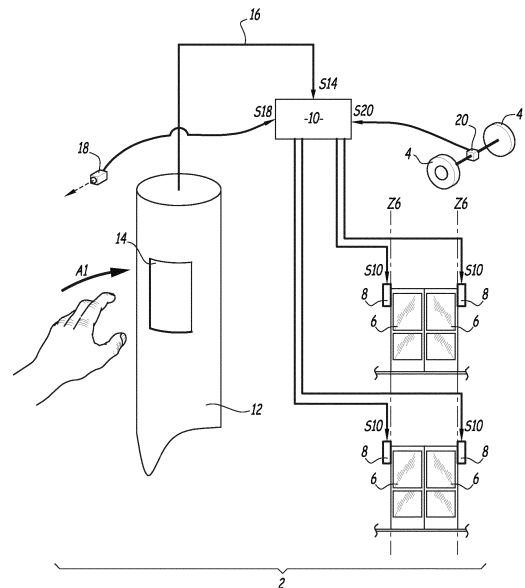
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(54) **Device for controlling the opening of doors, mass transit vehicle equipped with such a device, and method for controlling the opening of the doors of such a vehicle**

(57) The device (8, 10, 14) according to the invention for controlling the opening of doors (6) for a mass transit passenger vehicle (2) comprises a contactless detector (14) adapted to send a door opening signal ( $S_{14}$ ) to a control unit which controls at least one door actuator (8).

The method for controlling the opening of at least some of the doors (6) of the passenger transit vehicle (2) comprises at least the following steps: a) determining whether the vehicle (2) is stopped or in motion, b) if the contactless detector (14) is actuated while the vehicle is stopped, considering that opening of the doors has been requested and granting that request, c) if the contactless detector is actuated while the vehicle is in motion, comparing the actuation duration of the detector to a threshold value and, based on the result of that comparison, considering that opening of the doors has or has not been requested, d) if opening of the doors is considered to have been requested in step c), granting that request (120) at the next stop of the vehicle (2).



*Fig.1*

## Description

[0001] The invention relates to a device for controlling the opening of doors for a mass transit passenger vehicle.

[0002] In the field of mass passenger transit, in particular in the context of an urban or peri-urban system, it is known to equip vehicles of the bus type with buttons accessible to passengers and using which those passengers can request opening of the doors of the vehicle at the next passenger pickup/drop-off station stop, by pressing on one of said buttons. Such buttons may also be used to request opening of the doors when the vehicle is at such a station. Such buttons are manipulated by the passengers on a bus and may transmit microbes. In fact, a sick passenger or a passenger whose hands are contaminated may place microbes or germs on such a button that next risk migrating onto the hands of another passenger. This is particularly sensitive in case of epidemic.

[0003] The invention more particularly aims to resolve these drawbacks by proposing a new device for controlling the opening of doors with reduced risks of disease transmission. To that end, the invention relates to a device for controlling the opening of doors for a passenger transit vehicle, said device being **characterized in that** it comprises a contactless detector adapted to send a door opening signal to a control unit which controls at least one door actuator. Owing to the invention, it is possible for a user to request opening of the doors without touching a button directly, but instead using the contactless detector. Thus, the user does not risk having his hand contaminated by contact with the button.

[0004] According to other advantageous but optional features of the invention, such a device may incorporate one or more of the following features:

- The contactless detector is of the infrared type.
- The device comprises means for processing the signal emitted by the contactless detector, said processing means being capable of operating at least one door opening actuator.
- The processing means command the door opening actuator based on whether the vehicle is stopped or in motion.
- The processing means comprise means for computing the activation duration of the contactless detector.
- The device comprises means for determining a filling coefficient of the vehicle with passengers.

[0005] The invention also relates to a mass transit passenger vehicle equipped with a door opening control device as described above.

[0006] The invention lastly relates to a method for controlling the opening of at least some of the doors of a vehicle as described above, that method being **characterized in that** it comprises at least the following steps:

- a) determining whether the vehicle is stopped or in

motion;

- b) if the contactless detector is actuated when the vehicle is stopped, considering that opening of the doors has been requested and granting that request;
- c) if the contactless detector is actuated while the vehicle is in motion, comparing the actuation duration of the detector to a threshold value and, based on the results of the comparison, considering that opening of the doors has or has not been requested;
- d) if it is considered that opening of the doors has been requested in step c), granting that request the next time the vehicle is stopped.

[0007] According to other advantageous but optional aspects of the invention, such a method may incorporate one or more of the following features, considered in any technically allowable combination:

- During step c), it is considered that opening of the doors is requested when the actuation duration of the detector is below the threshold value.
- The method comprises an additional step e) consisting of setting the threshold value based on a filling coefficient of the vehicle with passengers.
- During step e), the higher the filling coefficient, the higher the threshold value is set.
- During step e), the filling coefficient is computed based on signals emitted by at least one device for measuring or estimating the number of passengers transported by the vehicle.

[0008] The invention will be better understood and other advantages thereof will appear more clearly in light of the following description of one embodiment of a device for controlling door opening, a vehicle and a method according to its principle, provided solely as an example and done in reference to the appended drawings, in which:

- figure 1 is a diagrammatic illustration of a door opening control device integrated into a bus and according to the invention, and
- figure 2 is a block diagram of the principle of a method for controlling the opening of the doors of the vehicle equipped with the device of figure 1.

[0009] The vehicle diagrammatically shown in figure 1 is a bus 2 that comprises a chassis (not shown) supported by wheels, two of which are shown in figure 1, bearing reference 4.

[0010] The bus 2 is equipped with doors 6 that are mounted in pairs and that are each hinged around a vertical axis Z6. The pivoting of each door 6 around its articulation axis Z6 is controlled by an actuator 8 which can be an electric motor or a pneumatic actuator. The various actuators are controlled by an electronic control unit 10, using electrical signals S10. In practice, unit 10 controls at least one actuator 8

**[0011]** Inside the passenger compartment of the bus 2, a post 12 is positioned that is equipped with a contactless detector 14, that contactless detector being connected by an electrical line 16 to the unit 10, to which it provides an electrical signal S14 usable by said unit.

**[0012]** Alternatively, the connection between the detector 14 and the unit 10 might be wireless.

**[0013]** When the user wishes to obtain opening of the doors 6, it suffices to pass the hand in front of the detector 14, as shown by arrow A1 in figure 1, so that the detector 14 uses the lines 16 to send a signal S14 to the unit 10 indicating that an object is in front of it and has been detected. The signal may then be interpreted as a request to open the doors 6, as emerges from the explanations that follow.

**[0014]** It will be noted that the user is not required to pass the hand in front of the contactless detector 14, and that a user wishing to obtain opening of the doors 6 may pass an object such as a glove, hat or handbag.

**[0015]** Thus, the elements 8, 10 and 14 together form a device D for opening the doors 6 for the bus 2.

**[0016]** Although several types of contactless detector may be considered with the invention, a detector of the infrared type is preferred inasmuch as it operates correctly, independently of the lighting conditions of the passenger compartment of the bus 2. This is important, since these conditions can vary quite rapidly, for example when the bus enters or leaves a tunnel.

**[0017]** In practice, the detector 14 may be a commercially available product such as that marketed by Biotime Technology under reference BK1.

**[0018]** Two cases are considered: either the bus is stopped, i.e., it is stopped at a passenger pickup/drop-off station, or the vehicle is in motion, i.e., it is on a journey between two pickup/drop-off stations. During motion, the speed of the vehicle might be null, for example when the vehicle is waiting at a red traffic light.

**[0019]** If the passenger actuates the contactless detector 14 by passing a hand or another object in front of it while the bus 2 is stopped, the unit 10 considers that the signal S14 then emitted by the detector 14 is a request to open the doors and grants it, immediately.

**[0020]** If the passenger passes a hand in front of the detector 14 while the vehicle is in motion, then the signal S14 emitted by the detector 14 may be a request to open the doors at the next bus stop.

**[0021]** In that case, any "false requests" should be taken into account resulting from a prolonged upright stance of one or more passengers in front of the detector 14.

**[0022]** In fact, the greater the number of passengers transported by the bus 2, the greater the risk of a person standing in front of the detector 14, even though that person does not necessarily wish to obtain opening of the doors 6 at the next stop at a passenger pickup/drop-off station.

**[0023]** To avoid untimely opening of the doors 6, the control unit 10 takes into account the time during which an object is present in front of the detector 14, i.e., the

duration during which said detector is actuated, to estimate whether the actuation in question corresponds to an actual request to open the doors or is a false request, related to the fact that a passenger or object is standing in front of the detector 14. In reference to figure 2, a step 100 is considered in which the detector 14 is actuated due to the fact that an object or part of the body of a passenger is located in front of that detector.

**[0024]** During a step 110, the unit 10 detects whether the bus 2 is in motion or not, by having access to the control parameters of the bus 2.

**[0025]** When the bus 2 is stopped at a passenger pickup/drop-off station, the unit 10 implements logic branch L1 by considering that opening of the doors has been requested and granting a request during a step 120, during which the unit 10 controls the motors 8 to open the doors 6, using signals S10.

**[0026]** If the bus 2 is in motion, the unit 10 implements a logic branch L2 during which it determines, during a step 130, the duration  $d_{14}$  during which the detector 14 is actuated. This determination occurs using a clock integrated into the unit 10 and which counts the time between the first moment  $t_1$  where the detector begins to be actuated and the second moment  $t_2$ , after the first moment, where it ceases to be actuated.

**[0027]** The duration  $d_{14}$  is then compared to a threshold value  $\Delta T$ , during a step 140.

**[0028]** The threshold value  $\Delta T$  is set so as to eliminate false requests to open the doors as much as possible.

**[0029]** More specifically, the value  $\Delta T$  is set as a function of a filling coefficient K of the bus 2. The bus 2 is equipped with a cell 18, of the photoelectric or equivalent type, that makes it possible to determine the approximate density of passengers in the passenger compartment of the bus 2. The bus 2 is also equipped with a pressure sensor 20 mounted on air cushions equipping at least one axle of the bus 2. This pressure sensor 20 makes it possible to estimate the mass transported by the bus 2 and, by deduction, to know the approximate number of passengers transported.

**[0030]** Measuring members 18 and 20 each provide the unit 10 with a signal S18, S20 that is used by that unit to determine the filling coefficient K, which may be expressed in percentage of the maximum passenger capacity of the bus 2 or otherwise. Based on the value of the coefficient K, the threshold value  $\Delta T$  may assume several values. For example, the threshold value  $\Delta T$  is equal to one second when the bus is "empty" or filled to less than one third of its capacity, 3 seconds when the bus is filled to between one and two thirds of its capacity, and 5 seconds when the bus is filled at more than two thirds of its capacity.

**[0031]** In figure 2, step 150 shows the computation of the coefficient K as a function of the signals S18 and S20 provided by the detection members 18 and 20, whereas step 160 shows the step for determining the threshold value  $\Delta T$  as a function of the value of the coefficient K, from values stored in a logic table 22. Steps 150 and 160

may be carried out periodically by the unit 10, for example every 1 second. Using the example of an "average" filled bus for which the value of  $\Delta T$  is set at 3 seconds, step 140 makes it so that, when the detector 14 is actuated for more than 3 seconds, i.e., when the duration  $d_{14}$  is greater than 3 seconds, the unit 10 follows logic branch L3 and considers that a passenger is standing in front of the sensor 14 because he has no other choice to remain within the passenger compartment of the bus 2. In that case, during a step 170, the signal S4 received from the detector 14 is ignored.

**[0032]** On the contrary, if the duration  $d_{14}$  during which the detector 14 is activated is shorter than or equal to 3 seconds, then the unit 10 follows logic branch L4 and considers that it is indeed receiving a request to open the doors, which it takes into account in step 180. Next, when the bus 2 reaches the next passenger pickup/drop-off station, it is possible for the unit 10 to carry out step 120 to in fact open the doors 6 using the actuators 8.

**[0033]** Steps 100 to 180 are carried out automatically by the unit 10.

**[0034]** Alternatively, the unit 10 is capable of opening only some of the doors 6 of the bus 2. This may be the case when several detectors 14 are distributed in the passenger compartment and only the doors closest to the actuated detector 14 are opened. Such is the case when opening of the door is controlled by zones front/middle/rear.

**[0035]** The invention has been described above in the case of its use in a bus. It is, however, applicable with other types of vehicles, such as trolleys or trams.

## Claims

1. A device (8, 10, 14) for controlling the opening of doors (6) for a passenger transit vehicle (2), **characterized in that** it comprises a contactless detector (14) adapted to send a door opening signal ( $S_{14}$ ) to a control unit which controls at least one door actuator (8).
2. The device according to claim 1, **characterized in that** the contactless detector (14) is of the infrared type.
3. The device according to one of the preceding claims, **characterized in that** the device comprises means (10) for processing the signal ( $S_{14}$ ) emitted by the contactless detector (14), said processing means being capable of operating ( $S_{10}$ ) at least one door opening actuator (8).
4. The device according to claim 3, **characterized in that** the processing means (10) command (110) the door (6) opening actuator (8) based on whether the vehicle is stopped or in motion.
5. The device according to claim 3 or 4, **characterized in that** the processing means comprise means (10) for computing the activation duration (d) of the contactless detector (14).
6. The device according to claim 5, **characterized in that** the device comprises means (10) for determining a filling coefficient (K) of the vehicle (2) with passengers.
7. A mass transit passenger vehicle (2) equipped with a device (8, 10, 14) for controlling the opening of doors (6) according to one of the preceding claims.
8. A method for controlling the opening of at least some of the doors (6) of a vehicle (2) for transporting passengers according to claim 7, **characterized in that** it comprises at least the following steps:
  - a) determining (110) whether the vehicle (2) is stopped or in motion,
  - b) if the contactless detector is actuated when the vehicle is stopped, considering (L1) that opening of the doors has been requested and granting that request (120);
  - c) if the contactless detector is actuated while the vehicle is in motion, comparing (140) the actuation duration ( $d_{14}$ ) of the detector to a threshold value ( $\Delta T$ ) and, based on the results of the comparison, considering that opening of the doors has (L4) or has not (L3) been requested;
  - d) if it is considered that opening of the doors has been requested in step c), granting (120) that request the next time the vehicle is stopped.
9. The method according to claim 8, **characterized in that** during step c), it is considered (L4) that opening of the doors (6) is requested when the actuation duration (d) of the detector is below the threshold value ( $\Delta T$ ).
10. The method according to claim 7 or 8, **characterized in that** it comprises an additional step consisting of
  - e) setting (160) the threshold value ( $\Delta T$ ) based on a filling coefficient (K) of the vehicle (2) with passengers.
11. The method according to claim 10, **characterized in that** during step e), the higher the filling coefficient (K), the higher the threshold value ( $\Delta T$ ) is set.
12. The method according to one of claims 10 or 11, **characterized in that** during step e), the filling coefficient (K) is computed based on signals ( $S_{18}$ ,  $S_{20}$ ) emitted by at least one device (18, 20) for measuring or estimating the number of passengers transported by the vehicle (2).

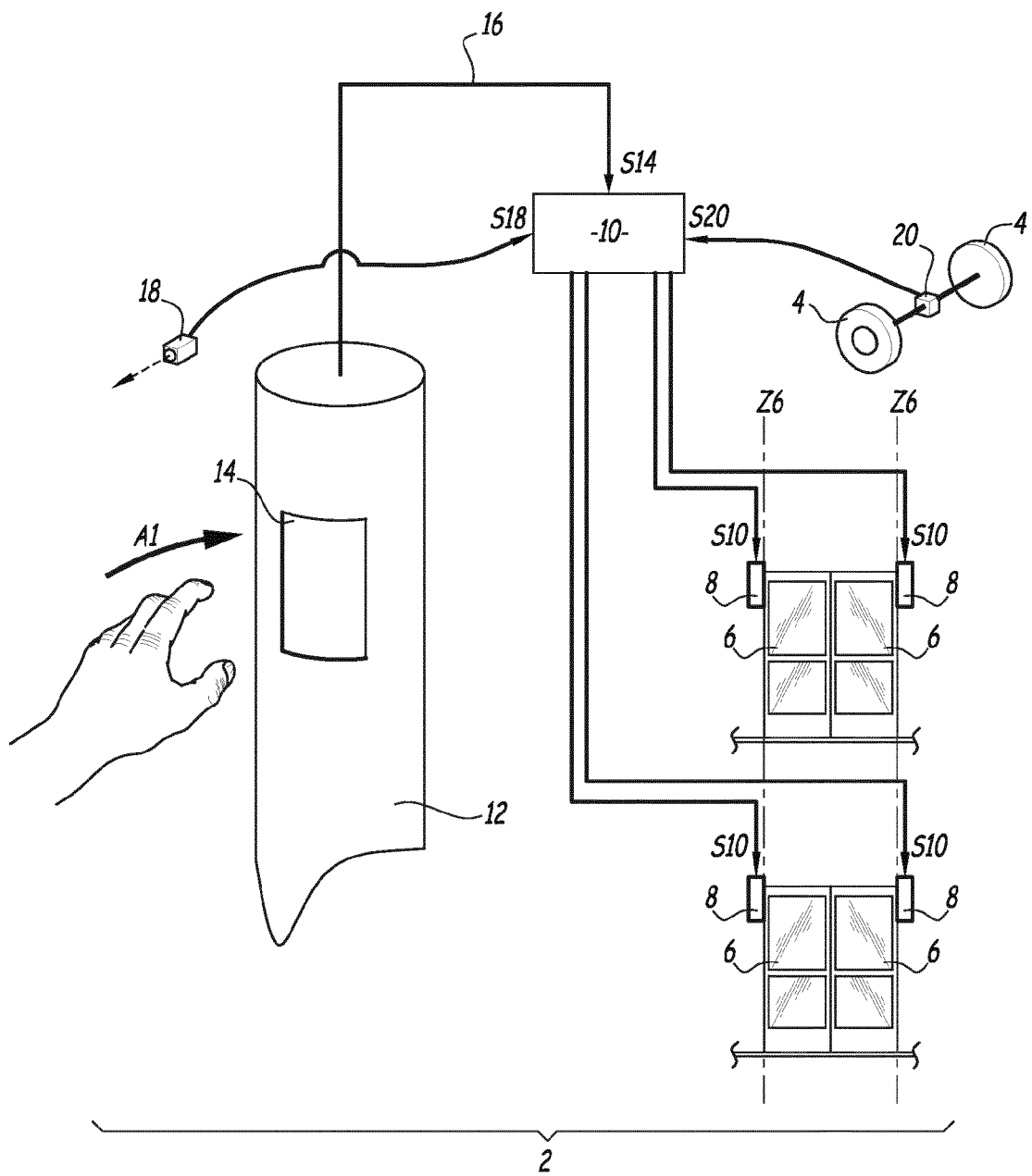


Fig.1

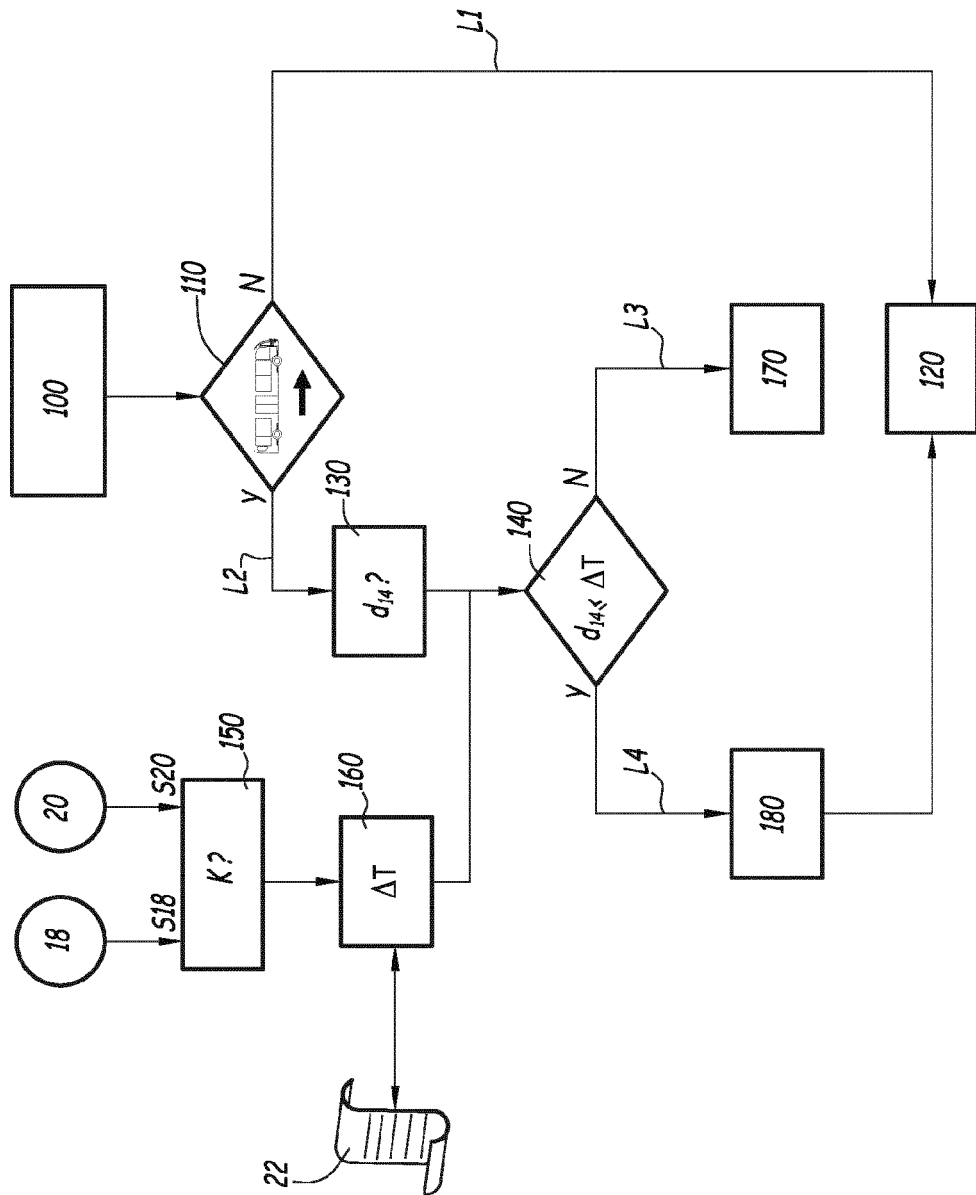


Fig.2



## EUROPEAN SEARCH REPORT

Application Number  
EP 13 18 8680

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The present search report has been drawn up for all claims			
Place of search		Date of completion of the search	Examiner
The Hague		31 July 2014	Van der Haegen, D
CATEGORY OF CITED DOCUMENTS			
X : particularly relevant if taken alone		T : theory or principle underlying the invention	
Y : particularly relevant if combined with another document of the same category		E : earlier patent document, but published on, or after the filing date	
A : technological background		D : document cited in the application	
O : non-written disclosure		L : document cited for other reasons	
P : intermediate document		& : member of the same patent family, corresponding document	

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EPO FORM 1503 03.82 (P04C01)



## EUROPEAN SEARCH REPORT

Application Number  
EP 13 18 8680

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DOCUMENTS CONSIDERED TO BE RELEVANT			
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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 31 July 2014	Examiner Van der Haegen, D
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			

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EPO FORM 1503 03.82 (P04C01)





Application Number

EP 13 18 8680

**CLAIMS INCURRING FEES**

The present European patent application comprised at the time of filing claims for which payment was due.

☐ Only part of the claims have been paid within the prescribed time limit. The present European search report has been drawn up for those claims for which no payment was due and for those claims for which claims fees have been paid, namely claim(s):

☐ No claims fees have been paid within the prescribed time limit. The present European search report has been drawn up for those claims for which no payment was due.

**LACK OF UNITY OF INVENTION**

The Search Division considers that the present European patent application does not comply with the requirements of unity of invention and relates to several inventions or groups of inventions, namely:

see sheet B

☒ All further search fees have been paid within the fixed time limit. The present European search report has been drawn up for all claims.

☐ As all searchable claims could be searched without effort justifying an additional fee, the Search Division did not invite payment of any additional fee.

☐ Only part of the further search fees have been paid within the fixed time limit. The present European search report has been drawn up for those parts of the European patent application which relate to the inventions in respect of which search fees have been paid, namely claims:

☐ None of the further search fees have been paid within the fixed time limit. The present European search report has been drawn up for those parts of the European patent application which relate to the invention first mentioned in the claims, namely claims:

☐ The present supplementary European search report has been drawn up for those parts of the European patent application which relate to the invention first mentioned in the claims (Rule 164 (1) EPC).



**LACK OF UNITY OF INVENTION  
SHEET B**

Application Number

EP 13 18 8680

The Search Division considers that the present European patent application does not comply with the requirements of unity of invention and relates to several inventions or groups of inventions, namely:

1. claims: 1-7

A device for controlling the opening of doors of a public transport vehicle.

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2. claims: 8-12

A method for controlling the opening of doors of a public transport vehicle.

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**ANNEX TO THE EUROPEAN SEARCH REPORT  
ON EUROPEAN PATENT APPLICATION NO.**

EP 13 18 8680

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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EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82