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(54) **A PASSENGER TRANSPORTATION MEANS FOR IMPROVED PASSENGER FLOW AND REDUCED DWELL TIMES AND A METHOD FOR CONTROLLING DOORS**

(57) The invention relates to a passenger transportation means for improved passenger flow and reduced dwell times,
- the passenger transportation means comprising at least two doors in each side wall.
- A set (21, 22) of at least one first door (31) and at least one second door (32) located adjacent to the first door (31) is positioned in each side wall (11) of the passenger transportation means (10), wherein
- the first door (31) is flush with the side wall (11) of the passenger transportation means (10) when the first door (31) is in a closed position and
- the second door (32) is offset (d) from the side wall (11) towards an interior space of the passenger transportation means when the second door (32) is in an open position.

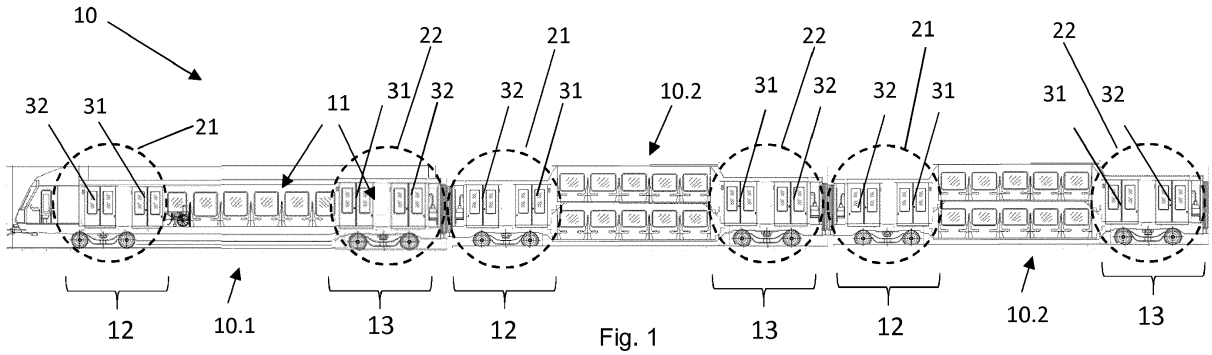

Fig. 1

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Description

[0001] The present invention relates to a passenger transportation means for improved passenger flow and reduced dwell times and a method for controlling doors.

[0002] Current door systems of vehicles for passenger transport, in particular rail vehicles, are arranged to accommodate high passenger flows between the vehicle and a stop, e.g. a railway station. The door size is critical for commuter trains which cope with a high number of passengers and high boarding and unboarding rates at stations. The door size is limited because an opening time must be kept to a minimum. Furthermore, large doors have drawbacks because they have a lower mechanical resistance than small doors whereas small doors limit the passenger flow.

[0003] Document EP 2 634 063 B1 discloses a sliding door provided in an interior of a rail vehicle between two interior parts. The sliding door comprises at least two door leaves which are guided parallel to one another in a respective rail. The rails are offset with respect to one another in a direction parallel to the door leaves. The rails are also arranged overlapping one another perpendicular to the door leaves. The rails are fastened to a ceiling of the rail vehicle, wherein the door leaves are arranged suspended
within the rails. However, this sliding door is only suitable for the interior of the rail vehicle because it still needs a lot of space in a direction perpendicular to the door leaves. In addition, the opening and closing of the sliding door is independent of a passenger flow.

[0004] The technical problem underlying the present invention consists in developing a vehicle for improved passenger flow and reduced dwell times and a method for controlling doors, wherein a door arrangement allows to group the passenger flow for boarding and unboarding, and the opening and closing of doors depends on a number of passengers. The technical problem outlined above is solved by the passenger transportation means according to claim 1 and the method defined in claim 10. The dependent claims define particular embodiments of the invention.

[0005] According to the invention the objectives are solved by a passenger transportation means for improved passenger flow and reduced dwell times,

- the passenger transportation means comprising at least two doors in each side wall.
- A set (21, 22) of at least one first door (31) and at least one second door (32) located adjacent to the first door (31) is positioned in each side wall (11) of the passenger transportation means (10), wherein
- the first door (31) is flush with the side wall (11) of the passenger transportation means (10) when the first door (31) is in a closed position and
- the second door (32) is offset (d) from the side wall (11) towards an interior space of the passenger transportation means when the second door (32) is in an open position.

[0006] An advantage of the inventive solution is that a defined passenger flow for boarding and unboarding is possible. The passenger flow is centralized at the set of at least one first door and at least one second door. Thus, the passenger flow is improved, and dwell times are reduced. The first door is flush with a side wall of the vehicle when the first door is in a closed position and the second door is offset from the side wall towards an interior space of the vehicle when the second door is in an open position. The offset allows for an overlapping of door leaves of the first door and the second door when the first door and the second door are each in an open position. If the passenger transportation means is narrowed by the offset in an end region, it is beneficial when running in a curve because the width of the passenger transportation means is locally reduced and thus allows for a larger passenger transportation means. The first door and/or the second door can be a sliding door, a pivot-and-slide door or a swing door.

[0007] In a preferred embodiment of the invention, a set (21, 22) of at least one first door (31) and at least one second door (32) is positioned in at least one end region (12, 13) and/or in a central region of the passenger transportation means (10). Thus, the arrangement of the set of doors is flexible.

[0008] Preferably, a first door leaf of the first door at least partly overlaps a second door leaf of the second door when the first door and the second door are each in an open position. Thereby, space can be saved in a longitudinal direction of the passenger transportation means.

[0009] Furthermore, the first door is spaced apart from the second door by at least a width of the second door leaf of the second door. This arrangement saves space and still ensures that a full movement of door leaves of the first door and the second door can be completed when both, the first door and the second door, are opened. If the first door and the second door have the same configuration the first door leaf and the second door leaf have the same width.

[0010] In another advantageous development of the invention the first door is an entrance door and the second door is an exit door or vice versa, or wherein a first set of a first door and a second door comprises an entrance zone and a second set of a first door and a second door comprises an exit zone. Thus, the passengers can be grouped, crowded boarding and unboarding can be avoided, and dwell times are reduced.

[0011] The first door and/or the second door can each have two lanes, and in particular the first door and/or the second door can each have a passage width of 1300 mm. Advantageously, standardized doors can be used.

[0012] Alternatively, the first door and/or the second door can each have three lanes, and in particular the first door and/or the second door can each have a passage width of 1600 mm. Thereby, the passenger flow can be

increased, and dwell times can be further reduced.

[0013] A vestibule of the passenger transportation means may extend along the passage widths of the first door and the second door, including a space between the first door and the second door corresponding to at least the width of the second door leaf of the second door. Thus, the vestibule is larger than a conventional vestibule and provides more space for standing passengers and boarding and unboarding passengers.

[0014] In particular, the passenger transportation means is a rail vehicle. The invention is especially useful for rail vehicles with a high number of passengers and long rail cars.

[0015] According to the invention the problem is also solved by a method for controlling doors of a passenger transportation means. At least one first door and/or at least one second door is opened at a station depending on passenger numbers in the passenger transportation means and at the station. An advantage of the inventive method is that the first door and/or the second door can be closed when there are fewer passengers and the first door and/or the second door can be opened when there are more passengers.

[0016] A first set of a first door and a second door can be opened first to allow passengers to leave the passenger transportation means, and the opening of a second set of a first door and a second door can be delayed to allow passengers to enter the passenger transportation means later. Thereby, the passenger flow can be controlled by reducing crowded boarding and unboarding such that dwell times are reduced.

[0017] Alternatively, a set of a first door and a second door is opened at once, in particular at a first station of a passenger transportation means run or if a station is less crowded than the passenger transportation means. Thus, a maximum door space is available for boarding and unboarding.

[0018] Ideally, color indicators for each first door and each second door indicate which one of the first door and the second door is an entrance door and which one of the first door and the second door is an exit door. Accordingly, the passenger flow can be further influenced to reduce boarding and unboarding times and thus dwell times too.

[0019] The accompanying drawings, which are incorporated in and constitute a part of this specification, illustrate one embodiment of the invention and, together with a description of the invention given above and the description given below, serve to explain the invention.

Fig. 1 shows a side view of a first part of an inventive passenger transportation means,

Fig. 2 shows a side view of a second part of the inventive passenger transportation means,

Fig. 3 is a cross sectional view of a set of a first door and a second door of the inventive passenger transportation means, and

Fig. 4 is a cross sectional view of a vestibule of the inventive passenger transportation means.

[0020] Fig. 1 and 2 show an example of an inventive passenger transportation means 10. With reference to Fig. 1 a first part of the passenger transportation means 10 comprises an end car 10.1 and two intermediate cars 10.2. According to Fig. 2 a second part of the passenger transportation means 10 comprises an intermediate car 10.2 and an end car 10.1. An inventive passenger transportation means 10 can as well have other configurations and/or numbers of intermediate cars 10.2.

[0021] In Fig. 1 and 2 each end car 10.1 and each intermediate car 10.2 of the passenger transportation means 10 has two opposite side walls 11 but only one of the two side walls 11 is shown. The end cars 10.1 and the intermediate cars 10.2 each have a first end region 12 and a second end region 13. In each first end region 12 there is a first set of doors 21. In each second end region 13 there is a second set of doors 22. The first set 21 comprises a first door 31 and a second door 32. The second set 22 also comprises a first door 31 and a second door 32.

[0022] Each first door 31 is adjacent to a second door 32. There is a passenger area between two first doors 31 in each end car 10.1 and each intermediate car 10.2. Accordingly, the first doors 31 of the first end regions 12 are located on the right of the second doors 32. The first doors 31 of the second end regions 13 are located on the left of the second doors 32.

[0023] Fig. 3 shows a second set 22 of a first door 31 and a second door 32 in more detail. The second door 32 has an offset d from the side wall 11. The first door 31 and the second door 32 are both shown in their open position each having a passage width pw. An opening direction is indicated by arrows and "open". The first door 31 and the second door 32 are sliding doors each comprising two door leaves. The first door 31 has a first door leaf 41 and the second door has a second door leaf 42. The first door leaf 41 overlaps the second door leaf 42. The second door leaf 42 has a width w. The offset d can be at least 150% of a thickness t of the second door leaf 42.

[0024] In Fig. 4 the set of doors 22 is shown together with a vestibule 50 of the passenger transportation means 10. The vestibule 50 extends along the first door 31 and the second door 32 including a space 51 between the first door 31 and the second door 32 in their closed positions. The space 51 has at least the same width w as the second door leaf 42.

[0025] In operation, the first doors 31 can be entrance doors and the second doors 32 can be exit doors, or vice versa. If the first doors 31 are entrance doors and the second doors 32 are exit doors, there can be placed, for instance, a green color indicator on the first doors 31 and/or a red color indicator on the second doors 32 indi-

cating passengers in advance which door should be used.

[0026] In addition, a method for controlling the first door 31 and the second door 32 is applied. Either one door or both doors of each set of doors 21, 22 can be opened dependent on the passenger numbers in the passenger transportation means 10 and at a station (not shown). For a regular number of passengers waiting at the station the second doors 32 should be opened first to allow passengers to leave the passenger transportation means 10. After a delay, the first doors 31 are opened to allow passengers to board later. Priority is given to the passengers leaving the passenger transportation means 10. Whenever the station is not crowded the first doors 31 and the second doors 32 may be opened at once such that as much passengers as possible can leave the passenger transportation means 10 rapidly, thus reducing dwell time.

Reference List

[0027]

10	Passenger transportation means
10.1	End car
10.2	Intermediate car
11	Side wall
12	First End region
13	Second end region
21	First set
22	Second set
31	First door
32	Second door
41	First door leaf
42	Second door leaf
50	Vestibule
51	Space

w	Width
t	Thickness
d	Offset
pw	Passage width

Claims

1. A passenger transportation means (10) for improved passenger flow and reduced dwell times,

- the passenger transportation means (10) comprising at least two doors (31, 32) in each side wall (11),

characterized in that

- a set (21, 22) of at least one first door (31) and at least one second door (32) located adjacent to the first door (31) is positioned in each side wall (11) of the passenger transportation means (10), wherein
- the first door (31) is flush with the side wall (11) of the passenger transportation means (10) when the first door (31) is in a closed position and
- the second door (32) is offset (d) from the side wall (11) towards an interior space of the passenger transportation means when the second door (32) is in an open position.

2. The passenger transportation means (10) according to claim 1, wherein a set (21, 22) of at least one first door (31) and at least one second door (32) is positioned in at least one end region (12, 13) and/or in a central region of the passenger transportation means (10).

3. The passenger transportation means (10) according to either of claims 1 or 2, wherein a first door leaf (41) of the first door (31) at least partly overlaps a second door leaf (42) of the second door (32) when the first door (31) and the second door (32) are each in an open position.

4. The passenger transportation means (10) according to claim 3, wherein the first door (31) is spaced apart from the second door (32) by at least a width (w) of the second door leaf (42) of the second door (32).

5. The passenger transportation means (10) according to any of the preceding claims, wherein the first door (31) is an entrance door and the second door (32) is an exit door or vice versa, or wherein a first set (21) of a first door (31) and a second door (32) comprises an entrance zone and a second set (22) of a first door (31) and a second door (32) comprises an exit zone.

6. The passenger transportation means (10) according to any of the preceding claims, wherein the first door (31) and/or the second door (32) each has two lanes, and in particular the first door (31) and/or the second door (32) each has a passage width (pw) of 1300 mm.

7. The passenger transportation means (10) according to any of the preceding claims, wherein the first door (31) and/or the second door (32) each has three lanes, and in particular the first door (31) and/or the second door (32) each has a passage width (pw) of 1600 mm.

8. The passenger transportation means (10) according to either of claims 6 or 7, wherein a vestibule (50) of the passenger transportation means (10) extends along the passage widths (pw) of the first door (31) and the second door (32), including a space (51) between the first door (31) and the second door (32) corresponding to at least the width (w) of the second door leaf (42) of the second door (32).

9. The passenger transportation means (10) according to any of the preceding claims, wherein the passenger transportation means (10) is a rail vehicle.

10. A method for controlling doors (31, 32) of a passenger transportation means (10) according to either of claims 1 to 9, **characterized in that** at least one first door (31) and/or at least one second door (32) is opened at a station depending on passenger numbers in the passenger transportation means and at a station.

11. The method according to claim 10, wherein a first set (21) of a first door (31) and a second door (32) is opened first to allow passengers to leave the passenger transportation means (10), and the opening of a second set (22) of a first door (31) and a second door (32) is delayed to allow passengers to enter the passenger transportation means (10) later.

12. The method according to claim 10, wherein a set (21, 22) of a first door (31) and a second door (32) is opened at once, in particular at a first station of a passenger transportation means run or if the station is less crowded than the passenger transportation means (10).

13. The method according to any of claims 10 to 12, wherein color indicators for each first door (31) and each second door (32) indicate which one of the first door (31) and the second door (32) is an entrance door and which one of the first door (31) and the second door (32) is an exit door.

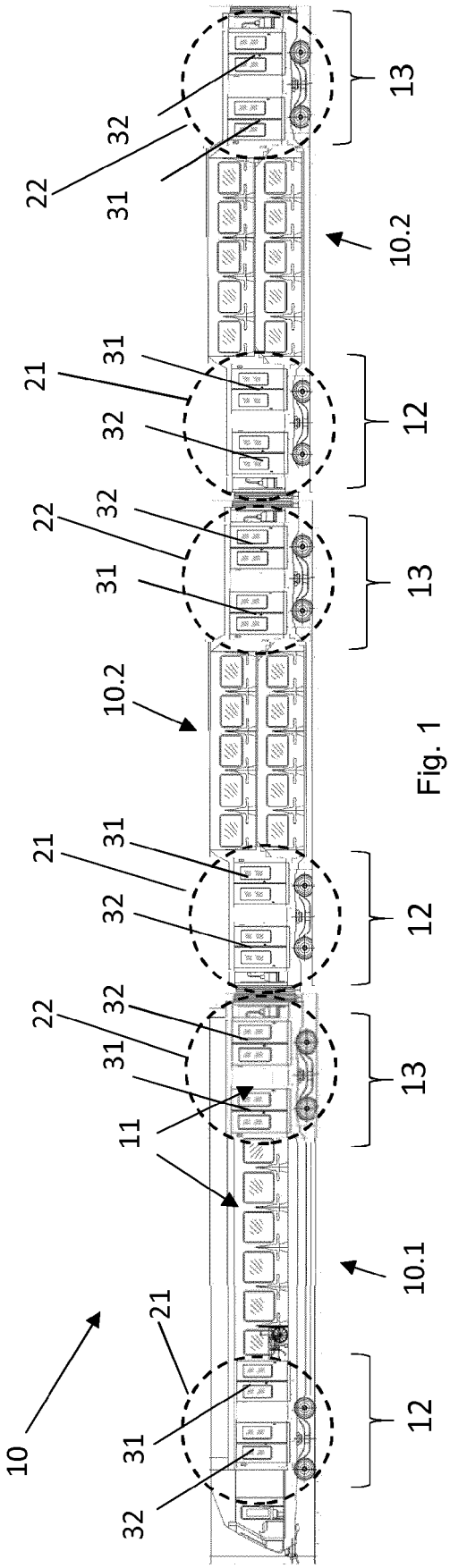


Fig. 1

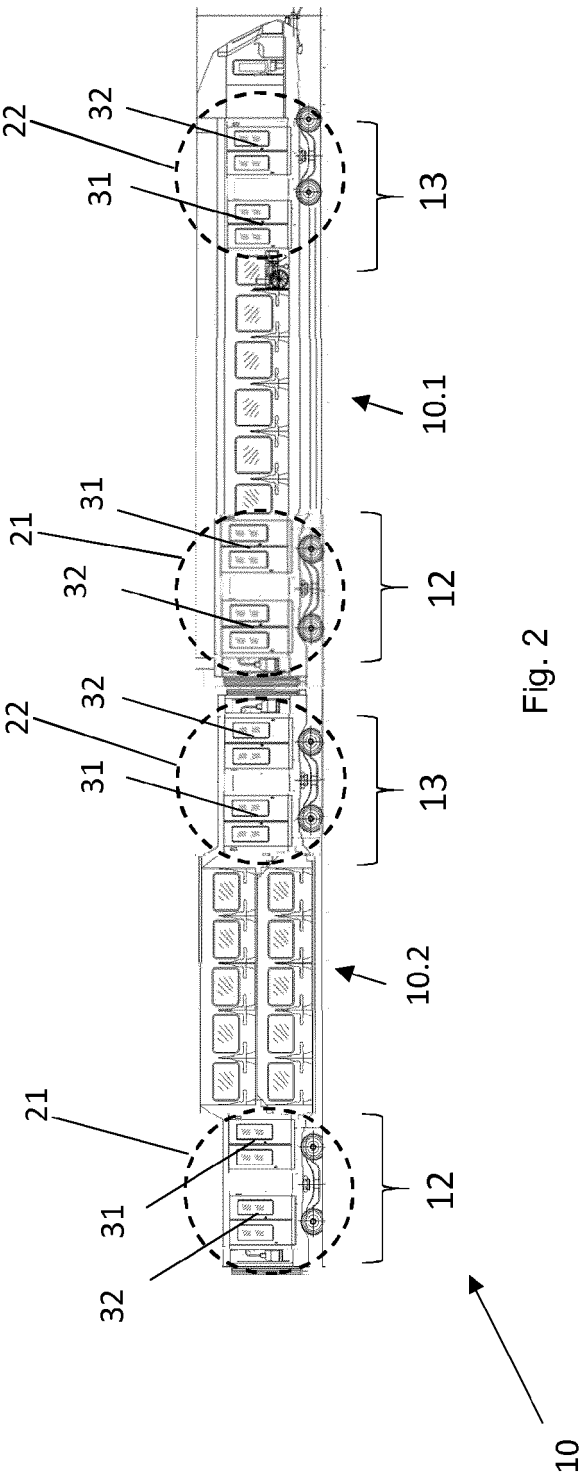
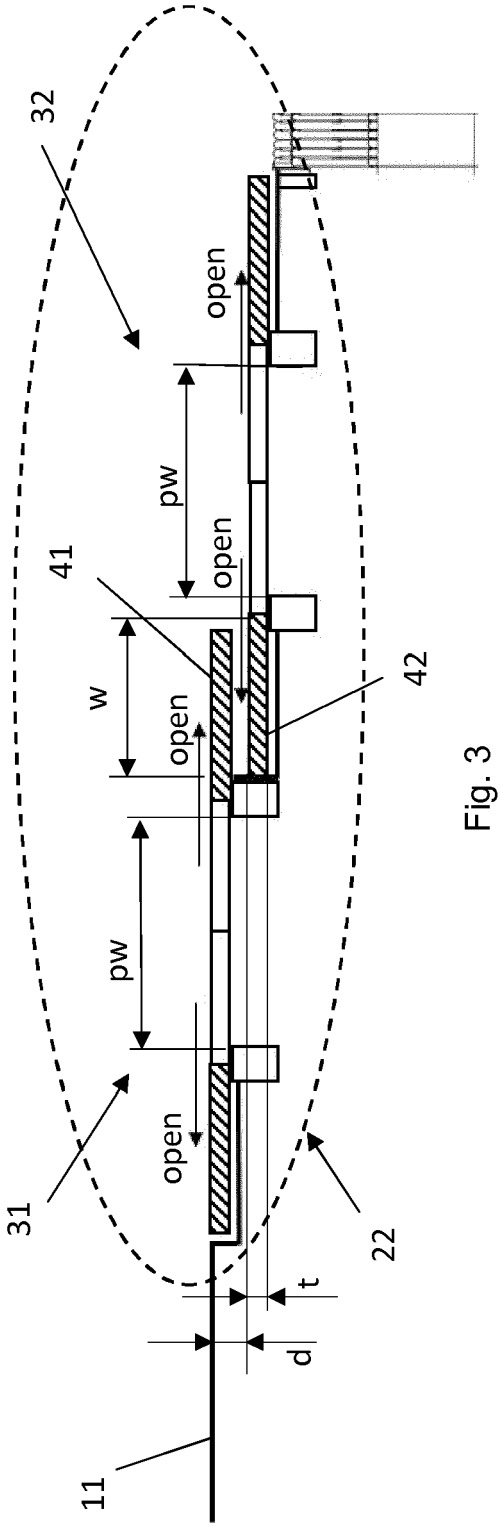


Fig. 2


32
open
pw
open
41
w
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42
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open
31
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11

Fig. 3

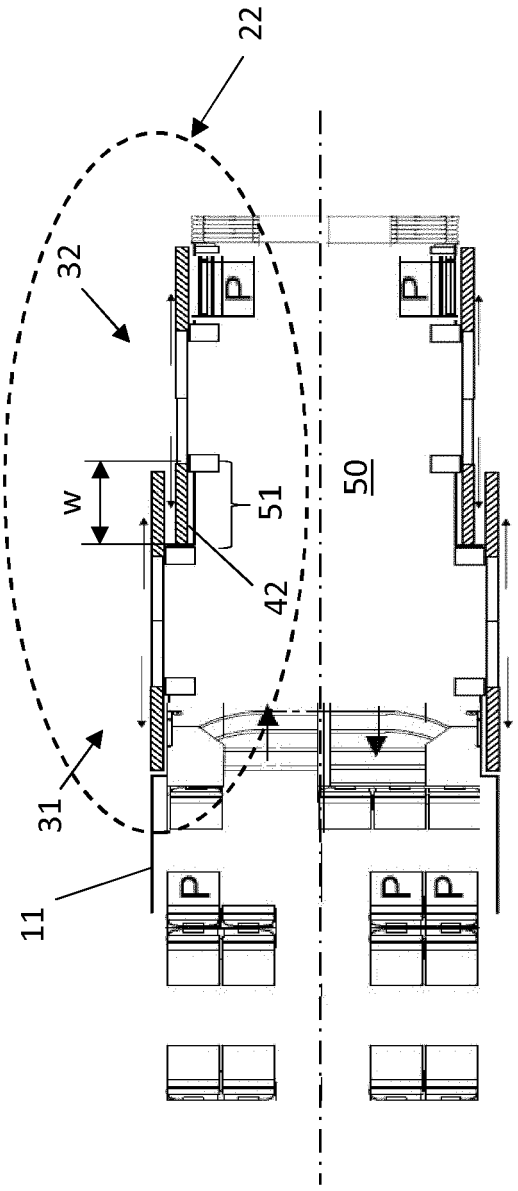
22
32
P
P
w
51
50
42
31
11
P
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Fig. 4

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EUROPEAN SEARCH REPORT

Application Number
EP 19 19 9339

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	Anonymous: "Motrice P.C.C (type 1969)", , 1 January 1969 (1969-01-01), XP055678457, Retrieved from the Internet: URL:https://web.archive.org/web/20190802205454/http://www.marseille-transports.com/materiel/PCC1969.jpg [retrieved on 2020-03-20] * the whole document *	1-13	INV. B61D19/02 B61D17/08 B61D19/00
A	US 947 520 A (PUTNAM HENRY S [US]) 25 January 1910 (1910-01-25) * figures 1-6 *	5	
A	JP 2018 083624 A (MASUYAMA SHIZUO) 31 May 2018 (2018-05-31) * figures 1, 3 *	1-4	

TECHNICAL FIELDS SEARCHED (IPC)

B61D

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	23 March 2020	Crama, Yves

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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23-03-2020

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 947520 A	25-01-1910	NONE	
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For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

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Patent documents cited in the description

- EP 2634063 B1 **[0003]**