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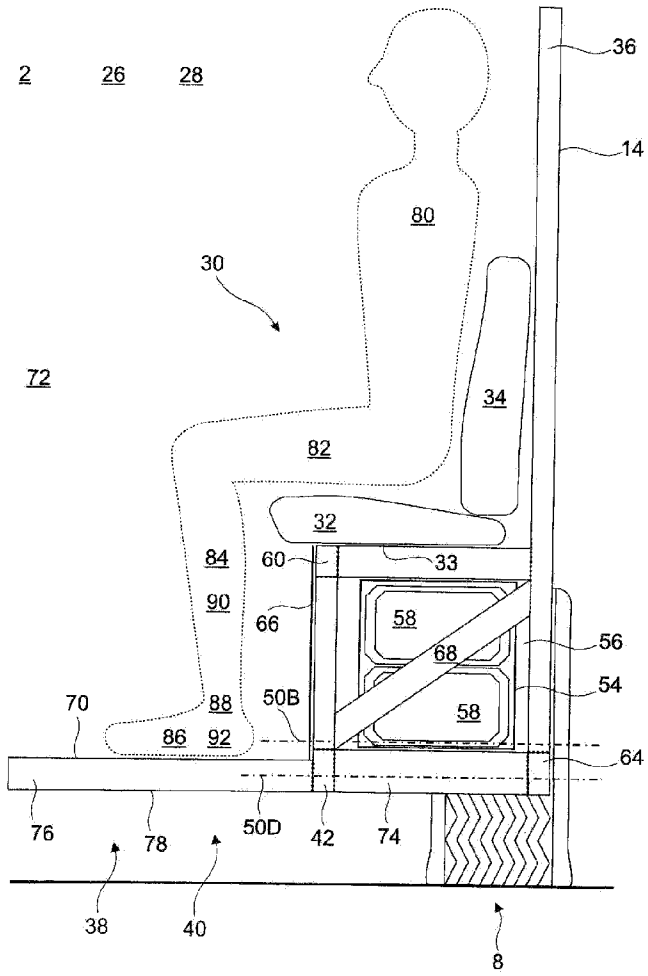
(54) **ELECTRIC BUS SEAT AND ELECTRIC BATTERY ARRANGEMENT.**

(57) The invention proposes an electric bus (2) exhibiting a seat arrangement. The invention provides an electric bus including: a side wall (14), a wheel (8) with an electric engine (52) disposed in the rim, a seat (30) with a seat base (32) and a leg area (88) which is below the seat base (32) and vertically level with the wheel (8); and electric energy storing means (54) powering the electric engine of the wheel (8) and arranged transversally between the side wall and the leg area (88) of the seat.



ELECTRIC BUS SEAT AND ELECTRIC BATTERY ARRANGEMENT

Technical field

The invention lies in the field of electric buses. More precisely, the invention concerns a seat arrangement within the passenger compartment of an autonomous electric bus. The invention considers the passenger safety of an electric bus.

Background of the invention

An electric bus provides a solution to pollution in cities. It permits to transport passengers without fine particles emissions or carbon dioxide emissions. Its silent engines increase the passengers' comfort and do not produce noise in the environment.

Such an electric bus generally exhibits a seating capacity of about fifty places, and about fifty standing places. More than one hundred places have to be foreseen in the passenger compartment while taking due care of the electric batteries that power the driving wheels. The positioning of the electric battery must also respect compacity requirements in order to maintain a reduced radius of turning curvature. The centre of gravity is also a design constraint.

In order to improve the passenger compartment accessibility, the electric bus exhibits a low platform which remains at the bus dock platform level during passenger boarding. This aspect notably eases the rolling chair entrance. However, during driving conditions the electric bus may be collided by another vehicle. More precisely, a long articulated electric bus may experience a side collision wherein the other vehicle strikes its side wall. Here, the front bumper of the other vehicle intrudes in the passenger compartment, which represents a danger for standing passengers and for sitting passengers.

Technical problem to be solved

It is an objective of the invention to present an electric bus which overcomes at least some of the disadvantages of the prior art. In particular, it is an objective of the invention to improve the passenger safety in an electric bus. More precisely, the invention intends to increase the passenger protection against side collision from other vehicles.

Summary of the invention

The invention has for object an electric bus including: a side wall, a wheel, an electric engine coupled to the wheel in order to drive the electric bus, a seat with a seat base and a leg area which is below the seat base and vertically level with the wheel; and electric energy storing means powering the electric engine and arranged between, notably transversally, the side wall and the leg area of the seat.

Preferably, the electric bus includes a low platform with a top surface, a passenger compartment with a longitudinal passageway; and the wheel includes a rotation axis.

Preferably, the wheel is vertically mobile between at least a driving position in which the rotation axis of the wheel is below the top surface, and a boarding position in which the rotation axis of the wheel is above the top surface of the low platform.

Preferably, the low platform includes a low platform structure bellow the electric energy storing means.

Preferably, the low platform includes a top surface projecting longitudinally along the whole length of the side wall, or the majority of the length of the side wall.

Preferably, the top surface is a planar top surface.

Preferably, the electric bus exhibits a rectangular floor, the electric energy storing means are disposed at a corner of the rectangular floor, preferably the electric bus includes electric energy storing means at each corner of the rectangular floor.

Preferably, the wheel includes a hub and a rim, the top surface being vertically level with the hub and/or with the rim, and the electric engine is disposed in the wheel notably in the rim.

Preferably, the electric bus includes a suspension system to which the wheel is mounted, said suspension system being vertically level the electric energy storing means.

Preferably, the rotation axis is vertically level with the electric energy storing means, notably in a boarding configuration, and/or vertically distant from the electric energy storing means during a driving configuration.

Preferably, the seat base is over the electric energy storing means.

Preferably, the seat includes a backrest parallel to the side wall.

Preferably, the seat is a first seat, the electric bus includes a longitudinal row of seats to which the first seat belongs.

Preferably, the electric bus includes a recess in which the electric energy storing means are disposed, and the side wall preferably includes a flap delimiting the recess.

Preferably, the electric bus includes an inclined bar delimiting the recess, the inclined bar projecting preferably vertically and transversally.

Preferably, the inclined bar is disposed below the seat, or the longitudinal row of seats respectively.

Preferably, the electric bus includes a wheel housing in which the wheel is disposed, said wheel housing delimiting longitudinally the recess.

Preferably, the seat base projects transversally over a majority of the width of the electric energy storing means.

Preferably, the electric bus includes a longitudinal upper beam to which the electric energy storing means and the seat are fixed.

Preferably, the longitudinal upper beam vertically separates the seat from the electric energy storing means.

Preferably, the low platform includes at least one lower longitudinal beam below the electric energy storing means, notably an inner lower longitudinal beam and/or an outer lower longitudinal beam which partially forms the side wall.

Preferably, the electric energy storing means include at least forty modules, the modules forming vertical or longitudinal rows.

Preferably, the electric energy storing means are a first electric energy storing means adjacent to the side wall, and the electric bus includes second electric energy storing means adjacent the side wall; the wheel being disposed between the first electric energy storing means and the second electric energy storing means.

Preferably, the seat base touches and/or overlaps transversally the leg area.

Preferably, the electric energy storing means are disposed transversally between the side wall and the passenger compartment, and/or the longitudinal passageway.

Preferably, the electric energy storing means are vertically thicker than the low platform.

Preferably, the electric bus includes a body or a unit, the low platform extending along the whole length of the body or unit.

Preferably, the flat surface and/or the top surface is adjacent and/or longitudinally level with the seat.

Preferably, the flat surface and/or the top surface projects transversally along the majority of the width of the electric bus.

Preferably, the whole electric energy storing means of the electric bus have a capacity of at least 500 kW.h.

Preferably, the electric bus includes a roof free of electric battery and/or of power accumulator.

Preferably, the wheel includes a rim and a hub, the rim and/or the hub being vertically level with the electric energy storing means.

Preferably, the backrest is fixed to the side wall.

Preferably, the low platform is a passenger low platform.

Preferably, the recess is adjacent to the wheel housing.

Preferably, the low platform includes a central beam including a smaller cross section than the lower longitudinal beam.

Preferably, the electric energy storing means separate transversally the leg area from the side wall.

Preferably, the electric bus includes a vertical plate separating transversally the leg area from the electric energy storing means and/or from the side wall.

Preferably, the vertical plate delimits the recess.

Preferably, the electric bus includes a lower half and an upper half, at least one, or a majority, or all the electric energy storing means being enclosed in said lower half.

Preferably, the electric energy storing means project transversally over a majority of the seat base.

Preferably, the seat, notably the longitudinal row of seats, is longitudinally level with the low platform, preferably level with the top surface.

Preferably, the seat(s) is/are (a) transversal seat(s).

Preferably, the ground clearance of the electric bus ranges from the half of the radius of the wheel to the radius of the wheel.

The leg area is not an essential aspect of the invention. The low platform is not an essential aspect of the invention. The electric engine is not necessarily in the wheel.

It is another object of the invention to provide an electric bus including:

a wheel coupled to an electric engine,

a low platform vertically level with the wheel, said low platform being notably adapted for standing passengers,

a longitudinal row of seats

electric energy storing means powering the electric engine, said electric energy storing means being disposed between the low platform and the longitudinal row of seats.

It is another object of the invention to provide an electric bus including:

a wheel housing,

a side wall delimiting the wheel housing,

a low platform vertically level with the wheel housing,

electric energy storing means disposed above the low platform,

a longitudinal row of seats with at least one seat over the electric energy storing means, and/or a seat astride the wheel housing and the electric energy storing means.

It is another object of the invention to provide an electric bus including:

a planar low platform notably adapted for standing passengers,

a passenger compartment on the planar low platform,

electric energy storing means arranged above the planar low platform,

a longitudinal row of seats projecting along the whole length of the electric energy storing means,

a wheel with a rotation axis vertically level with the passenger compartment and the electric energy storing means.

It is another object of the invention to provide an electric bus including:

a low platform with a top surface,

an electric engine,

a wheel with and a rotation axis over the top surface, said wheel being notably coupled to the electric engine,

a seat with a seat base which exhibits a lower surface vertically distant from the top surface, and

electric energy storing means arranged vertically between the top surface of the low platform and the lower surface of the seat base, and/or, the rotation axis is disposed vertically between the lower surface of a seat and the top surface of the low platform.

It is another object of the invention to provide an electric bus including:

a seat,

a recess with electric energy storing means,

a wheel housing with a wheel comprising an electric engine electrically connected to the electric energy storing means,

an inclined bar below the seat and forming an interface between the wheel housing and the recess.

The different objects of the invention may be combined to each other. In addition, the preferable options of each object of the invention may be combined with the other objects of the invention, unless the contrary is explicitly mentioned.

Technical advantages and effects of the invention

The present invention provides an electric bus architecture in which the electric energy storing means are involved in side collision safety. Indeed, the electric energy storing means form a safety block behind the side wall. There, their strength is used to protect the passengers, and notably their legs. More precisely, the legs and the backs of passengers sitting against the side wall are more protected. When the electric energy storing means are disposed at corners of the platform, they also provide protection against corner collisions, and substantially a protection against rear collisions from other vehicles.

The solid aspect of the electric energy storing means adds another barrier against physical intrusion. Moreover, the electric energy storing means are fixed to the structure of the electric bus. Since they are fixed to the beam(s) to which the wheels are fixed, the electric energy storing means benefit from a robust anchorage.

In the context of a collision with a personal car, the front bumper is generally at the low platform level, and/or at the electric energy storing means level. Consequently, during a side collision the front bumper intrusion is blocked or reduced. In addition, the supporting structure and the brackets enabling the electric energy storing means fixation increase the collision energy absorption potential.

Brief description of the drawings

Several embodiments of the present invention are illustrated by way of figures, which do not limit the scope of the invention, wherein

- figure 1 provides a schematic illustration of a side view of an electric bus in accordance with a preferred embodiment of the invention;
- figure 2 provides a schematic illustration of a transversal view of an electric bus seat arrangement in accordance with a preferred embodiment of the invention;
- figure 3 provides a schematic illustration of a longitudinal view of an electric bus seat arrangement in accordance with a preferred embodiment of the invention;
- figure 4 provides a schematic illustration of an aerial view of an electric bus seat arrangement in accordance with a preferred embodiment of the invention.

Detailed description of the invention

This section describes the invention in further detail based on preferred embodiments and on the figures. Similar reference numbers will be used to describe similar or the same concepts throughout different embodiments of the invention.

It should be noted that features described for a specific embodiment described herein may be combined with the features of other embodiments unless the contrary is explicitly mentioned.

Features commonly known in the art will not be explicitly mentioned for the sake of focusing on the features that are specific to the invention. For example, the electric bus in accordance with the invention is evidently equipped with a computer, even though such computer is not explicitly referenced on the figures nor referenced in the description.

In the following description, the word "longitudinal" may correspond to the main elongation of the electric bus, and/or to the main driving direction of the electric bus. It may correspond to a central direction that projects along all the units of the electric bus. The transversal direction is perpendicular to the longitudinal direction of the electric bus. The word "inner" and "outer" are considered transversally. The word "outer" is directed toward the electric bus environment.

Figure 1 shows a vehicle for mass transportation. The vehicle is adapted for transportation of passengers in cities and may transport about one hundred passengers, for instance one hundred and twenty passengers. The vehicle may be a bus, notably an electric bus 2. An electric bus 2 is understood as a bus using electric power for its driving engine(s), preferably exclusively electric energy. Hence, the electric bus 2 may be free of combustion engine.

The electric bus 2 may be an articulated bus. It may comprise a first unit 4 and a second unit 4 (partially represented). Each unit 4 may be a trailer and/or a tractor. Each unit 4 may be self-

supporting. These units 4 may be joined by a connection, for instance a hinged connection 6 enabling the units 4 to swivel with respect to each other. In the current illustrative example, only two units 4 are represented, however it is contemplated in the current invention that the electric bus 2 includes three, four, or more units 4. An electric bus with a single unit is also foreseeable.

Each unit 4 includes one or several axles. Each axle includes wheels 8 engaging the ground. The wheels 8 may be driving wheels. At least one or each wheel 8 may be linked to the corresponding unit 4 by a suspension system (not represented in the current figure).

One or several or to each wheel 8 may be dotted with an electric engine (not represented in the current figure). These electric engines permit to rotate the wheels 8 on themselves in order to drive, to propel, the electric bus 2.

At least one or each unit 4 may include doors 10. The doors 10 may be arranged between side windows 12. The doors 10 provide an access to the passengers.

Each unit 4 may include side walls 14, notably two side walls 14 (only one per unit is apparent). These side wall 14 may be transversally opposed. The side walls 14 may form the outer surface of the corresponding unit 4, and thus of the electric bus 2. The side walls 14 may receive the doors 10 and/or the side windows 12. One side wall may be free of door, and/or of side window. The side window(s) may be replaced by equipment. The side walls 14 may be part of the structure of the units 4.

The side walls 14 may receive flaps 16. The flaps 16 may be moved between an open and a closed position. The flaps 16 may open on electric energy storing means (not represented), for instance electric batteries. The latter may be enclosed in recess (not represented) which are actually closed by the flaps 16. The electric energy storing means render the electric bus 2 electrically autonomous. Thus; the electric bus 2 may dispense from catenary and overhead lines.

The side walls 14 may delimit wheel housings 18. Each wheel housing 18 may receive at least one wheel 8, or at least two wheels 8 which are longitudinally offset, preferably longitudinally distant. At least one or each wheel housing 18 may comprise a housing arch forming a part of the contour of the corresponding side wall 14.

The vehicle 2 exhibit a roof 20. The roof 20 may join two transversally opposite side walls 14. The roof 20 may receive equipment, for instance an air conditioning device 22, or other devices. The roof 20 may be free of energy storing means, preferably free of electric energy storing means. Preferably, a majority the electric energy storing means are gathered in the lower half of the electric bus 2. Then, the centre of gravity is lowered, and the risk of tilting the electric bus in the event of a side collision are reduced. The electric bus 2, and notably the units 4, include longitudinal ends 24. The electric energy storing means may be arranged at the longitudinal ends 24.

The side walls 14 may define the passenger compartment between them. The passenger compartment is adapted for standing passenger, and for sitting passenger as well. For this purpose, the electric bus exhibits a seat arrangement within the passenger compartment.

Figure 2 shows a passenger compartment 26 with a seat arrangement 28 of an electric bus, notably a portion of a unit. The unit as the electric bus may be identical or similar to the ones as described in relation with figure 1. Figure 2 represents a sectional view of the passenger compartment 26 along a vertical and longitudinal plane.

The seat arrangement 28 may comprise at least one row of seats 30. The longitudinal row may be a longitudinal row in that the seats 30 are longitudinally in contact of each other, or longitudinally side by side. Longitudinally, the seats 30 may be regularly spaced from each other. The seats 30 may be identical and/or may form a longitudinal alignment. Each seat 30 may include a seat base 34 and notably a backrest 34 in elevation with respect to the corresponding seat base 32. The seat bases 34 may be horizontal.

The backrest 34 may face the longitudinal centreline of the bus, or of the unit respectively. Thus, the seats 30 may be transversal seats where passenger look in the transversal direction. Each seat 30 may present a lower surface 33, notably under the seat base 32.

In spite a single row is represented, two opposite seat rows may be considered. There, the backrests 34 may face each other transversally. In the represented longitudinal row, three seats 30 are apparent, however the invention contemplates other number of seats pro row. For instance, three seats 30 may be associated to each wheel 8, which means that the unit may comprise twenty-four seats, and the electric bus may include forty-eight seats 30. Then, each longitudinal row may include at least: six, or twelve, or twenty-four seats 30. The longitudinal row of seats 30 may extend up to a longitudinal end 24. The latter may be formed by a vertical post 36.

A low platform 40 may delimit the passenger compartment 26. The low platform 40 may be joined to the side walls. The low platform 40 may be flat, and/or planar. It may comprise a single planar top surface projecting along the majority of the length of the passenger compartment 26, or along the whole length. It may project from one longitudinal end 24 to a longitudinally opposite longitudinal end 24 of a unit.

The low platform 40 may comprise a low platform structure 38. The low platform structure 38 may be formed of beams, notably longitudinal beams and transversal beams which are interconnected. The low platform structure 38 may form a grid, notably a single layer grid. The beams may be tubular beams, for instance of rectangular cross section. The beams may be joined by welding or gluing. Thus, the beams may form a one-piece element. The beams may be formed of aluminium, polymer composite materials enriched with carbon fibres are considered too in order to reduce the overall weight.

The low platform 40, and thus the low platform structure 38, may comprise a lower longitudinal beam 42. The lower longitudinal beam 42 may extend on the majority or the whole vertical thickness of the low platform 40. It may face the ground. It may project longitudinally along the majority of the unit.

The wheel 8 may be inflatable. Thus, it may flatten against the ground due to the weight of the electric bus. The wheel 8 may comprise a hub 44, a rim 46 and a tire 48. Its rotation axis 50 is represented. The rotation axis 50 may be arranged transversally.

The rotation axis 50 may be above the lower longitudinal beam 42. The wheel 8 is equipped with an electric engine 52 in order to propel the electric bus. It may be coaxially mounted to the wheel 8. It may be disposed within the rim 46, and may engage the hub 44. Thus, the electric engine may share the rotation axis 50 of the wheel 8.

Electric energy storing means 54 may power the electric engine 52. The electric energy storing means 54 may be located in the recess 56. It may be an electric battery pack, for instance of LiMn2O4 with LiNiO2. It may include several modules 58. The modules 58 may define two longitudinal rows or alignments. Alternatively, the modules may form vertical stacks. The electric energy storing means 54, for instance in a battery pack contained in one recess 56 may count at least forty modules 54.

The electric energy storing means 54, and notably each module 58, may be disposed on the low platform 40, preferably above the lower longitudinal beam 42. The wheel 8 may be fixed to said lower longitudinal beam 42. The electric energy storing means 54 may be vertically thicker than the low platform 40, and/or may be placed thereon.

The electric energy storing means 54, and notably each module 58, may be disposed under the seats 30, preferably under the seat bases 32, and/or under the lower surface 33. In addition, the recess 56 may be disposed under the seats 30. Thus, the seats 30 may cover and/or hide the electric energy storing means 54. An upper longitudinal beam 60 may form the interface between the seats 30 and the electric energy storing means 54. The upper longitudinal beam 60 may form a fixation support receiving the seat bases 32 and the modules 58.

The upper longitudinal beam 60 may extend along the recess 56 and the wheel housing 18. A vertical bar 62 may form the interface between the recess 56 and the wheel housing 18. The vertical bar 62 may be beneath the seats 30, notably beneath the seat bases 32.

The recess 56 may be longitudinally longer than a seat, and/or may extend along at least two seats 30. The recess 56 may be defined by the upper longitudinal beam 60, the lower longitudinal beam 42, the vertical bar 62, the vertical post 36. These bar 62, post 36 and beams (60; 42) form and straighten the recess 56, and may form a protecting cage around the electric energy storing means 54.

Figure 3 provides a schematic illustration of a seat arrangement 28. The seat arrangement 28 may be similar the to one as described in the preceding figure. The current illustration may be a longitudinal view of the seat arrangement 28.

Optionally, only a half of the seat arrangement 28 is represented, the other half may be deduced by a transversal symmetry. Thus, the electric bus may comprise several electric energy storing means 54 at each side, or at each side wall 14. The side wall 14 may be adjacent to the electric energy storing means 54, and may delimit transversally the recess 56.

As apparent in the current figure, the electric energy storing means 54 may from two stacked alignments of modules 58. The electric energy storing means 54 may be transversally and/or vertically level with the wheel 8.

The electric energy storing means 54 may be transversally and/or longitudinally level with the seat 30, notably the seat base 32. The seat 30 may project along the whole transversal width of the electric energy storing means 54, notably by means of the seat base 32 and of the backrest 34. The latter may be parallel to the side wall 14, and may be fixed thereon.

As it may be deduced from a combination of figure 2 and 3, the recess 56 may exhibit a hexahedral shape. The upper longitudinal beam 60 may be separate and/or distant from the side wall 14. In addition, the lower longitudinal beam 42 as previously described may be a first lower longitudinal beam or an inner lower longitudinal beam. In addition, the low platform 40, and thus the low platform structure 38, may comprise an outer lower longitudinal beam 64. The former may form the side wall 14. These lower longitudinal beams (42; 64) may delimit the recess 56. A vertical plate 66 may close the recess 56, and isolate it from the passenger compartment 26. Other plates or fitting may be added in order to delimit the passenger compartment 26 from the environment and/or from the recess 56.

The recess 56 may include an inclined bar 68. The inclined bar 68 may extend vertically and transversally. Its inclination with a horizontal plane may range between 30° and 60°, values included. The inclined bar 68 may face the electric energy storing means 54. It may project from the side wall 14, for instance from the vertical post 36, toward the lower longitudinal beam 42, notably the inner lower longitudinal beam. The inclined bar 68 may project down to the low platform 40, and may be in contact of the former. Thus, in the event of a side collision toward the electric energy storing means 54 the collision energy is transferred to the low platform 40 by the inclined bar 68. Another inclined bar may be provided at the interface between the recess 56 and the wheel housing.

The low platform 40 may comprise a top surface 70 which delimits the passenger compartment 26. The top surface 70 may be a planar surface. It may be flat, which means without step, in order to keep rolling chair access. It may start at the doors, for instance through the longitudinal row of seats 30. The top surface 70 may project transversally on the majority of the electric bus 2, for instance from a seat 30 to the transversally opposite seat (not represented). The top surface 70 may

form the floor of a longitudinal passage 72. The longitudinal passage 72 may extend along the whole unit, or the whole electric bus 2. The longitudinal passage 72 may join each seat 30 of the electric bus 2.

The low platform 40 may comprise beams of different thicknesses, notably different vertical thicknesses. For instance, an outer transversal beam 74 forming the recess 56 may be thicker than an inner transversal beam 76 under the longitudinal passage 72, preferably vertically thicker. The same may apply to longitudinal beams of the low platform 40. Thus, the recess 56 may form a side stringer of the electric bus 2.

The suspension system of the wheel 8 may include an actuator (not represented). The actuator permits to move vertically the wheel 8 with respect to the low platform 40. Consequently, the electric bus may be lifted, or tilted about a longitudinal axis. This permits to keep a ground clearance in a driving configuration, and to supress a vertical gap with a bus platform in a boarding configuration (currently represented). The respective positions of the wheel 8 are represented through its rotation axis 50B in a boarding configuration, and through a fictional rotation axis 50D in the driving configuration. These positions may be defined when the electric bus is on a planar ground. The ground clearance may be smaller than the radius of the wheels 8, and or represent at least 25% of the diameter of the wheels 8.

It may be noted that in the boarding configuration, the rotation axis 50B is above the low platform 40. It may be above the top surface 70. It may be vertically level with the electric energy storing means 54. Then, access to the passenger compartment remains easy. In the driving configuration, the rotation axis 50D may be vertically level the low platform 40, or more generally above the sub surface 78 of the low platform 40. Then, in the driving configuration the passenger compartment remains low, and the overall height of the electric bus 2 may be reduced.

A passenger 80 is represented seated on the seat 30. The passenger 80 comprises legs with femurs 82 on the seat base 32, tibias 84, and feet 86 on the low platform 40. It is defined that the seat 30 includes a leg area 88. The leg area 88 may comprise a tibia area 90 and a foot area 92 receiving respectively the tibias 84 and the feet 86 of the passenger 80. The leg area 88 may be vertically between the low platform 40 and the seat base 32. More generally, the leg area 88 is not limited to real or theorical legs. It may be vertically between the lower surface 33 and the top surface 70.

In the boarding configuration, and possibly in the driving configuration, the rotation axes (50B; 50D) may be vertically level with the leg area 88, for instance vertically level with the tibia area 90 and/or the foot area 92. These areas (88-92) may be vertically level with the electric energy storing means 54. Therefore, in the event of a side collision, the legs of the passenger 80 are protected by the electric energy storing means 54. More specifically, the tibias 84 are hidden by the electric energy storing means 54 with regard to a side collision. By the way, the passenger whole body may benefit from this safety. Injuries to passenger backs are also limited by the blocking effect provided by the electric energy storing means 54.

Figure 4 provides a schematic illustration of a seat arrangement 28. The seat arrangement 28 may be similar to the ones as described in the preceding figures. The current illustration is a top view of the seat arrangement 28. The side wall 14, the longitudinal end 24, the upper longitudinal beam 60, the longitudinal passage 72 and the inner transversal beam 76 are referenced.

The wheel 8 with its electric engine 52 are represented at distance from the electric energy storing means 54, and from the corresponding recess 56. A transversal bar 94 may be part of the interface between the wheel housing 18 and the recess 56. The transversal bar 94 projects from the side wall 14 to the upper longitudinal beam 60 in order to provide side collision strength.

The vertical post 36 may form a corner 96 of the electric bus 2. The electric energy storing means 54 may be disposed at this corner 96 in order to provide corner protection. The low platform 40, and notably the floor formed thereon, may exhibit a rectangular shape. Optionally, the electric bus includes electric energy storing means 54 at each corner 96.

The leg areas 88 of the seats 30 may be within the longitudinal passage 72, and inward with respect to the seat bases 32 (in doted lines). The seat bases 32 may cover their respective leg areas 88. The leg areas 88 may be separated from the side wall 14 by the recess 56 and the electric energy storing means 54, notably by the upper longitudinal beam 60. The leg areas 88 may be longitudinally distant from one another. Each of them may be associated to a single seat 30.

The suspension system 98 of the wheel 8 is longitudinally distant from the electric energy storing means 54. It may be transversally level with the electric energy storing means 54. It may be vertically level with the electric energy storing means 54, for instance in the boarding and/or in the driving configuration.

Since the wheel may be fixed to the beams (42; 60), the latter have to be reinforced in order to support the electric bus 2. Since these beams (42; 60) receive the electric energy storing means 54 and/or form the recess 56, the combination of the electric energy storing means 54 and the beams is even more robust.

The embodiments of figures 2 to 4 may be isolated from one another. It is also considered to combine the teachings of figures 2 to 4, and optionally with the teaching of figure 1.

In figures 2 to 4, only a portion of electric bus is represented. The whole bus may be obtained by one or two symmetries.

It should be understood that the detailed description of specific preferred embodiments is given by way of illustration only, since various changes and modifications within the scope of the invention will be apparent to the person skilled in the art. The scope of protection is defined by the following set of claims.

Claims

1. Electric bus (2) including:
   - a side wall (14),
   - a wheel (8)
   - an electric engine (52) coupled to the wheel (8) in order to drive the electric bus (2),
   - a seat (30) with a seat base (32) and a leg area (88) which is below the seat base (32) and vertically level with the wheel (8); and
   - electric energy storing means (54) powering the electric engine (52) and arranged between the side wall (14) and the leg area (88) of the seat (30).

2. The electric bus (2) according to claim 1, wherein the electric bus (2) includes a low platform (40) with a top surface (70), a passenger compartment (26) with a longitudinal passageway (72); and the wheel (8) includes a rotation axis (50).

3. The electric bus (2) according to claim 2, wherein the wheel (8) is vertically mobile between at least a driving position in which the rotation axis (50D) of the wheel (8) is below the top surface (70), and a boarding position in which the rotation axis (50B) of the wheel (8) is above the top surface (70) of the low platform (40).

4. The electric bus (2) according to any of claims 2 to 3, wherein the wheel includes a hub (44) and a rim (46), the top surface (70) being vertically level with the hub (44) and with rim (46), and the electric engine (52) is disposed in the wheel (8) notably in the rim (46).

5. The electric bus (2) according to any of claims 2 to 4, wherein top surface (70) projects longitudinally along the whole length of the side wall (14), or the majority of the length of the side wall (14).

6. The electric bus (2) according to any of claims 2 to 5, wherein the rotation axis (50) is vertically level with the electric energy storing means (54), notably in a boarding configuration and/or vertically distant from the electric energy storing means (54) during a driving configuration.

7. The electric bus (2) according to any of claims 1 to 6, wherein the electric bus (2) includes a recess (56) in which the electric energy storing means (54) are disposed, and the side wall (14) includes a flap (16) delimiting the recess (56).

8. The electric bus (2) according to claim 7, wherein electric bus (2) includes an inclined bar (68) delimiting the recess (56), the inclined bar (68) projecting vertically and transversally.

9. The electric bus (2) according to claim 8, wherein the inclined bar (68) is disposed under the seat (30), or the longitudinal row of seats (30) respectively.

10. The electric bus (2) according to any of claims 7 to 9, wherein the electric bus (2) includes a wheel housing (18) in which the wheel (8) is disposed, said wheel housing (18) delimiting longitudinally the recess (56).

11. The electric bus (2) according to any of claims 1 to 10, wherein the electric bus (2) includes a suspension system (98) to which the wheel (8) is mounted, said suspension system (98) being vertically level the electric energy storing means (54).

12. The electric bus (2) according to any of claims 1 to 11, wherein the low platform (40) includes a low platform structure (38) under the electric energy storing means (54).

13. The electric bus (2) according to any of claims 1 to 12, wherein the seat (30) is a first seat, the electric bus (2) includes a longitudinal row of seats (30) to which the first seat belongs.

14. The electric bus (2) according to any of claims 1 to 13, wherein the seat base (32) projects transversally over a majority of the width of the electric energy storing means (54).

15. The electric bus (2) according to any of claims 1 to 14, wherein the electric bus (2) includes a longitudinal upper beam (60) to which the electric energy storing means (54) and the seat (30) are fixed.

16. The electric bus (2) according to 15, wherein the longitudinal upper beam (60) vertically separates the seat (30) from the electric energy storing means (54).

17. The electric bus (2) according to any of claims 1 to 16, wherein the low platform (40) includes at least one lower longitudinal beam (42) below the electric energy storing means (54), notably an inner lower longitudinal beam, and an outer lower longitudinal beam (64) which partially forms the side wall (14).

18. The electric bus (2) according to any of claims 1 to 17, wherein the electric energy storing means (54) include at least forty modules (58), the modules (58) forming vertical or longitudinal row(s).

19. The electric bus (2) according to any of claims 1 to 18, wherein the electric bus (2) exhibits a rectangular floor, the electric energy storing means (54) are disposed at a corner (36) of the rectangular floor, preferably the electric bus (2) includes electric energy storing means (54) at each corner (36) of the rectangular floor.

20. The electric bus (2) according to any of claims 1 to 19, wherein the electric energy storing means (54) are a first electric energy storing means (54) adjacent to the side wall (14), and the electric bus (2) includes second electric energy storing means (54) adjacent to said side wall (14); the wheel (8) being disposed between the first electric energy storing means (54) and the second electric energy storing means (54).

P10065-LU traduction des revendications.

1. Bus électrique (2) comprenant :

• une paroi latérale (14),

• une roue (8),

• un moteur électrique (52) couplé à la roue (8) de manière à entraîner le bus électrique (2),

• un siège (30) avec une assise de siège (32) et une zone pour jambes (88) qui est située sous l'assise de siège (32) et verticalement au niveau de la roue (8) ; et

• des moyens de stockage d'énergie électrique (54) alimentant le moteur électrique (52) et disposés entre la paroi latérale (14) et la zone pour jambes (88) du siège (30).

2. Bus électrique (2) selon la revendication 1, caractérisé en ce que le bus électrique (2) comprend une plate-forme basse (40) avec une surface supérieure (70), un compartiment passager (26) avec un passage longitudinal (72) ; et la roue (8) comprend un axe de rotation (50).

3. Bus électrique (2) selon la revendication 2, caractérisé en ce que la roue (8) est mobile verticalement entre au moins une position de circulation dans laquelle l'axe de rotation (50D) de la roue (8) est situé sous la surface supérieure (70), et une position d'embarquement dans laquelle l'axe de rotation (50B) de la roue (8) est situé au-dessus de la surface supérieure (70) de la plate-forme basse (40).

4. Bus électrique (2) selon l'une quelconque des revendications 2 à 3, caractérisé en ce que la roue comprend un moyeu (44) et une jante (46), la surface supérieure (70) étant verticalement au niveau du moyeu (44) et de la jante (46), et le moteur électrique (52) est disposé dans la roue (8), notamment dans la jante (46).

5. Bus électrique (2) selon l'une quelconque des revendications 2 à 4, caractérisé en ce que la surface supérieure (70) s'étend longitudinalement sur toute la longueur de la paroi latérale (14), ou sur la majorité de la longueur de la paroi latérale (14).

6. Bus électrique (2) selon l'une quelconque des revendications 2 à 5, caractérisé en ce que l'axe de rotation (50) est verticalement au niveau des moyens de stockage d'énergie

électrique (54), notamment dans une configuration d'embarquement, et/ou verticalement à distance des moyens de stockage d'énergie électrique (54) en configuration de circulation.

7. Bus électrique (2) selon l'une quelconque des revendications 1 à 6, caractérisé en ce que le bus électrique (2) comprend un dégagement (56) dans lequel les moyens de stockage d'énergie électrique (54) sont disposés, et la paroi latérale (14) comprend un volet (16) délimitant le dégagement (56).

8. Bus électrique (2) selon la revendication 7, caractérisé en ce que le bus électrique (2) comprend une barre inclinée (68) délimitant le dégagement (56), la barre inclinée (68) s'étendant verticalement et transversalement.

9. Bus électrique (2) selon la revendication 8, caractérisé en ce que la barre inclinée (68) est disposée sous le siège (30) ou la rangée longitudinale de sièges (30) respectivement.

10. Bus électrique (2) selon l'une quelconque des revendications 7 à 9, caractérisé en ce que le bus électrique (2) comprend un passage de roue (18) dans lequel la roue (8) est disposée, ledit passage de roue (18) délimitant longitudinalement le dégagement (56).

11. Bus électrique (2) selon l'une quelconque des revendications 1 à 10, caractérisé en ce que le bus électrique (2) comprend un système de suspension (98) auquel la roue (8) est montée, ledit système de suspension (98) étant verticalement au niveau des moyens de stockage d'énergie électrique (54).

12. Bus électrique (2) selon l'une quelconque des revendications 1 à 11, caractérisé en ce que la plate-forme basse (40) comprend une structure de plate-forme basse (38) sous les moyens de stockage d'énergie électrique (54).

13. Bus électrique (2) selon l'une quelconque des revendications 1 à 12, caractérisé en ce que le siège (30) est un premier siège, le bus électrique (2) comprend une rangée longitudinale de sièges (30) à laquelle appartient le premier siège.

14. Bus électrique (2) selon l'une quelconque des revendications 1 à 13, caractérisé en ce que l'assise de siège (32) s'étend transversalement sur une majorité de la largeur des moyens de stockage d'énergie électrique (54).

15. Bus électrique (2) selon l'une quelconque des revendications 1 à 14, caractérisé en ce que le bus électrique (2) comprend une poutre longitudinale supérieure (60) à laquelle les moyens de stockage d'énergie électrique (54) et le siège (30) sont fixés.

16. Bus électrique (2) selon 15, caractérisé en ce que la poutre longitudinale supérieure (60) sépare verticalement le siège (30) des moyens de stockage d'énergie électrique (54).

17. Bus électrique (2) selon l'une quelconque des revendications 1 à 16, caractérisé en ce que la plate-forme basse (40) comprend au moins une poutre longitudinale inférieure (42) en dessous des moyens de stockage d'énergie électrique (54), notamment une poutre longitudinale inférieure interne, et une poutre longitudinale inférieure externe (64) qui forme partiellement la paroi latérale (14).

18. Bus électrique (2) selon l'une quelconque des revendications 1 à 17, caractérisé en ce que les moyens de stockage d'énergie électrique (54) comprennent au moins quarante modules (58), les modules (58) formant une ou plusieurs rangées verticales ou une ou plusieurs rangées longitudinales.

19. Bus électrique (2) selon l'une quelconque des revendications 1 à 18, caractérisé en ce que le bus électrique (2) présente un sol rectangulaire, les moyens de stockage d'énergie électrique (54) sont disposés dans un coin (36) du sol rectangulaire, préférentiellement le bus électrique (2) comprend des moyens de stockage d'énergie électrique (54) à chaque coin (36) du sol rectangulaire.

20. Bus électrique (2) selon l'une quelconque des revendications 1 à 19, caractérisé en ce que les moyens de stockage d'énergie électrique (54) sont des premiers moyen de stockage d'énergie électrique (54) adjacents à la paroi latérale (14), et le bus électrique (2) comprend des deuxièmes moyens de stockage d'énergie électrique (54) adjacents à ladite paroi latérale (14); la roue (8) étant disposée entre les premiers moyen de stockage d'énergie électrique (54) et les seconds moyen de stockage d'énergie électrique (54).

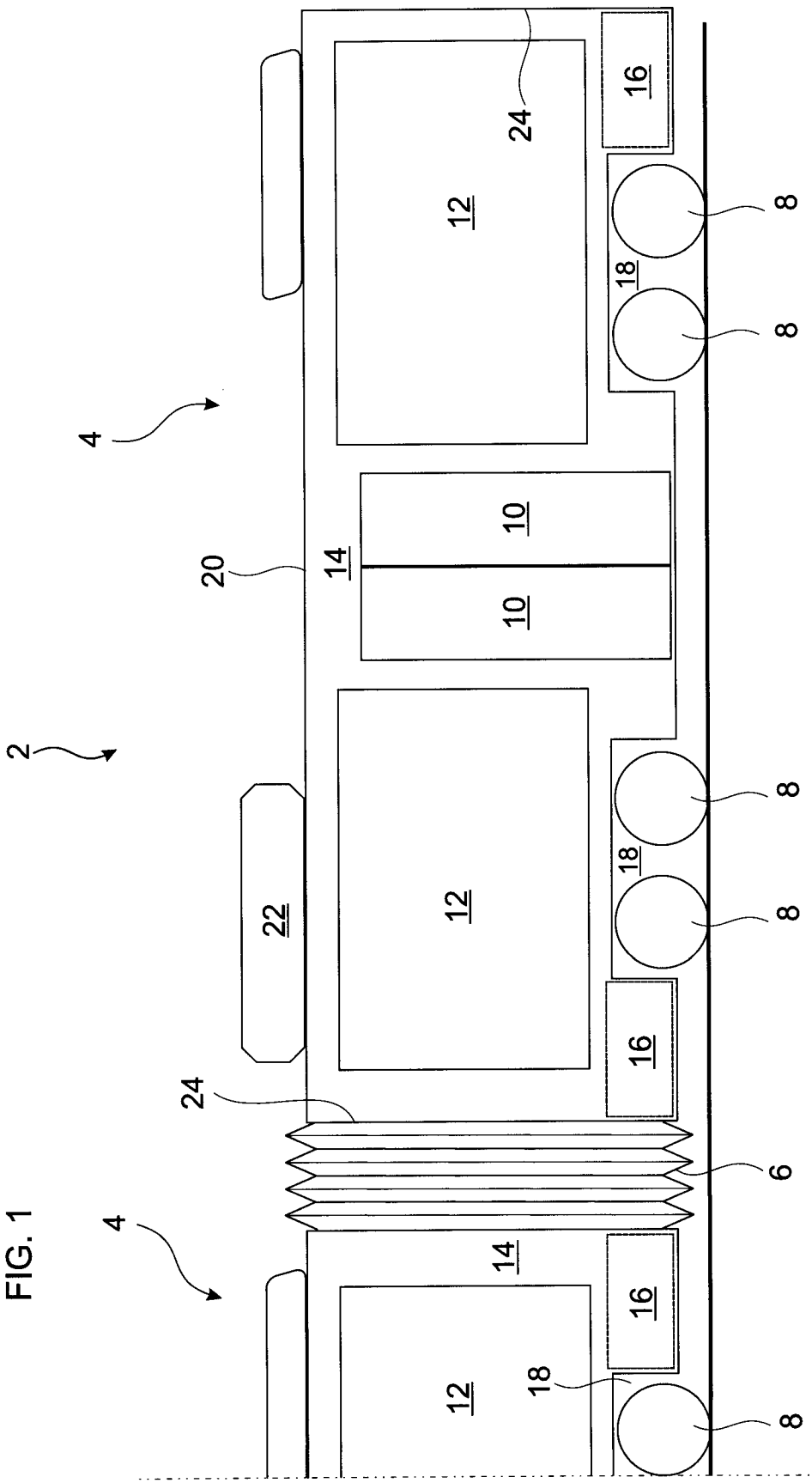


FIG. 1

FIG. 2

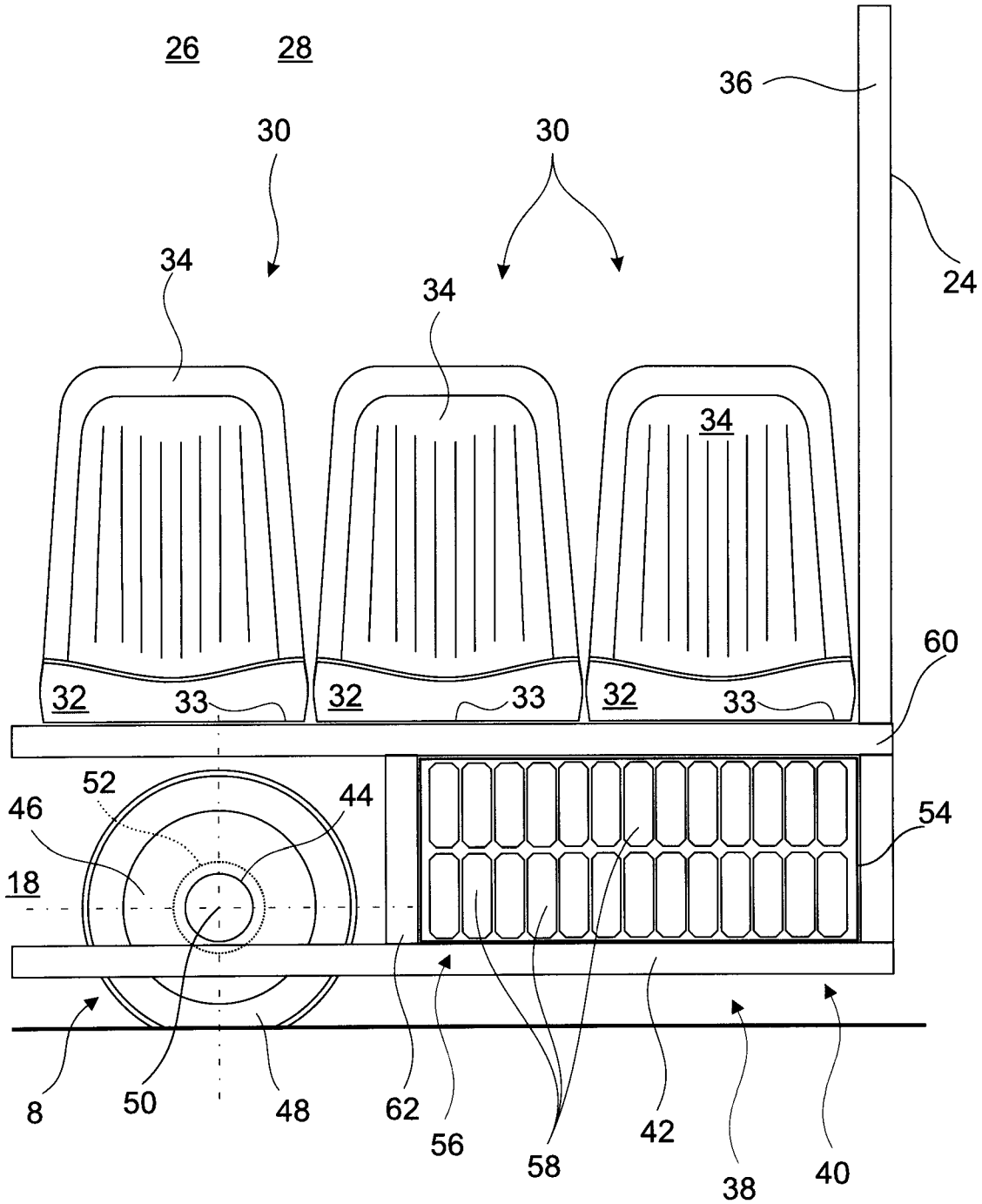

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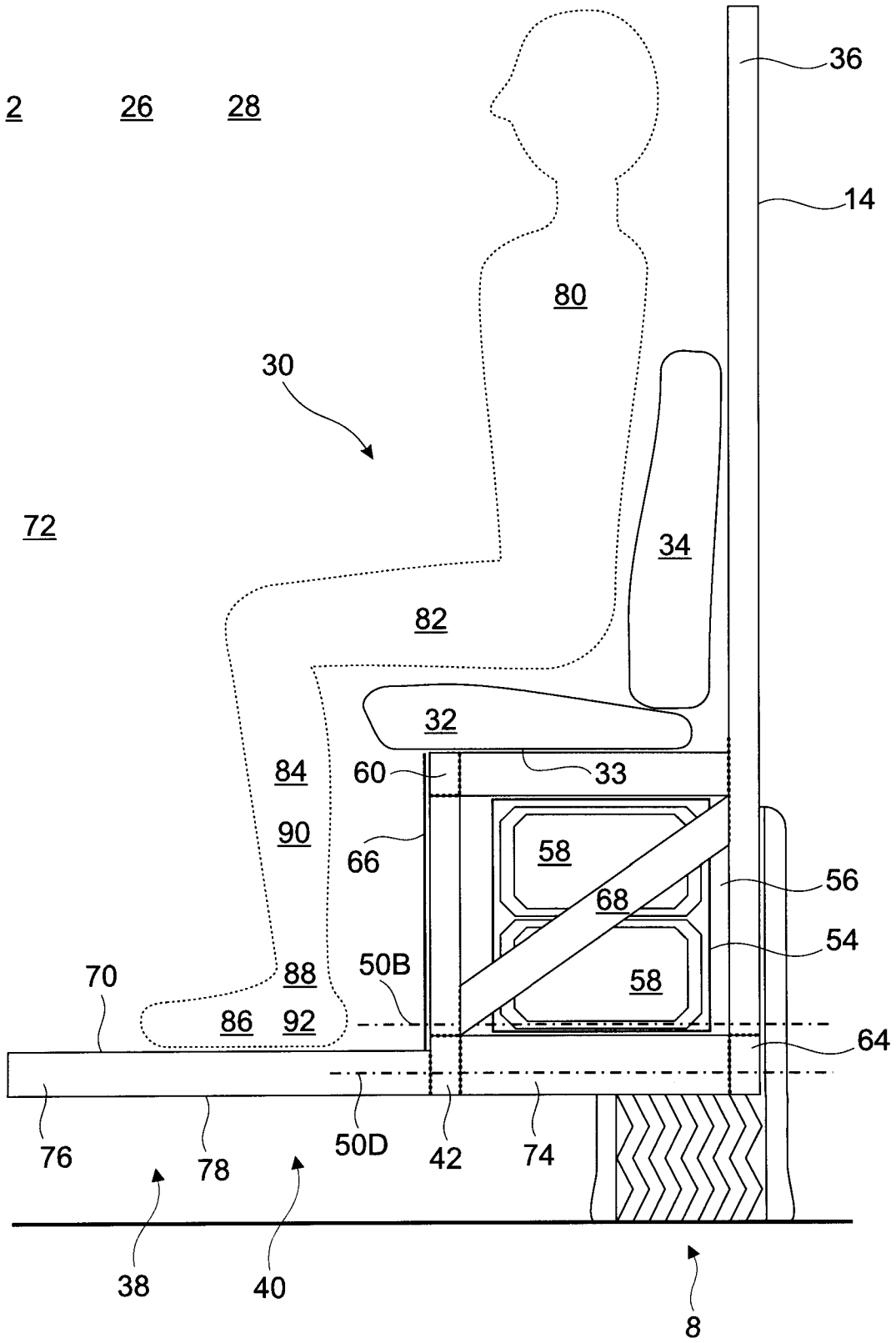
FIG. 3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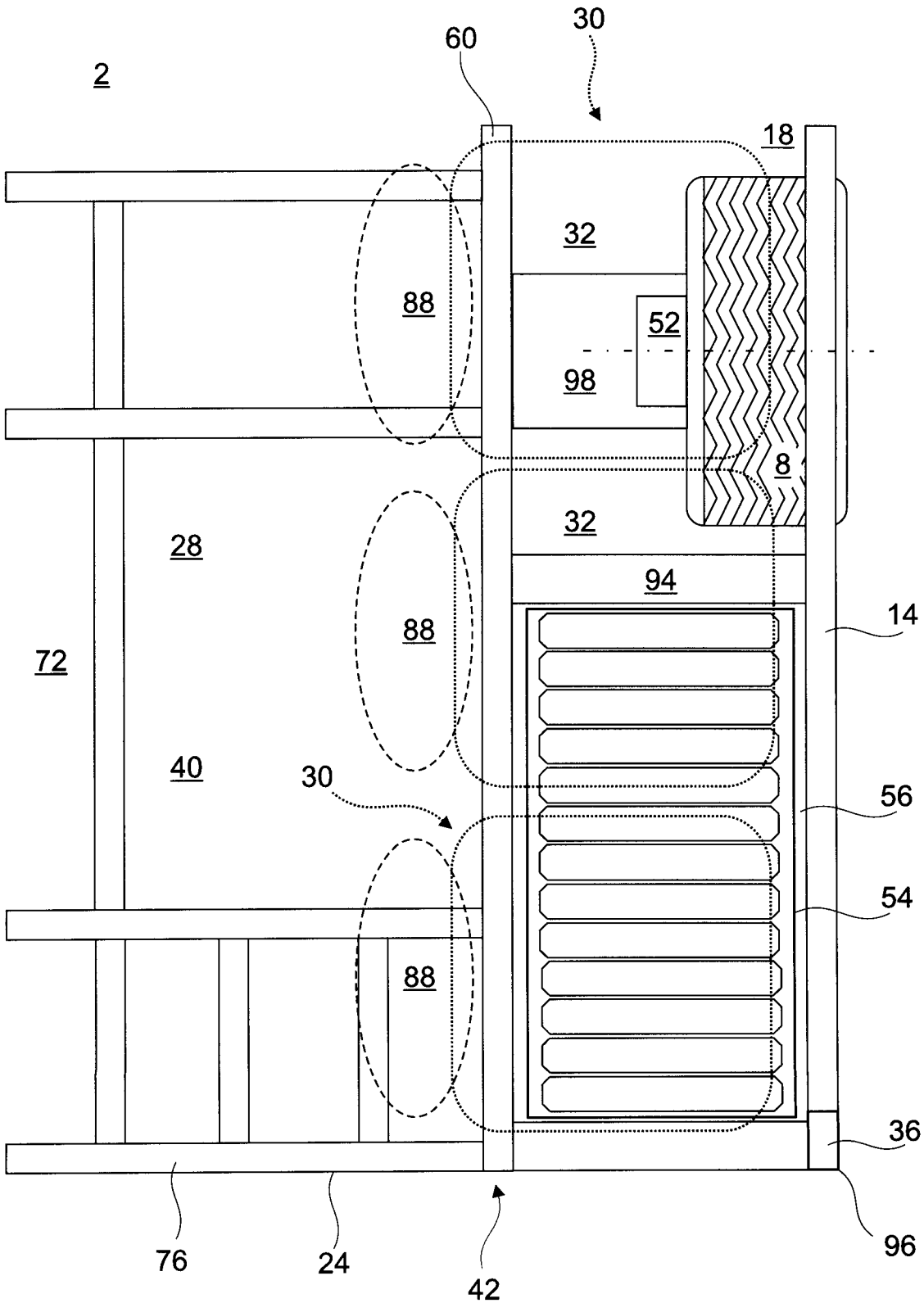
FIG. 4