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(54) **AIRCRAFT SEATING SYSTEM**

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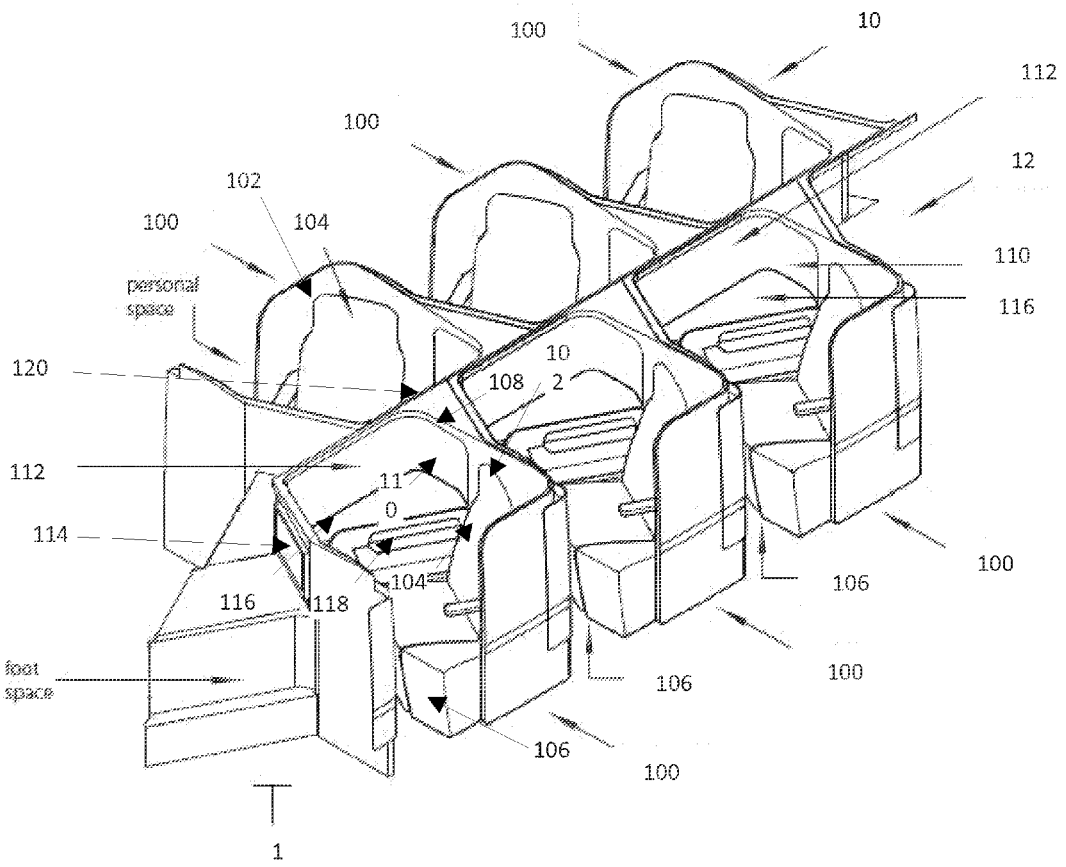
(57) **ABSTRACT**

An aircraft seating system including a plurality of personal units, with each personal unit including a seat having a top portion and bottom portion, a central partition extending along one side of the seat from a rear surface of the seat to an area in front of the seat, a surface between the central partition and the seat, with the surface affixed to the central partition at a predetermined height, where the personal units are arranged in a first column and a second column along a central axis such that each personal unit includes a side aligned with the central axis, and the predetermined height of the surface is configured such that a passenger in a first personal unit may insert their legs and feed into the space below the surface of a second personal unit in front of the first personal unit.



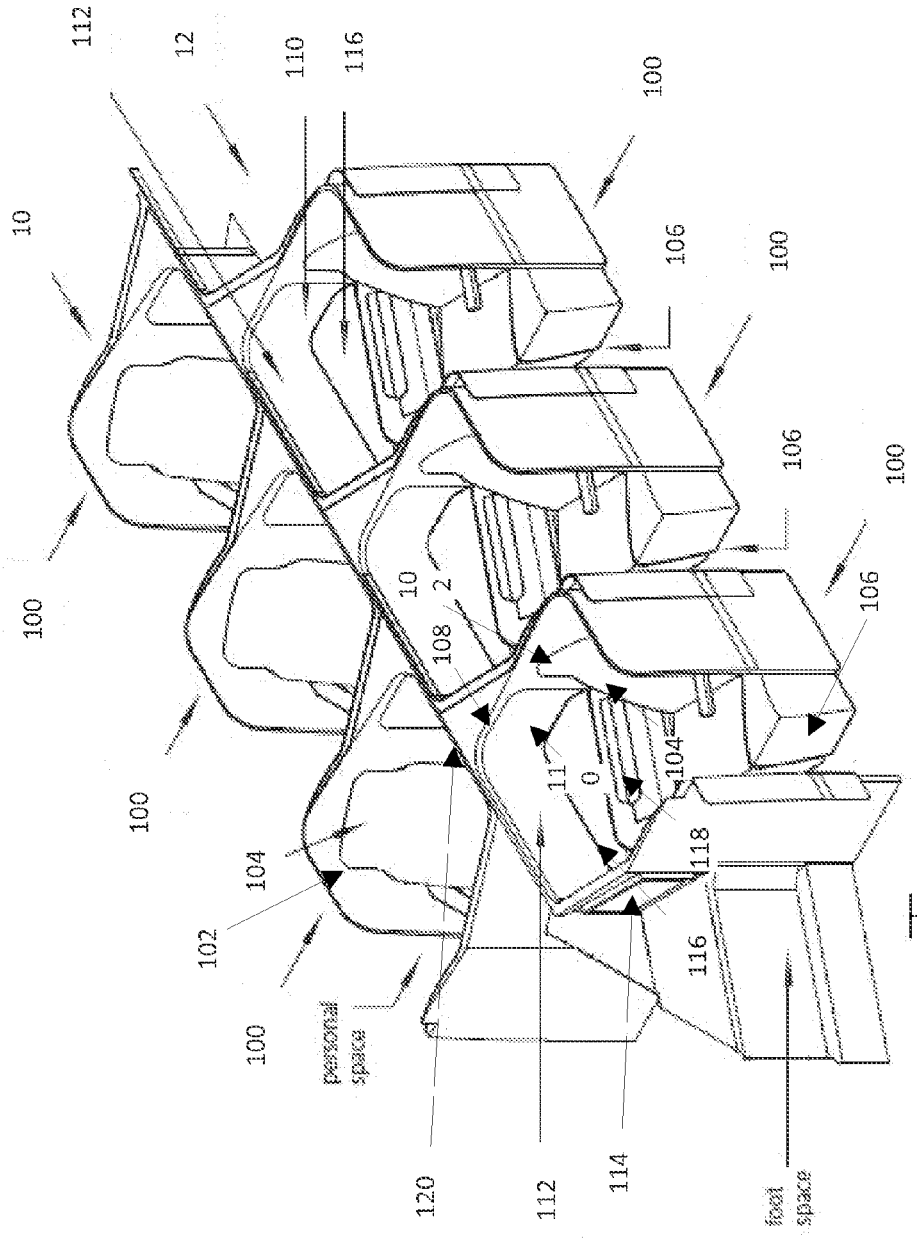

112
12
110
116
100
10
106
100
106
100
10
2
108
106
100
111
0
104
118
104
102
116
100
personal space
120
112
114
foot space
1

FIG. 1

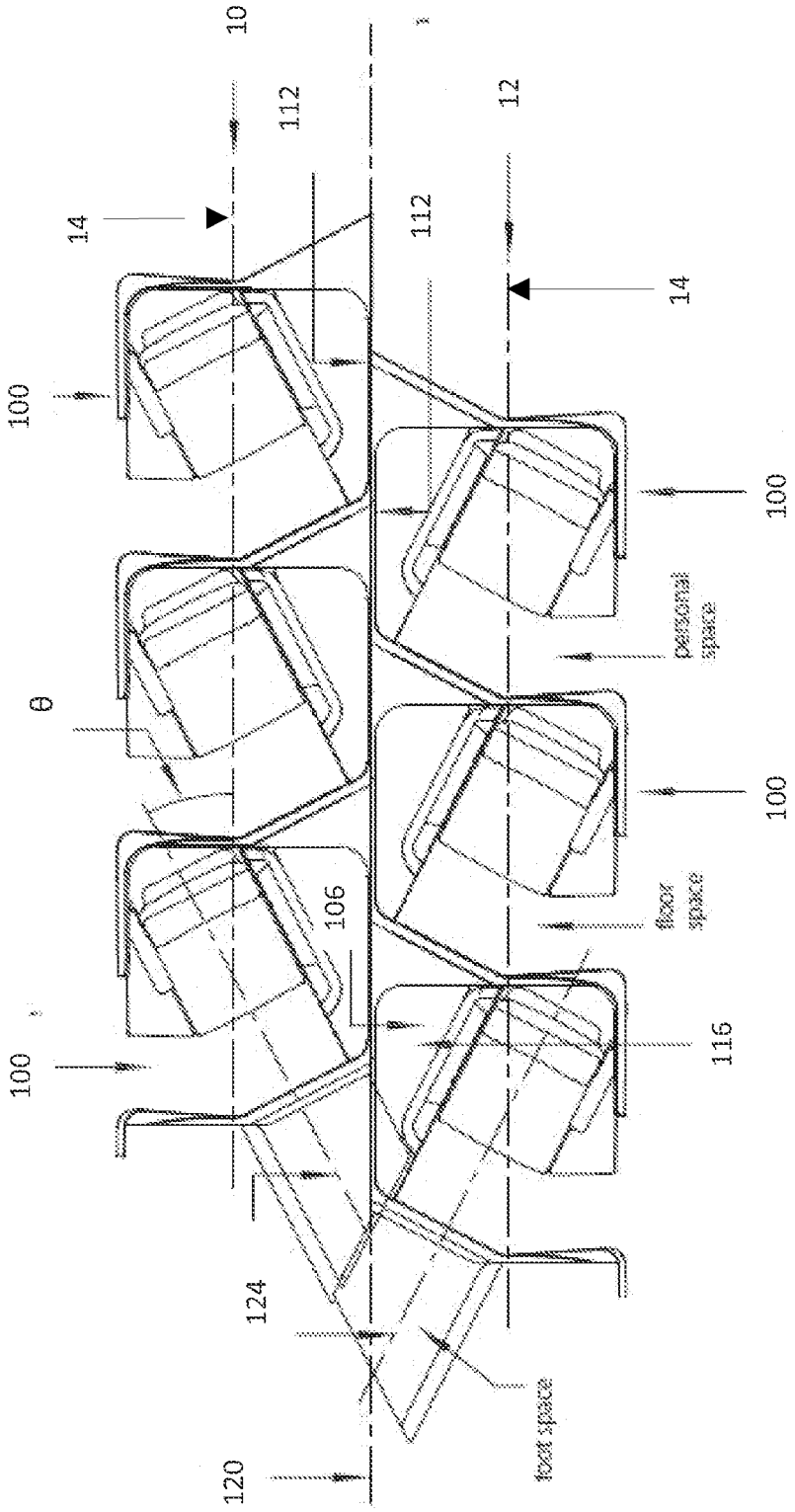

10
12
14
14
112
112
100
100
100
100
θ
106
116
124
120
personal space
floor space
foot space

FIG. 2

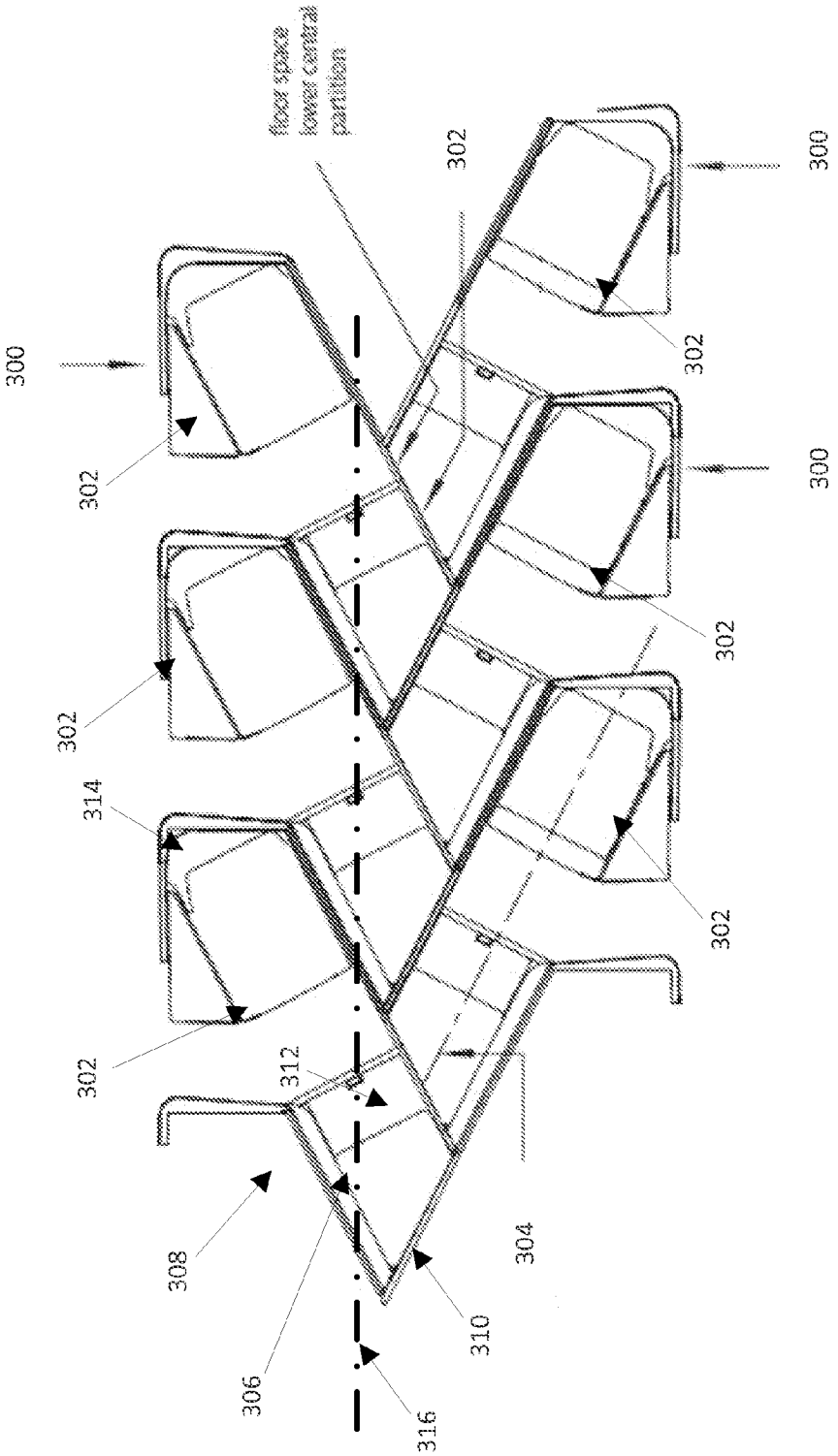

float space
lower central
partition
300
302
314
312
304
308
306
310
316

FIG. 3

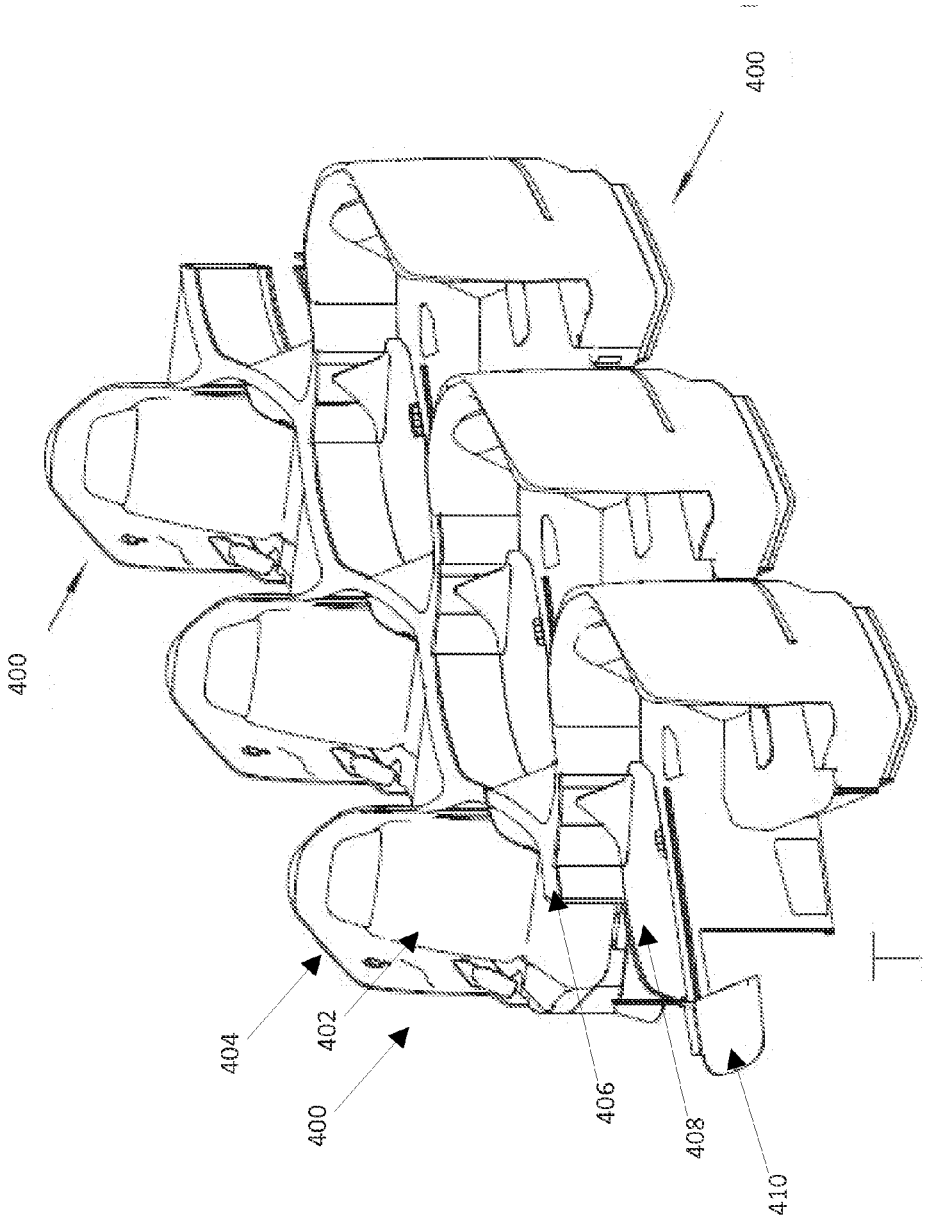


FIG. 4

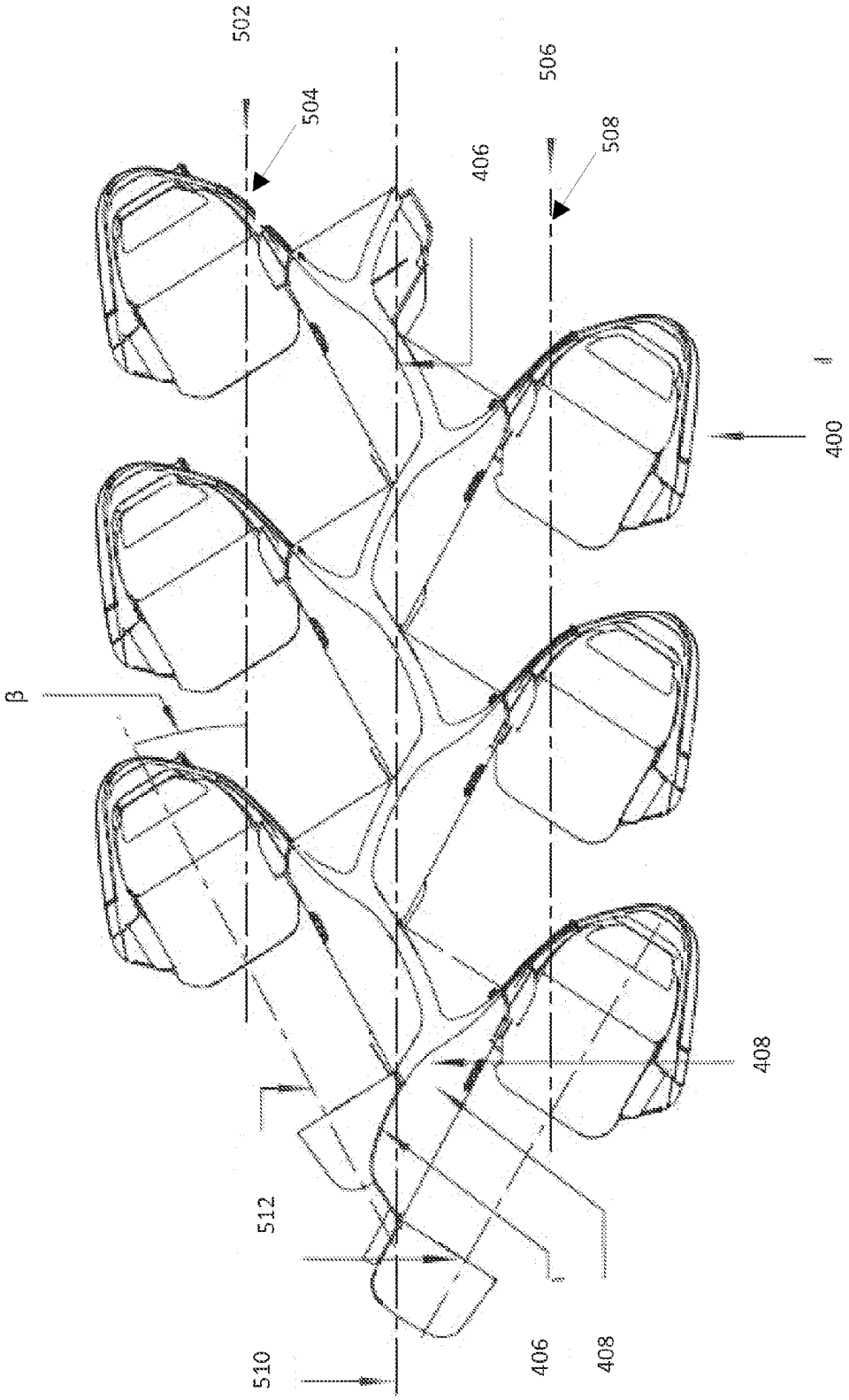


FIG. 5

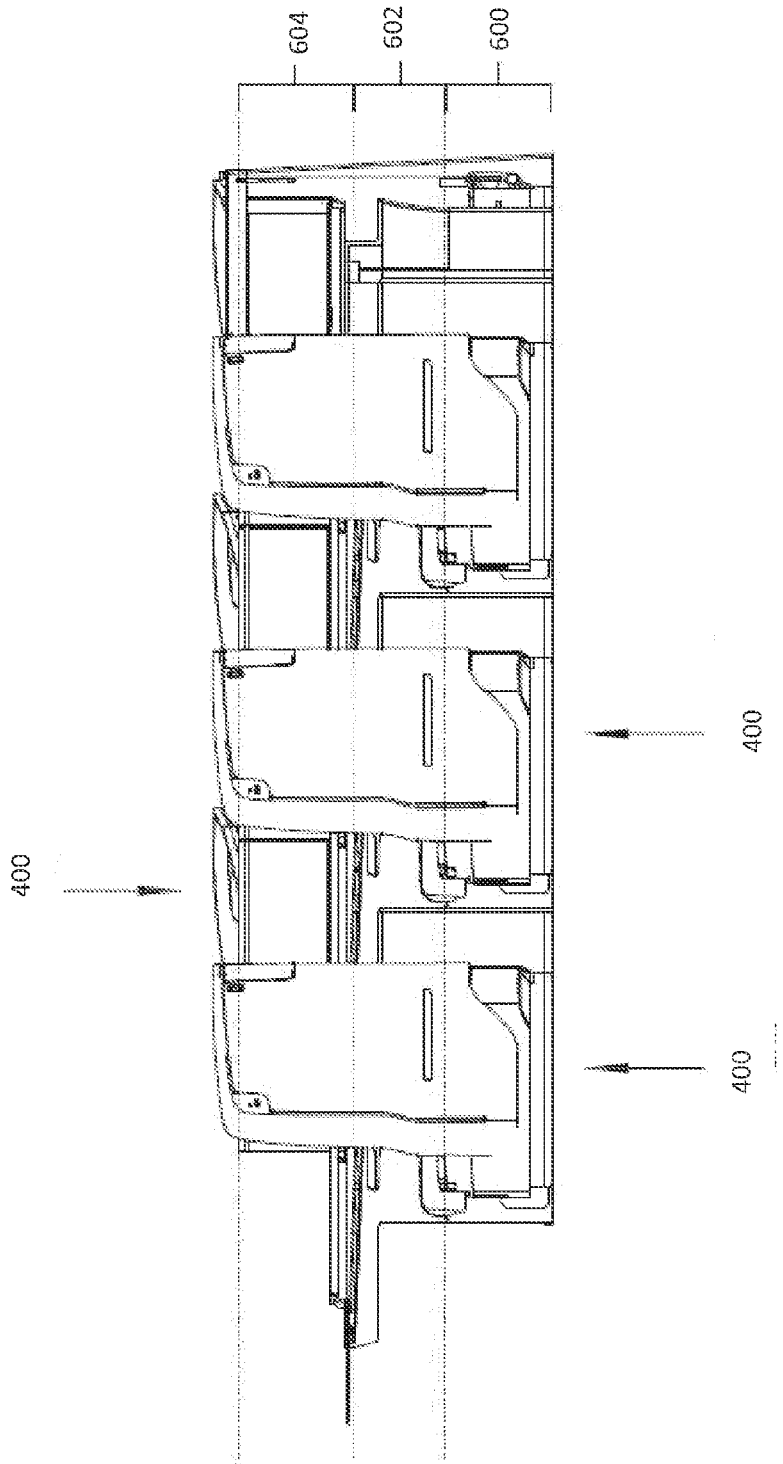


FIG. 6

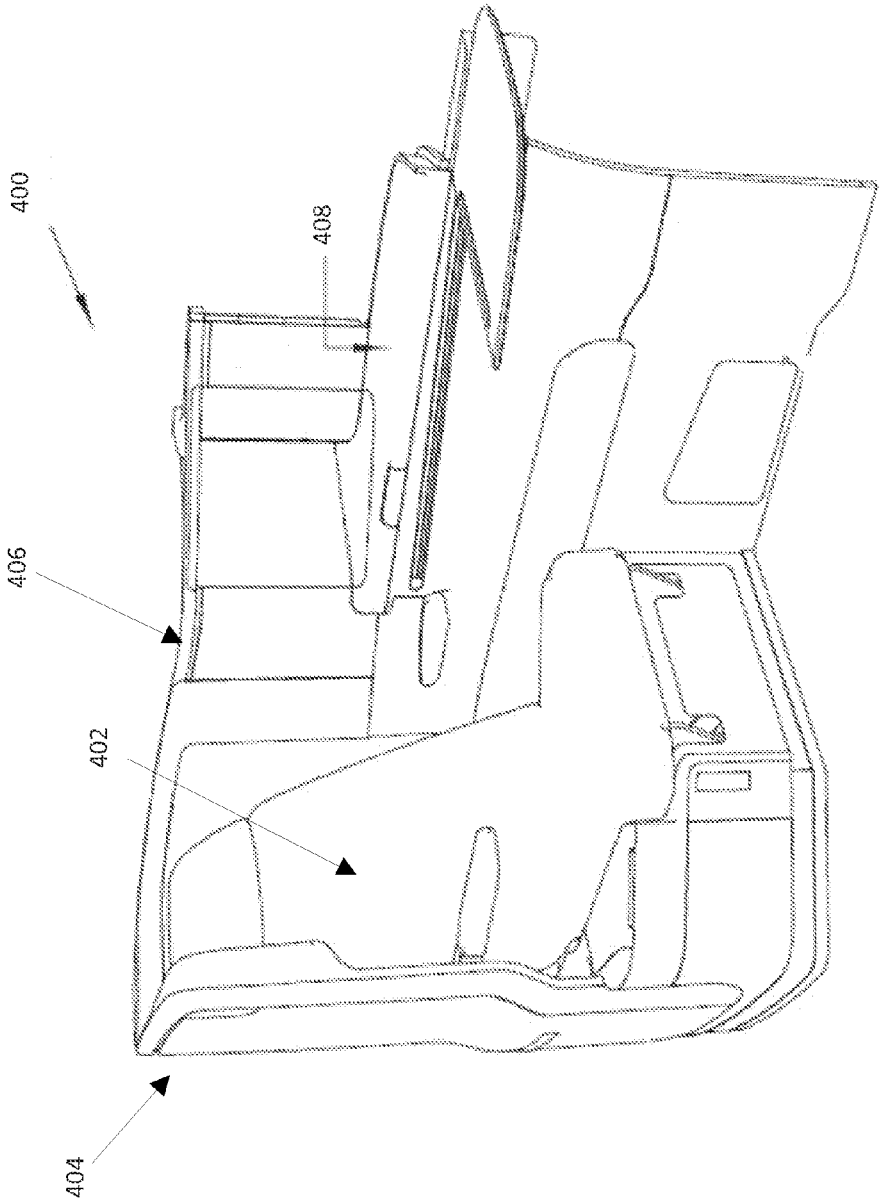


FIG. 7

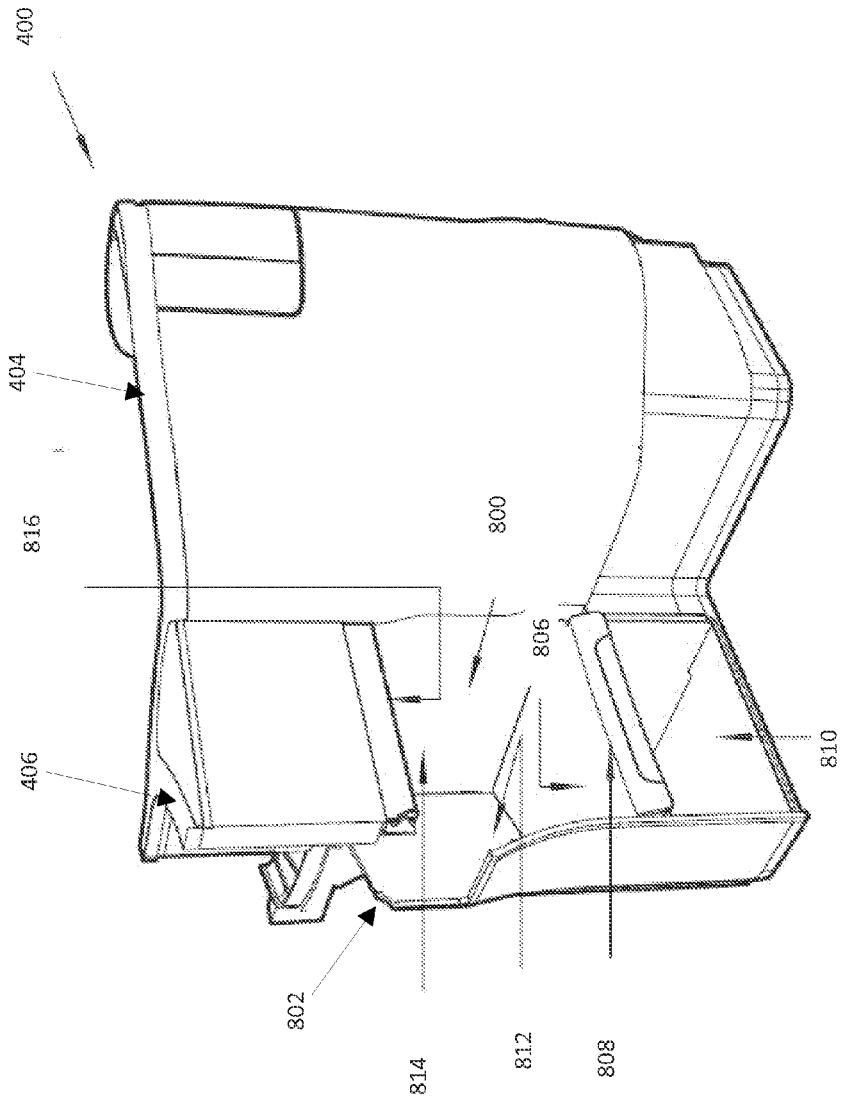


FIG. 8

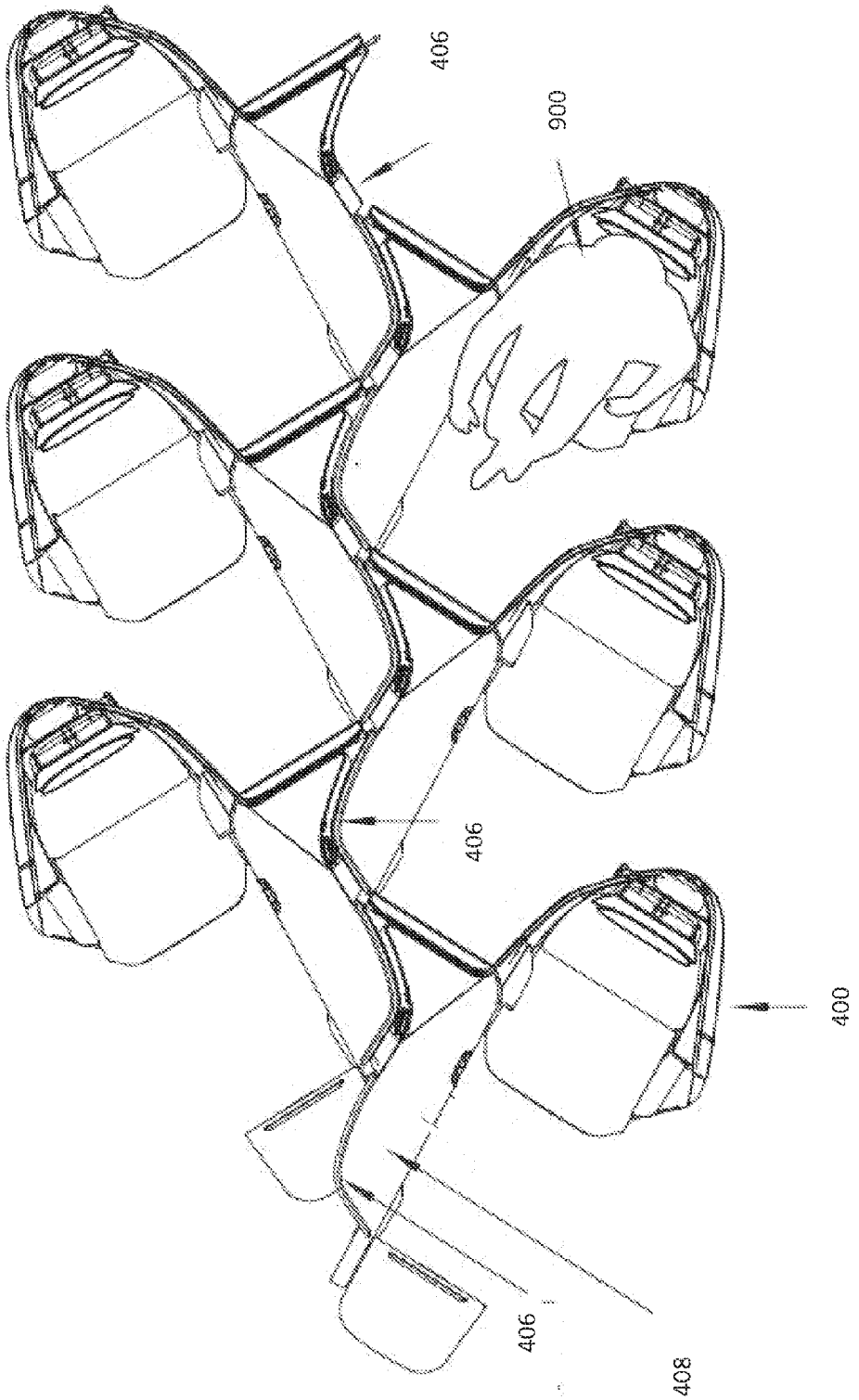


FIG. 9

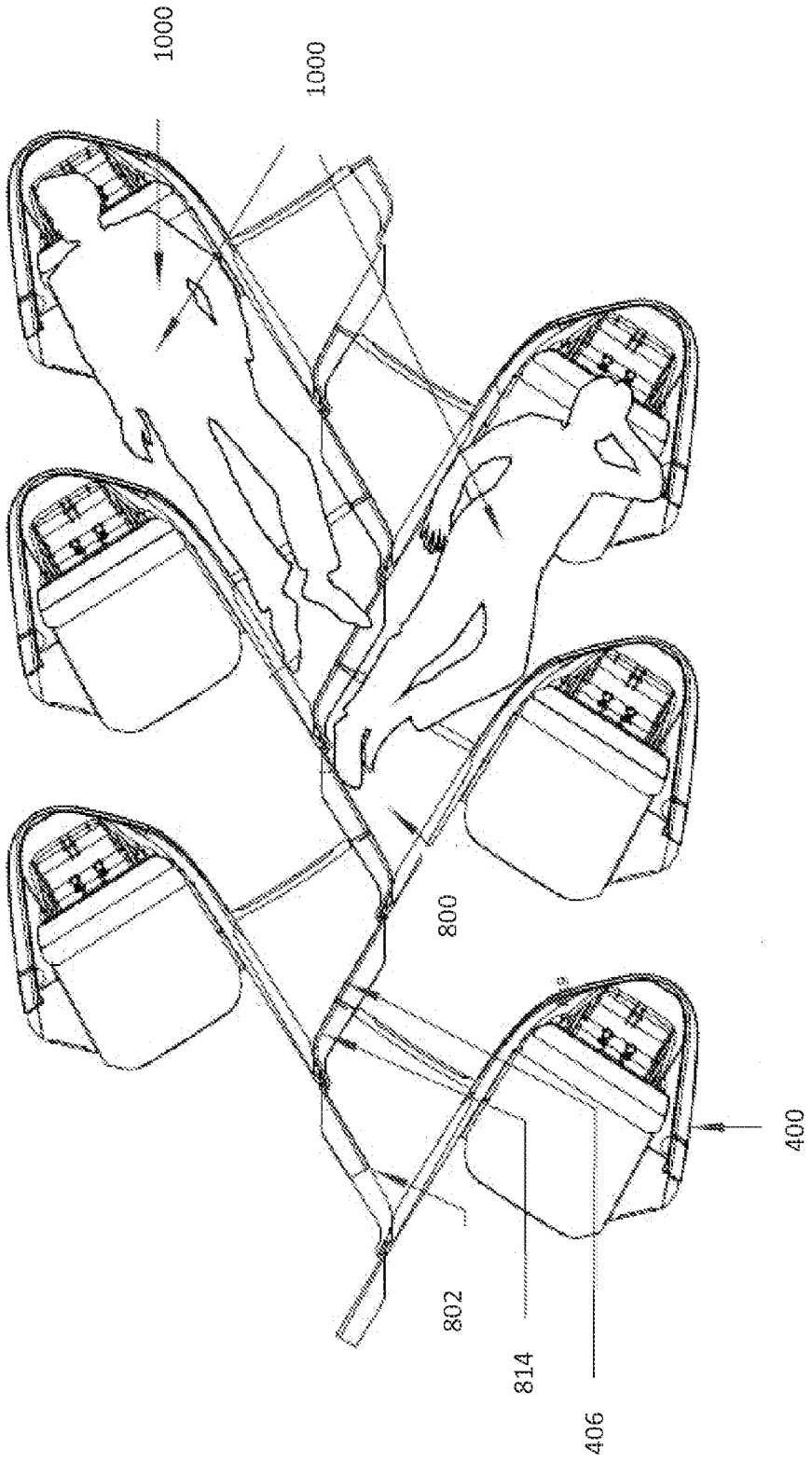


FIG. 10

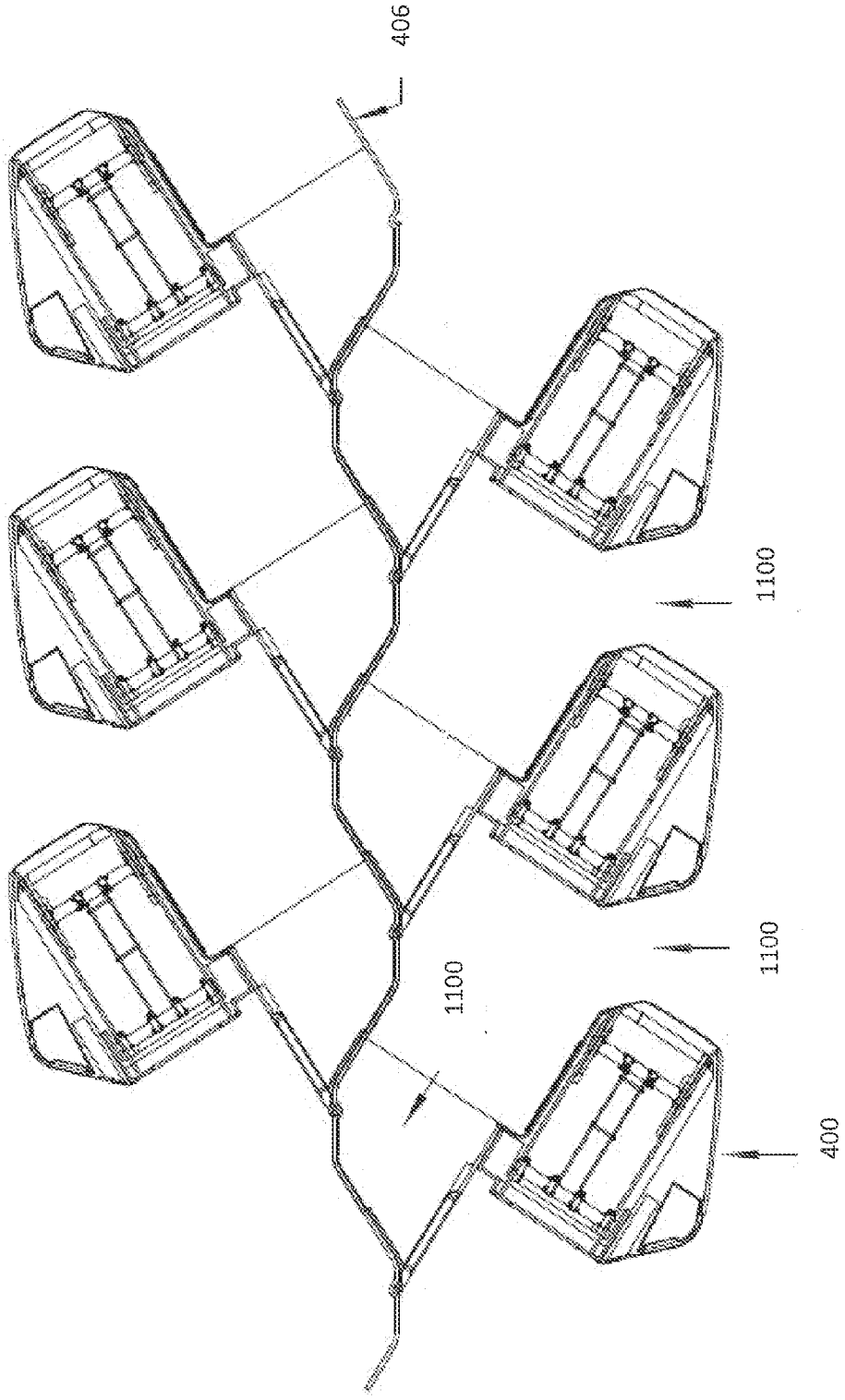


FIG. 11

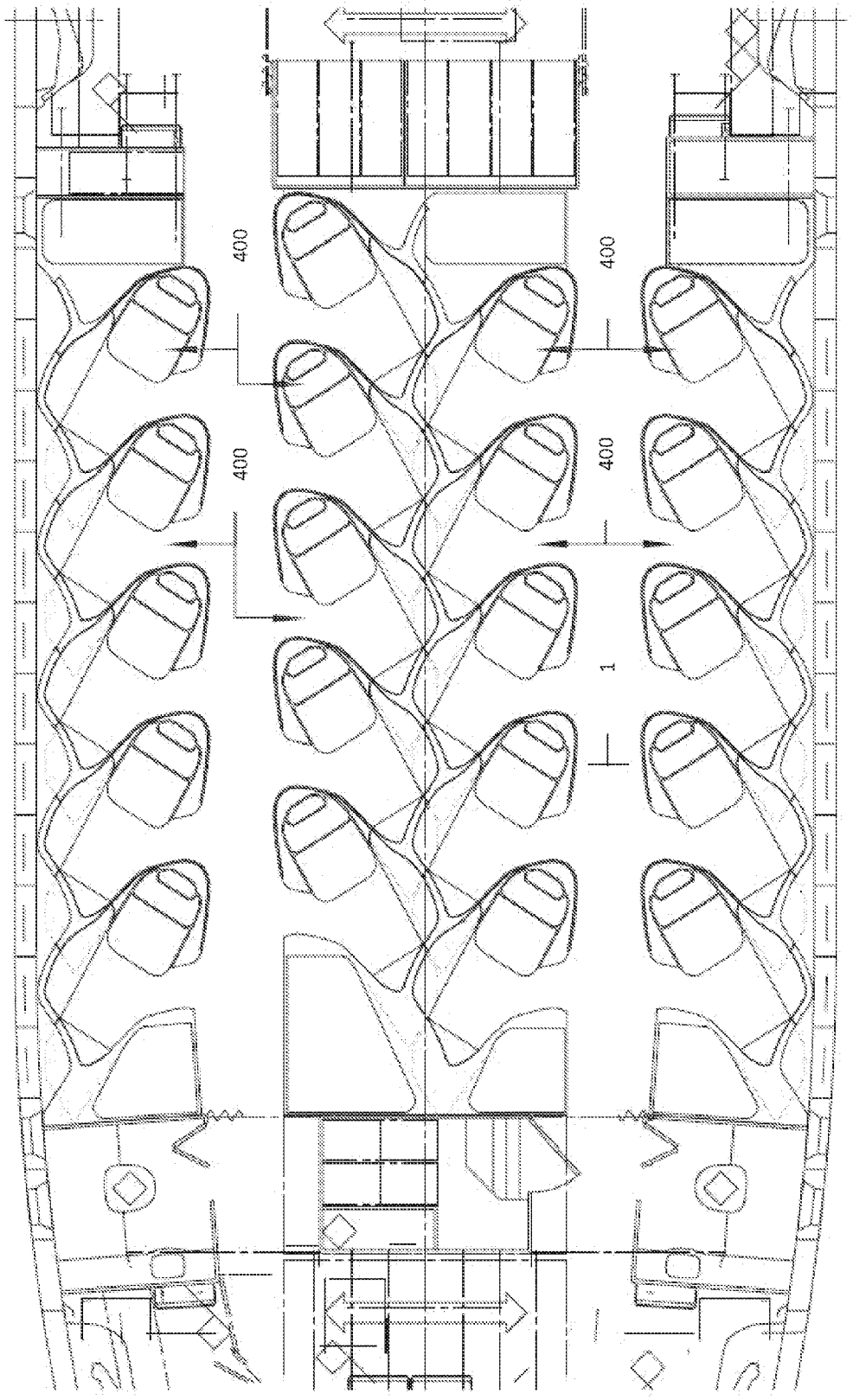


FIG. 12

AIRCRAFT SEATING SYSTEM

BACKGROUND OF THE INVENTION

[0001] A variety of passenger seating systems for aircrafts have been proposed, including GB2326824 and EP1417113. These show "herringbone" arrangements of seat units. Due to the space limitations on an aircraft, there is a desire for each seat unit to take up a minimum amount of space, such that a higher number of seat units can be installed in a given floor area of an aircraft.

[0002] The seat units can be configured in a bed mode and a seat mode. The bed mode enables the passenger to lie in a recumbent position on a bed, while the seat mode enables the passenger to sit in a seated position on a seat. Some components that form the seat may also form the bed, and vice versa. There is also a desire to ensure that the bed is of a sufficient length to accommodate even a relatively tall person.

[0003] It has been appreciated by the inventors that there are disadvantages with the above arrangements and that improvements can be made.

BRIEF SUMMARY OF THE INVENTION

[0004] One embodiment of the present invention includes an aircraft seating system including a plurality of personal units, with each personal unit including a seat having a top portion and bottom portion, a central partition extending along one side of the seat from a rear surface of the seat to an area in front of the seat, a surface between the central partition and the seat, with the surface affixed to the central partition at a predetermined height, where the personal units are arranged in a first column and a second column along a central axis such that each personal unit includes a side aligned with the central axis, and the predetermined height of the surface is configured such that a passenger in a first personal unit may insert their legs and feed into the space below the surface of a second personal unit in front of the first personal unit.

[0005] In another embodiment, the central partition includes a first extension portion having one side substantially perpendicular to a side of the seat, a second extension portion extending substantially perpendicularly from an edge of the first extension portion on a side of the first partition furthest from the seat, and a third extension portion extending substantially perpendicularly from an edge of the second extension portion furthest from the first extension portion such that a surface of the third extension portion faces a front surface of the seat.

[0006] In another embodiment, the first extension portion connects to the second connection portion via a curved surface.

[0007] In another embodiment, the second extension portion connects to the third connection portion via a curved surface.

[0008] In another embodiment, the first partition, second partition and third partition extends from the floor of the aircraft to a height at least equal to the height of the top portion of the seat.

[0009] In another embodiment, the heights of the first partition, second partition and third partition are substantially equal.

[0010] In another embodiment, the surface is positioned such that the top portion of the surface is at least substantially coplanar with an arm of the seat.

[0011] In another embodiment, the surface is positioned above an arm of the seat.

[0012] In another embodiment, the surface is positioned below an arm of the seat.

[0013] In another embodiment, the second partition in each personal unit is aligned such that they form a central axis with the central axis being substantially parallel with a first column axis of the first column of personal units and second column axis of a second column of personal units.

[0014] In another embodiment, the seat of each personal unit is aligned with the space created by the surface of another personal unit along a longitudinal axis.

[0015] In another embodiment, the longitudinal axis is angled from the central axis by a predetermined angle.

[0016] In another embodiment, the central partition has a substantially wave shaped form.

[0017] In another embodiment, the aircraft system includes a second surface positioned in front of the seat.

[0018] Another embodiment of the present invention includes an aircraft system including a plurality of personal units, with each personal unit including a seat configured to extend the length of the personal unit along a longitudinal axis of the personal unit, a first partition, a second partition, a third partition, and a fourth partition, where the partitions form a surface area portion and a seat portion, and the second partition acts as a common partition such that the second partition forms a portion of at least two personal units.

[0019] In another embodiment, the personal units are arranged along a central axis with a first row of personal units being angled along a longitudinal axis at a first angle from the central axis and a second row of partitions being angled along a longitudinal axis at a second angle such that the seat portion of one personal unit in the first or second column is adjacent to the surface area portion in an adjacent personal unit.

[0020] In another embodiment, the first partition, second partition, third partition and fourth partition extend from the floor of the aircraft to a height at least equal to the height of the top portion of the seat.

BRIEF DESCRIPTION OF THE SEVERAL VIEWS OF THE DRAWING

[0021] FIG. **1** depicts a perspective view of an arrangement of personal units;

[0022] FIG. **2** depicts a top view of a plurality of seating units aligned along a central axis;

[0023] FIG. **3** depicts another embodiment of personal units;

[0024] FIG. **4** depicts another embodiment of personal units;

[0025] FIG. **5** depicts a top view of the personal units of FIG. **4**.

[0026] FIG. **6** depicts a side view of the personal units of FIG. **4**;

[0027] FIG. **7** depicts a perspective view of the personal unit of FIG. **4**;

[0028] FIG. **8** depicts a rear view of the personal unit of FIG. **4**;

[0029] FIG. **9** depicts a top view of the personal units of FIG. **4** with a person seated in a seat of the personal unit;

[0030] FIG. **10** depicts a top view of the personal units of FIG. **4** with a reclined person in the seat of the personal unit;

[0031] FIG. **11** depicts a top view of the personal unit depicting the floor space exposed in each personal unit; and

[0032] FIG. **12** depicts a top view of the personal units installed in an aircraft.

DETAILED DESCRIPTION OF THE INVENTION

[0033] A plurality of personal units is provided. Each personal unit defines a personal space useable by a single passenger. The personal units are arranged on a substantially flat floor **1** of the aircraft. A first set of the personal units are arranged in a first column and a second set are arranged in a second column. The two columns define first and second column axes. The two columns are substantially parallel. Each personal unit defines a longitudinal axis between a forward end and a rearward end of the personal unit. The longitudinal axis is parallel to the floor. The forward end is closer to the front of the aircraft. The longitudinal axis of each personal unit is at an acute angle with respect to the respective column axis. Each seat unit in the same column forms substantially the same acute angle. Each personal unit is configurable in a seat mode and a bed mode. In the seat mode, a seat is situated in the personal unit, and in the bed mode, a bed is situated in the personal unit. The transition between modes is similar to that of GB2326824, which is incorporated by reference herein, in which a seat back reclines and a seat pan moves forwards to form part of the bed.

[0034] FIG. **1** depicts a perspective view of an arrangement of personal units **100**. Each personal unit **100** includes a seat **102** having a top portion **104** and bottom portion **106**, a central partition **108** extending a long one side of the seat **102** from a rear surface of the seat **102** to an area in front of the seat **102**. The central partition **108** includes a first extension portion **110** having one side substantially perpendicular to a side of the seat **102**, a second extension portion **112** extending perpendicularly from an edge of the first extension portion **110** on a side of the first partition **110** furthest from the seat **102**, and a third extension portion **112** extending perpendicularly from an edge of the second extension portion **102** furthest from the first extension portion **110** such that a surface of the third extension portion **114** faces a front surface of the seat **102**. In one embodiment, the first partition **110** is connected to the second partition **112** at a substantially 90 degree angle. In another embodiment, the first partition **110** connects to the second partition **112** by a curved surface defined radius (r). Each of the first partition **110**, second partition **112** and third partition **114** extends from the floor of the aircraft to a height at least equal to the height of the top portion **104** of the seat **102**. In one embodiment, the height of the first partition **110**, second partition **112** and third partition **114** are substantially equal. In another embodiment, the height of the first partition **110**, second partition **112** and third partition are not equal. In another embodiment, the height of the first partition **110** and second partition **112** are substantially equal but different than the third partition **114**. In another embodiment, the height of the first partition **110** and third partition **114** are substantially equal but different than the second partition **112**.

[0035] A surface **116** is positioned between the first partition **110**, second partition **112**, third partition and the seat **102** such that the edges of the surface **116** are substantially in contact with a lower edge, the edge closest to the floor of the aircraft, of the first partition **110**, second partition **112** and third partition **114**. The surface **116** is positioned such that the top portion of the surface **116** is at least substantially coplanar with an arm **118** of the seat **102**. In another embodiment, the surface **106** is positioned above the arm **118** of the seat **102**. In yet another embodiment, the surface **106** is positioned below the arm **118** of the seat **102**. The first partition **110**, second partition **112**, third partition **114** and bottom of the surface **116**, i.e. the surface facing the aircraft floor, form an open space that is sized to accommodate the lower portion of the human body.

[0036] The second partition **112** in each panel are aligned such that they form a central axis **120** with the central axis **120** being substantially parallel with the first column **10** axis and second column **12** axis. The central axis of each seat **102** is angled from the central axis **120** at a predefined angle such that the central axis of a bottom portion **106** of each seat **102** substantially aligns with the open space created by the first, second and third partitions **110**, **112** and **114** and the bottom portion of the surface **116** of the seating portion **100** in front of each seating portion. An enclosure **122** having side walls **124** defining the open space is positioned in front of seating units **100** having no seating unit **100** in front.

[0037] FIG. **2** depicts a top view of a plurality of seating units **100** aligned along a central axis **120**. The central axis of each seat **102** is substantially aligned with the central axis of the open space formed by the first, second and third **110**, **112** and **114** portions and the surface **116** to form a longitudinal axis **124**. The central axis of each seat **102** is angled from the central axis **14** of the first column **10** or second column **12** by an angle θ. In one embodiment, each seat **102** is angled from the first column central axis **14** and second column central axis **14** axis at the substantially the same angle. In another embodiment, each seat **102** is angled from the first ach seat **102** is angled from the first column central axis **14** and second column central axis **14** axis at the different angles

[0038] FIG. **3** depicts another embodiment of personal units **300**. Each personal unit **300** includes a seat **302**. Each seat **302** is configured to extend the length of the personal unit **200** along a longitudinal axis **304** of each personal unit **300**. Each personal unit **100** includes a first partition **308**, second partition **310**, third partition **312** and fourth partition **314** with the partitions forming a surface area portion and a seat portion. The second partition **310** in each personal unit **100** acts as a common partition such that the second partition **110** forms a portion of at least two personal units **100**. The personal units **100** are arranged along a central axis **316** with a first row of personal units being angled along a longitudinal axis **304** at a first angle from the central axis and a second row of partitions being angled along a longitudinal axis **304** at a second angle such that the seat portion of one personal unit **300** in the first or second column is adjacent to the surface area portion in an adjacent personal unit **100**.

[0039] FIG. **4** depicts another embodiment of a personal unit **400**. Each personal unit **400** includes a seat **402** having a partition **404** extending along the side and back surfaces of the seat **402**. In one embodiment, the partition **404** is configured such that the peripheral vision of a person seated in the seat is obscured. Each partition **400** is arranged along a central partition **406**. In one embodiment, the central partition **406** is substantially wave shaped. A first surface unit **408** is position between the central partition **406** and the seat **402** and a second surface unit **410** extends from an end of the first surface unit **408** furthest from the seat **402** such that an edge of the second surface unit **410** is parallel with the front surface of the seat **402**.

[0040] FIG. **5** depicts a top view of the personal units of FIG. **4**. The personal units **400** are in a first column **502** along a first column axis **504** and a second column **506** along a second column axis **508** on either side of a central axis **510**

extending down the length of the central partition **406**. The longitudinal axis **512** of each seat is angled from the first column axis or second column axis by an angle β. In one embodiment, the angle β is substantially equal for each personal unit **400**. In another embodiment, the angle β is different for each personal unit **400**

[0041] FIG. **6** depicts a side view of the personal units **400** of FIG. **4**. Each personal unit **400** is separated into three layers with each layer being substantially parallel to the floor. The layers are stacked one on top of another, with the floor at the bottom. The lowest layer is the floor space layer **600**, then the foot space layer is next upwards (i.e. in a direction perpendicular to the floor), then the side space layer is at the top. The boundary between the first column and the second column is differently structured in at least two of the respective layers. This results in a situation in which a personal space in one layer of one personal unit is partially stacked with respect to a personal space in another layer of one personal unit in the other column. Thus portions of each personal space cross a notional central plane normal to the floor and between the column axes, resulting in a stacked arrangement of portions of personal space in the region of the notional central plane, as described above.

[0042] The boundary between the first and second columns in a respective layer is formed at least partially by a partition between the columns. Different partitions in at least two different layers are structured differently. Each partition may be, for example, substantially straight (e.g. running parallel to the column axes), or may be, for example, corrugated. The corrugation may be curved, like a sine wave when viewed from above, or may be zig-zagged, like a triangular wave when viewed from above.

[0043] The foot space layer **602** includes a foot space, in which the person inserts his feet when in the recumbent position. The foot space is at the forward end of the personal unit. By stacking the foot space with portions of personal space of adjacent personal units, in particular crossing the notional central place, a wider, longer foot space may be achieved.

[0044] The side space layer **604** includes a side space, which the person can use and access (at least) when in the seated position. The side space is located to one side of the person when in this position.

[0045] The floor space layer **600** includes a floor space. The floor space comprises a space in which the person will put his feet when in the seated position. In some embodiments, the floor space also comprises a space at least partially underneath the foot space, which may be used for storage. In some embodiments, the floor space comprises a space at least partially underneath the side space, which may be used for storage. The gap between these spaces may include part of the foot space of an adjacent personal unit in the same column and/or the foot space of a personal unit in the other respective column.

[0046] In the foot space layer **600** and the floor space layer **602**, the central partition between the two columns is zigzagged. The zigzagging parts cross either side of the central partition in the side space layer. The foot space and the floor space of each personal unit therefore extends underneath the central partition in the side space layer. The floor space and the foot space of a respective personal unit extend in the forward direction until it reaches a partition defining a side of a respective personal unit in the other column. Each straight part of the zigzag therefore defines a forward end of the foot space and the floor space, respectively. The personal units are therefore arranged in these layers in an "interlocking herringbone" formation. The zigzag formed between the two columns has internal angles that are obtuse (e.g. 100°-170° or 120°-150°, which results in the forward end of the foot space and the floor space not being perpendicular to the sides of the personal unit. One side of the personal unit is therefore longer than the other, which results in a longer maximum length of the personal unit. In the foot space layer **600**, this creates a longer maximum length of the part of the personal space that is occupied by the person when in the recumbent position. (In other embodiments, the zigzag is formed of right-angles.)

[0047] In another embodiment, the side space layer, the central partition between the two columns is corrugated, such that the side space side partition extends substantially more parallel to the longitudinal axis of the personal unit than in the first embodiment. The shelf is therefore of a substantially uniform width, rather than being substantially triangular. The foot space layer and the floor space layer are structured similarly to the first embodiment, but with a more corrugated central partition.

[0048] Each personal unit has the foot space, the floor space and the side space. All of these spaces form part of the personal space for that personal unit.

[0049] As will be apparent, the personal units **400** are arranged in an array of individual personal units **400**, specifically including two columns of units in the described embodiments. The array is formed by a corresponding array of unit cells or personal space defining units in some embodiments.

[0050] FIG. **7** depicts a perspective view of the personal unit **400** of FIG. **4**. The personal unit **400** includes the seat **402**, the partition **404**, the central partition **406**, the first surface **408** and the second surface **410**.

[0051] FIG. **8** depicts a rear view of the personal unit **400** of FIG. **4**. The central partition **406** curves away from the partition **404** of the personal unit **400** to form a footrest portion **800** for an adjacent personal unit **402**. A footrest partition **802** extends from the central partition **406** to form the enclosed footrest portion **802**. The footrest portion includes a footrest surface **804** connected to the footrest partition **802**. The edge of the footrest surface **804** is curved downward towards the aircraft floor **1**. The footrest surface **804** is positioned at above the aircraft floor such that a space is formed between the aircraft floor **1** and the footrest surface **804**. In one embodiment, the height of the footrest surface **804** above the floor is adjustable. In another embodiment, the height of the footrest surface **804** above the floor is fixed.

[0052] The footrest partition **806** includes a front partition **812** formed by the footrest partition **806**, a side partition **814** formed by the portion of the partition **404** adjacent to the footrest partition **806**, an upper footrest partition **816** formed by the portion of the central partition **406**. The width of the central partition **406** may be increased to form the upper footrest partition **816**.

[0053] FIG. **9** depicts a top view of the personal units **400** of FIG. **4** with a person **900** seated in a seat of the personal unit **400**. FIG. **10** depicts a top view of the personal units **400** of FIG. **4** with a reclined person **1000** in the seat **402** of the personal unit **400**. FIG. **11** depicts a top view of the personal unit **400** depicting the floor space **1100** exposed in each personal unit **400**. FIG. **12** depicts a top view of the personal units **400** installed in an aircraft.

[0054] The floor space of each personal unit is, in some embodiments, partially defined by a unit cell, in particular

where the unit cell provides storage space underneath the foot well, with the remainder being defined by the cabin floor. In other embodiments, the floor space may be defined entirely by a unit cell, or a combination of unit cells. In yet other embodiments, the floor space is defined entirely by the cabin floor.

[0055] The personal units are attached to tracks that run under or along the floor, parallel to the respective column axis. The footrest defining a lower boundary of a foot space has an extendable part extendable towards the backward end of the personal unit, which may assist in forming the bed. The extension may take the form of a flip-up extension or a drawer that slides from under the footrest. A seat pan extension may also be analogously formed to extend forward from the seat pan.

[0056] The seats may convert into beds according to EP1417113, which is incorporated by reference herein, in which a backrest of the seat is folded forward, with the opposite side of the backrest used to form part of the bed.

[0057] The angle between the longitudinal axis and the respective column axis is about approximately 30 degrees. In some embodiments, the angle is between approximately 20 to approximately 55 degrees.

[0058] The personal units in the first column are offset from the respective personal units in the second column, in a direction parallel to the column axes, by an amount which is between approximately 0 and approximately 1 times the distance between adjacent personal units in the same direction, for example about approximately 0.5 times or between approximately 0.2 to approximately 0.8 times.

[0059] The preceding detailed description is merely some examples and embodiments of the present disclosure and that numerous changes to the disclose embodiments can be made in accordance with the disclosure herein without departing from its spirit or scope. The preceding description, therefore, is not meant to limit the scope of the disclosure but to provide sufficient disclosure to one of ordinary skill in the art to practice the invention with undue burden.

1. An aircraft seating system including:
- a plurality of personal units, with each personal unit including
  - a seat having a top portion and bottom portion,
  - a central partition extending along one side of the seat from a rear surface of the seat to an area in front of the seat,
  - a surface between the central partition and the seat, with the surface affixed to the central partition at a predetermined height,
- wherein
- the personal units are arranged in a first column and a second column along a central axis such that each personal unit includes a side aligned with the central axis, and
- the predetermined height of the surface is configured such that a passenger in a first personal unit may insert their legs and feed into the space below the surface of a second personal unit in front of the first personal unit.

2. The aircraft seating system of claim **1** wherein the central partition includes
- a first extension portion having one side substantially perpendicular to a side of the seat;
- a second extension portion extending substantially perpendicularly from an edge of the first extension portion on a side of the first partition furthest from the seat; and
- a third extension portion extending substantially perpendicularly from an edge of the second extension portion furthest from the first extension portion such that a surface of the third extension portion faces a front surface of the seat.

3. The aircraft system of claim **2** wherein the first extension portion connects to the second connection portion via a curved surface.

4. The aircraft system of claim **2** wherein the second extension portion connects to the third connection portion via a curved surface.

5. The aircraft system of claim **1** wherein the first partition, second partition and third partition extends from the floor of the aircraft to a height at least equal to the height of the top portion of the seat.

6. The aircraft system of claim **5** where the heights of the first partition, second partition and third partition are substantially equal.

7. The aircraft system of claim **1**, wherein the surface is positioned such that the top portion of the surface is at least substantially coplanar with an arm of the seat.

8. The aircraft system of claim **1**, wherein the surface is positioned above an arm of the seat.

9. The aircraft system of claim **1**, wherein the surface is positioned below an arm of the seat.

10. The aircraft system of claim **2**, wherein the second partition in each personal unit is aligned such that they form a central axis with the central axis being substantially parallel with a first column axis of the first column of personal units and second column axis of a second column of personal units.

11. The aircraft system of claim **1** wherein the seat of each personal unit is aligned with the space created by the surface of another personal unit along a longitudinal axis.

12. The aircraft system of claim **11** wherein the longitudinal axis is angled from the central axis by a predetermined angle.

13. The aircraft system of claim **1** wherein the central partition has a substantially wave shaped form.

14. The aircraft system of claim **1** including a second surface positioned in front of the seat.

15. An aircraft system including:
- a plurality of personal units, with each personal unit including
  - a seat configured to extend the length of the personal unit along a longitudinal axis of the personal unit,
  - a first partition,
  - a second partition,
  - a third partition, and
  - a fourth partition,
- wherein the partitions form a surface area portion and a seat portion,
- the second partition acts as a common partition such that the second partition forms a portion of at least two personal units.

16. The aircraft system of claim **15**, wherein the personal units are arranged along a central axis with a first row of personal units being angled along a longitudinal axis at a first angle from the central axis and a second row of partitions being angled along a longitudinal axis at a second angle such that the seat portion of one personal unit in the first or second column is adjacent to the surface area portion in an adjacent personal unit.

17. The aircraft system of claim **15** wherein the first partition, second partition, third partition and fourth partition

extend from the floor of the aircraft to a height at least equal to the height of the top portion of the seat.

18. A plurality of personal passenger units for installation on aircraft, each personal unit being arranged to define a longitudinal axis, the personal units being arranged, when installed, to form first and second columns along a floor to define respective first and second column axes, the personal units in each column being arranged side-by-side in a longitudinally offset relationship at an acute angle to the respective column axis, each personal unit being arranged to define a personal space for accommodating a person in a seated position and accommodating the person in a recumbent position, wherein at least some of the personal units are arranged such that a stacked part of the personal space of the respective personal unit is arranged in a stacked relationship, in a direction perpendicular to the floor, with respect to a stacked part of the personal space of a personal unit in the respective other column.

19. The plurality of personal units of claim **18**, wherein the stacked part of the personal space of the respective personal unit and the stacked part of the personal space of the personal unit in the respective other column are spaced apart from each other in a direction perpendicular to the floor.

20. The plurality of personal units claim **18**, wherein the at least some of the personal units are arranged such that a stacked part of the personal space of the respective personal unit is arranged in a stacked relationship, in a direction perpendicular to the floor, with respect to a stacked part of the personal space of a personal unit in the respective same column.

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