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(54) **INTERFACE MODULE BETWEEN AN AIR TREATMENT UNIT AND AN INTERIOR SPACE OF A DOUBLE-DECK CAR BODY**

(57) A double-deck car body (10) of a rail vehicle comprises an upper end wall (24) facing a lower roof section (20) at an end of an upper deck (16) of the double-deck car body (10). The upper end wall (24) is provided with an opening (26) having a maximal width larger than 1m, preferably larger than 1,2 m and a maximal height larger than 0,5 m, preferably larger than 0,8 m. An air treatment unit (32) is located on top of the lower roof

section (20) and faces at a distance the upper end wall (24) and the opening (26). An interface module (40) comprises a mounting plate (42) shaped to fit over a peripheral edge of the opening (26) so as to close and seal the opening (26), and through ducts (48, 50) tightly passing through the mounting plate (42) for connecting the air treatment unit (32) to an interior space (12) of the double-deck car body (10).

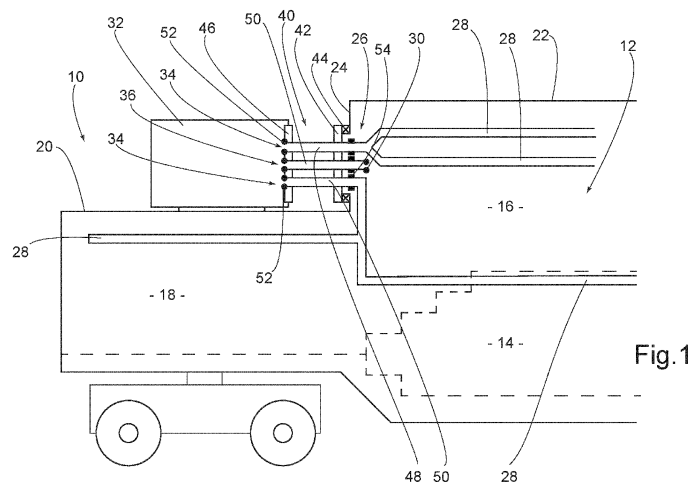


Fig.1

Description

TECHNICAL FIELD OF THE INVENTION

[0001] The present invention relates to the connection of an air treatment unit to a double-deck car body of a rail vehicle.

BACKGROUND ART

[0002] Double-deck rail vehicles are known in the art with an upper deck limited to a middle section of the car body of the rail vehicle and an upper end wall that faces a lower roof section at an end of the upper deck. In such instances, it may be advantageous to provide the upper end wall with a large opening, through which various bulky pre-assembled and pre-tested subunits or modules of the interior fitting of the upper deck can be inserted, such as complete luggage racks, ceilings, seat modules or air ducts modules. Such openings are closed with a plate at the end of the assembly process.

[0003] It is also known in the art to use the available space outside the car body on top of the lower roof section facing the upper end wall of a double-deck rail vehicle to position electrical equipment, such as a main transformer, as disclosed e.g. in US 2022/227234 A1 or US 10,611,385 B2 or an air treatment unit, as known from the "Regio 2N" series by Bombardier Transportation and Alstom. Usually, the air treatment unit and the passenger compartment inside the car body are connected to one another by means of individual through ducts, which are individually passed through holes in the upper end wall of the double-deck rail vehicle, as disclosed e.g. in KR20110077078. The work of assembling the individual parts that connect the air treatment unit to the air ducts inside the vehicle is time-consuming and tedious, particularly due to access difficulties.

SUMMARY OF THE INVENTION

[0004] The invention aims to provide a vehicle configuration in which the use of pre-assembled modules to facilitate the final assembly of the car body is further increased. According to a first aspect of the invention, there is provided an interface module for a double-deck car body of a rail vehicle comprising an upper end wall facing a lower roof section at an end of an upper deck of the double-deck car body, wherein the upper end wall is provided with an opening having a maximal width larger than 1m, preferably larger than 1,2 m and a maximal height larger than 0,5 m, preferably larger than 0,8 m, and the double-deck car body is provided with an air treatment unit located on top of the lower roof section, the air treatment unit facing at a distance the upper end wall and the opening. Throughout the description, the terms "interface module" define a structural unit, which is pre-assembled before it is mounted on the rail vehicle. The interface module of the invention comprises a mounting plate

shaped to be joined with/ to fit over a peripheral edge of the opening so as to close and seal the opening, and through ducts tightly passing through the mounting plate for tightly connecting the air treatment unit to an interior space of the double-deck car body.

[0005] The opening of the upper front wall is large enough to enable the introduction into the car body of bulky pre-assembled and pre-tested subunits or modules of the interior fitting, such as complete overhead luggage racks, ceilings, seat modules or air ducts modules. Once these items have been introduced in the car body, the interface module is used both to close the large opening of the upper front wall of the car body and to connect the air treatment unit to the car body.

[0006] The air treatment unit can be an air heating unit, an air conditioning unit, an air filtering unit, an air ventilating unit or a unit combining one or more of filtering, heating, ventilation and air conditioning (HVAC).

[0007] In one embodiment, the air treatment unit is provided with several air outlet ports and at least one air inlet port, the through ducts including inlet through ducts for connecting the air outlet ports to inlet air distribution ducts provided inside the double-deck car body for distributing inlet air into an interior space of the double-deck car body, and at least one outlet through duct for connecting the at least one air inlet port to the interior space of the double-deck car body. The through duct can be straight and parallel to each other, or intertwined, if necessary, to ensure a proper connection between each outlet port of the air treatment unit and a corresponding air distribution duct inside the double-deck car body. As the interface module is pre-assembled and constitutes a structural unit, a complex layout of the through duct can be chosen if necessary while keeping subsequent installation on the vehicle simple.

[0008] In one embodiment, a sealing gasket assembly is provided for sealing an interface between the mounting plate and the peripheral edge of the opening.

[0009] In one embodiment, the through ducts are rigidly fixed at an intermediate portion thereof to the mounting plate.

[0010] In one embodiment, a reinforcement frame is attached to an inner side of the mounting plate for supporting the through ducts.

[0011] In one embodiment, through ducts are rigid.

[0012] In one embodiment, at least one of the through ducts is provided with a connection flange for connecting said at least one of the through ducts to an air duct inside the double-deck car body. One or more of the connection flanges may be provided fast release clamps.

[0013] In one embodiment, the interface module comprises an end plate for connecting the air treatment unit to the through ducts, the end plate being provided with apertures through which the through ducts exit. The end plate can be provided with ring seals for individually sealing a periphery of each of the apertures of the end plate.

[0014] In one embodiment, the interface module is provided with one or more electrical bushings for electrical

connections between an electrical circuit inside the car body and outside electrical conductors. Preferably, at least one of the one or more electrical bushings is provided with at least one electrical terminal on one side of the mounting plate and preferably with two opposite electrical terminals on both sides of the mounting plate.

[0015] The above-mentioned embodiments can be combined.

[0016] According to another aspect of the invention, there is provided an assembly method for assembling a double deck car body of a rail vehicle, the double-deck car body comprising: an upper end wall facing a lower roof section at an end of an upper deck of the double-deck car body, wherein the upper end wall is provided with an opening having a maximal width larger than 1m, preferably larger than 1,2 m and a maximal height larger than 0,5 m, preferably larger than 0,8 m. The method comprises

- Closing the opening with an interface module as described above,
- Providing an air treatment unit onto the lower roof section, the air treatment unit facing the upper end wall,
- Fixing the interface module to the air treatment unit such that the through ducts are tightly connected to the air treatment unit,
- Fixing the air treatment unit to the lower roof section at a distance from the upper end wall and opening, and
- Connecting at least one of the through ducts to an air distribution duct provided inside the double-deck car body.

[0017] Fixing the interface module to the air treatment unit may include tightly connecting the through ducts of the interface module to corresponding air ports of the air treatment unit.

[0018] In one embodiment, the interface module is fixed to the air treatment unit before the opening is closed with the interface module and the air treatment unit is fixed to the lower roof section. In an alternative embodiment, the opening is closed with the interface module before the interface module is fixed to the air treatment unit and the air treatment unit is fixed to the lower roof section.

[0019] Advantageously, bulky pre-assembled and pre-tested subunits or modules of the interior fitting of the upper deck of the double-deck car body can be inserted through the opening before closing the opening with the interface module.

[0020] According to another aspect of the invention, there is provided a double-deck car body of a rail vehicle comprising:

- a lower roof section and an upper end wall facing the lower roof section at an end of an upper deck of the double-deck car body, wherein the upper end wall is provided with an opening having a maximal width larger than 1m, preferably larger than 1,2 m and a maximal height larger than 0,5 m, preferably larger than 0,8 m,
- an air treatment unit located on the lower roof section, the air treatment unit facing at a distance the upper end wall and the opening, and
- an interface as disclosed hereinbefore, wherein the mounting plate closes and seals the opening, and
- the through ducts are connected to the air treatment unit and to the interior space of the double-deck car body.

[0021] In one embodiment, the air treatment unit is provided with several air outlet ports and at least one air inlet port, the through ducts including inlet through ducts, which connect the air outlet ports to inlet air distribution ducts provided inside the double-deck car body for distributing inlet air into an interior space of the double-deck car body, and at least one outlet through duct which connects the at least one air inlet port to the interior space of the double-deck car body.

BRIEF DESCRIPTION OF THE FIGURES

[0022] Other advantages and features of the invention will then become more clearly apparent from the following description of a specific embodiment of the invention given as non-restrictive example only and represented in the accompanying drawings in which:

- figure 1 is a longitudinal section through a double-deck car body of a rail vehicle according to the invention;
- figure 2 is a schematic front view of the double-deck car body of figure 1.
- figure 3 is an isometric view of an interface module for the car body of figure 1;
- figure 4 is another isometric view of the interface module of figure 2.

[0023] Corresponding reference numerals refer to the same or corresponding parts in each of the figures.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

[0024] With reference to Figure 1, a double-deck car body 10 of a rail vehicle has an interior space 12 divided

into a lower deck 14, an upper deck 16, and one or more vestibules 18 for passengers to enter or exit the rail vehicle and access the lower and upper decks 14, 16. Each vestibule 18 is covered by a lower roof section 20. An upper roof section 22 covers the upper deck 16. An upper end wall 24 of the upper deck 16 faces the lower roof section 20 at one end of the upper deck 16. The upper end wall 24 is provided with an opening 26, which has a cross-section area greater than 0,65 m², a maximal width larger than 1m, preferably larger than 1,2 m and a maximal height larger than 0,5 m, preferably larger than 0,7 m.

[0025] Each of the lower and upper decks 14, 16 is provided with inlet air ducts 28 for distributing inlet air into the car body, e.g. along each side wall of each deck and/or in the ceiling of each of the lower and upper decks. The car body is further provided with one or more outlet air vents and/or ducts 30, e.g. one for the upper deck 16, one for the lower deck 14 and one for each vestibule 18.

[0026] An air treatment unit 32, e.g. an HVAC unit, is fixed onto the lower roof section 20 outside of the car body 10 and faces the upper end wall 24 and the opening 26 at a distance outside from the opening 16 and from the upper end wall 24. The air treatment unit 32 is provided with several air outlet ports 34 and at least one air inlet port 36. The air outlet ports and air inlet port(s) are preferably coplanar.

[0027] A preassembled interface module 40 is used to connect the air treatment unit 32 with the inlet air ducts 28 and with the interior space 12 of the double-deck car body 10. This preassembled interface module 40, illustrated in more details in figures 3 and 4, comprises a mounting plate 42 shaped to fit over a peripheral edge of the opening 26 in the upper end wall 24 of the car body 10 so as to close and seal the opening 26. A sealing gasket assembly 44 seals the interface between the mounting plate 42 and the peripheral edge of the opening 26. This sealing gasket assembly 44 may be part of the interface module 40 or provided independently.

[0028] The preassembled interface module further comprises an end plate 46 located at a distance from the mounting plate 42 and shaped so as to fit onto the wall of the air treatment unit 32 and a set of through ducts 48, 50 that pass tightly through the mounting plate 42 and terminate in apertures of the end plate 46.

[0029] The set of through ducts includes inlet through ducts 48 for connecting the air outlet ports 34 to the inlet air distribution ducts 28 provided inside the double-deck car body 10 and at least one outlet through duct 50 for connecting the at least one air inlet port 36 of the air treatment unit 32 to the one or more outlet air vents and/or ducts 30 and to the interior space 12 of the double-deck car body 10.

[0030] The through ducts 48, 50 are preferably rigid or semi-rigid at least in an intermediate portion between the mounting plate 42 and the end plate 46.

[0031] The end plate 46 is provided with individual seal rings 52 around each of the apertures to ensure a tight connection between the through ducts 48, 50 and the re-

spective inlet and outlet air ports of the air treatment unit 32.

[0032] Inside the car body 10, the inlet through ducts 48 protrude inwardly from the mounting plate 42 and are each connected to one or more of the inlet air distribution ducts 28. The inlet through ducts 48 are preferably provided each with a connection flange 54 with a quick release clamp for fast connection with a respective one of the inlet air distribution ducts 28. The air distribution ducts 28 may be parallel to one another as shown or intertwined, if necessary.

[0033] The outlet through duct 50 may be directly open into the interior space 12 or connected to the interior space through one or more outlet air distribution ducts (not shown).

[0034] The interface module 40 may comprise a reinforcement frame 56 attached to an inner side of the mounting plate 42 for supporting one or more of the through ducts 48, 50.

[0035] The interface module 40 may further be provided with one or more electrical bushings (not shown) for connecting an electrical circuit inside the car body 10 and outside electrical conductors, e.g. for connection to the air treatment unit 32. The one or more electrical bushings are preferably provided with at least one electrical terminal on one side of the interface module and preferably with two opposite electrical terminals on both sides of the interface module.

[0036] During assembly of the car body 10, bulky pre-assembled and/or pre-tested subunits or modules of the interior fitting of the upper deck of the car body can be inserted through the opening 26 before the opening is closed with the interface module 40. The air treatment unit 32 is subsequently placed onto the lower roof section 20 and connected to the end plate 46 of the interface module 40. Alternatively, the interface module 40 is fixed to the treatment unit 32 before the subassembly comprising the air treatment unit 32 and the interface module 40 is fitted to the lower roof section 20.

[0037] The through ducts 48, 50 are subsequently connected to the inlet air distribution ducts 28 by means of the quick release clamps 54.

[0038] As a variant, one of the vestibules can be entirely and partly replaced with a driver's cabin.

Claims

1. An interface module (40) for a double-deck car body (10) of a rail vehicle comprising an upper end wall (24) facing a lower roof section (20) at an end of an upper deck (16) of the double-deck car body (10), wherein the upper end wall (24) is provided with an opening (26) having a maximal width larger than 1m, preferably larger than 1,2 m and a maximal height larger than 0,5 m, preferably larger than 0,8 m, and the double-deck car body (10) is provided with an air treatment unit (32) located on top of the lower roof

section (20), the air treatment unit (32) facing at a distance the upper end wall (24) and the opening (26),

characterised in that the interface module (40) comprises

- a mounting plate (42) shaped to be joined with/ to fit over a peripheral edge of the opening (26) so as to close and seal the opening (26), and
- through ducts (48, 50) tightly passing through the mounting plate (42) for tightly connecting the air treatment unit (32) to an interior space (12) of the double-deck car body (10).

2. The interface module (40) of claim 1, wherein the air treatment unit (32) is provided with several air outlet ports and at least one air inlet port, the through ducts including inlet through ducts (48) for connecting the air outlet ports to inlet air distribution ducts (28) provided inside the double-deck car body (10) for distributing inlet air into an interior space (12) of the double-deck car body (10), and at least one outlet through duct (50) for connecting the at least one air inlet port to the interior space (12) of the double-deck car body (10).
3. The interface module (40) of claim 1 or claim 2, further provided with a sealing gasket assembly (44) for sealing an interface between the mounting plate (42) and the peripheral edge of the opening (26).
4. The interface module (40) of any one of the preceding claims, wherein the through ducts (48, 50) are rigidly fixed at an intermediate portion thereof to the mounting plate (42).
5. The interface module (40) of any one of the preceding claims, further comprising a reinforcement frame (56) attached to an inner side of the mounting plate (42) for supporting the through ducts (48, 50).
6. The interface module (40) of any one of the preceding claims, wherein the through ducts (48, 50) are rigid.
7. The interface module (40) of any one of the preceding claims, wherein at least one of the through ducts (48, 50) is provided with a connection flange (54) for connecting said at least one of the through ducts (48, 50) to an air duct (28) inside the double-deck car body (10), wherein the connection flange (54) is preferably provided with a fast release clamp.
8. The interface module (40) of any one of the preceding claims, further provided with an end plate (46) for connecting the air treatment unit (32) to the through ducts (48, 50), the end plate (46) being provided with apertures through which the through ducts

(48, 50) exit.

9. The interface module (40) of claim 8, wherein the end plate (46) is provided with ring seals (52) for individually sealing a periphery of each of the apertures of the end plate (46).
10. The interface module (40) of any one of the preceding claims, further provided with one or more electrical bushings for electrical connections between an electrical circuit inside the car body and outside electrical conductors.
11. An assembly method for assembling a double deck car body (10) of a rail vehicle, the double-deck car body comprising: an upper end wall (24) facing a lower roof section (20) at an end of an upper deck (16) of the double-deck car body (10), wherein the upper end wall (24) is provided with an opening (26) having a maximal width larger than 1m, preferably larger than 1,2 m and a maximal height larger than 0,5 m, preferably larger than 0,8 m,
characterised in that the method comprises:
 - Closing the opening with an interface module (40) according to any one of the preceding claims,
 - Providing an air treatment unit (32) onto the lower roof section (20), the air treatment unit (32) facing the upper end wall (24),
 - Fixing the interface module (40) to the air treatment unit (32) such that the through ducts (48) are tightly connected to the air treatment unit (32),
 - Fixing the air treatment unit (32) to the lower roof section (20) at a distance from the upper end wall (24) and opening (26), and
 - Connecting at least one of the through ducts (48) to an air distribution ducts (26) provided inside the double-deck car body (10).
12. The assembly method of claim 11, wherein fixing the interface module (40) to the air treatment unit (32) includes tightly connecting the through ducts (48, 50) of the interface module (40) to corresponding air ports of the air treatment unit (32).
13. The assembly method of claim 11 or claim 12, wherein one of the following is true:
 - The interface module (40) is fixed to the air treatment unit (32) before the opening is closed with the interface module (40) and the air treatment unit (32) is fixed to the lower roof section (20), or
 - The opening is closed with the interface module (40) before the interface module (40) is fixed to the air treatment unit (32) and the air treatment

unit (32) is fixed to the lower roof section (20).

14. The assembly method of any one of claims 11 to 13, wherein bulky pre-assembled and pre-tested subunits or modules of the interior fitting of the upper deck (16) of the double-deck car body (10) are inserted through the opening (26) before closing the opening (26) with the interface module (40). 5
15. A double-deck car body (10) of a rail vehicle comprising 10
- a lower roof section (20) and an upper end wall (24) facing the lower roof section (20) at an end of an upper deck (16) of the double-deck car body (10), wherein the upper end wall (24) is provided with an opening (26) having a maximal width larger than 1m, preferably larger than 1,2 m and a maximal height larger than 0,5 m, preferably larger than 0,8 m, 15 20
 - an air treatment unit (32) located on the lower roof section (20), the air treatment unit (32) facing at a distance the upper end wall (24) and the opening (26), and
 - an interface module (40) according to any one of claims 1 to 11, wherein the mounting plate (32) closes and seals the opening (26), and 25
 - the through ducts (48) are connected to the air treatment unit and to the interior space (12) of the double-deck car body (10). 30

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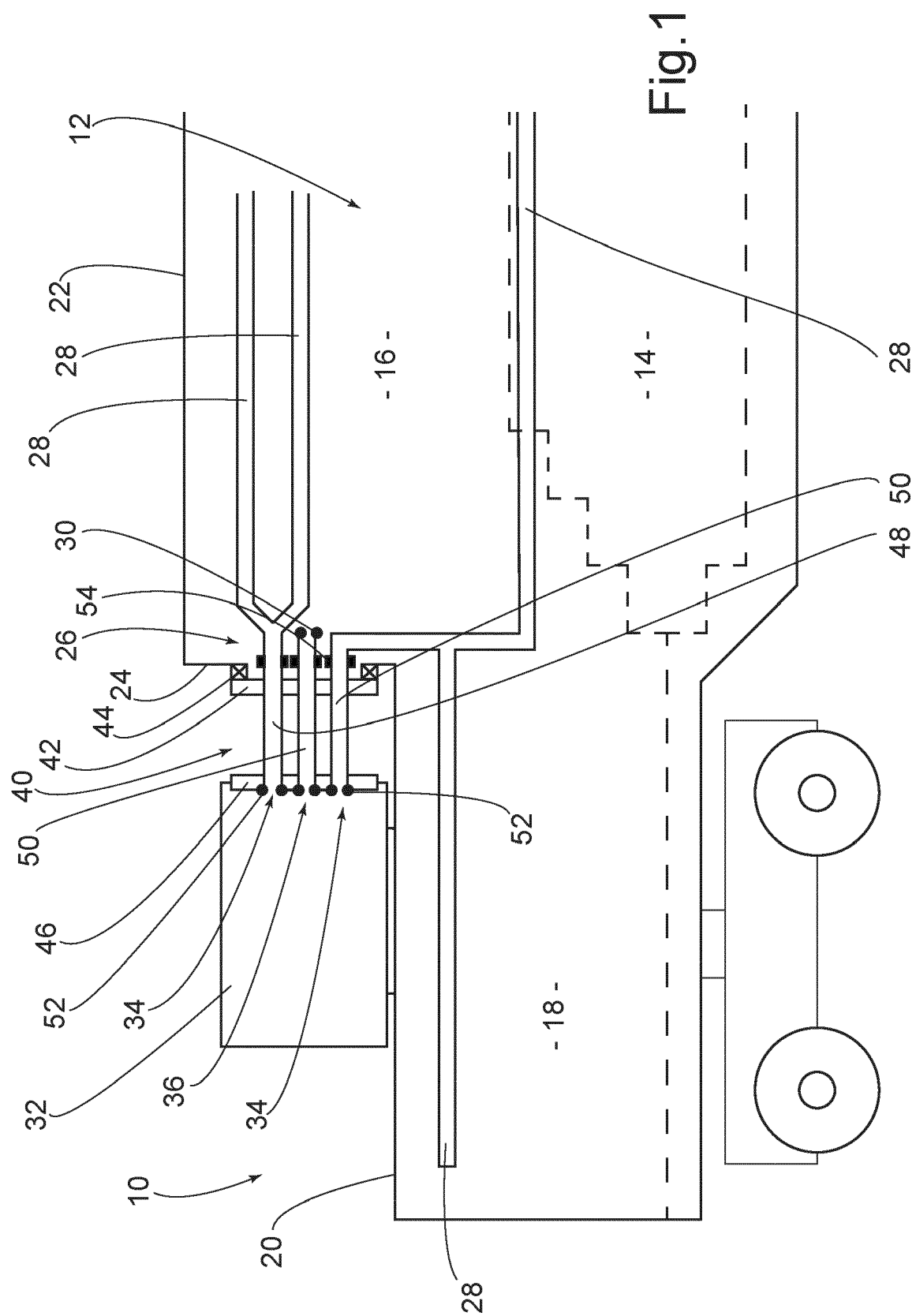
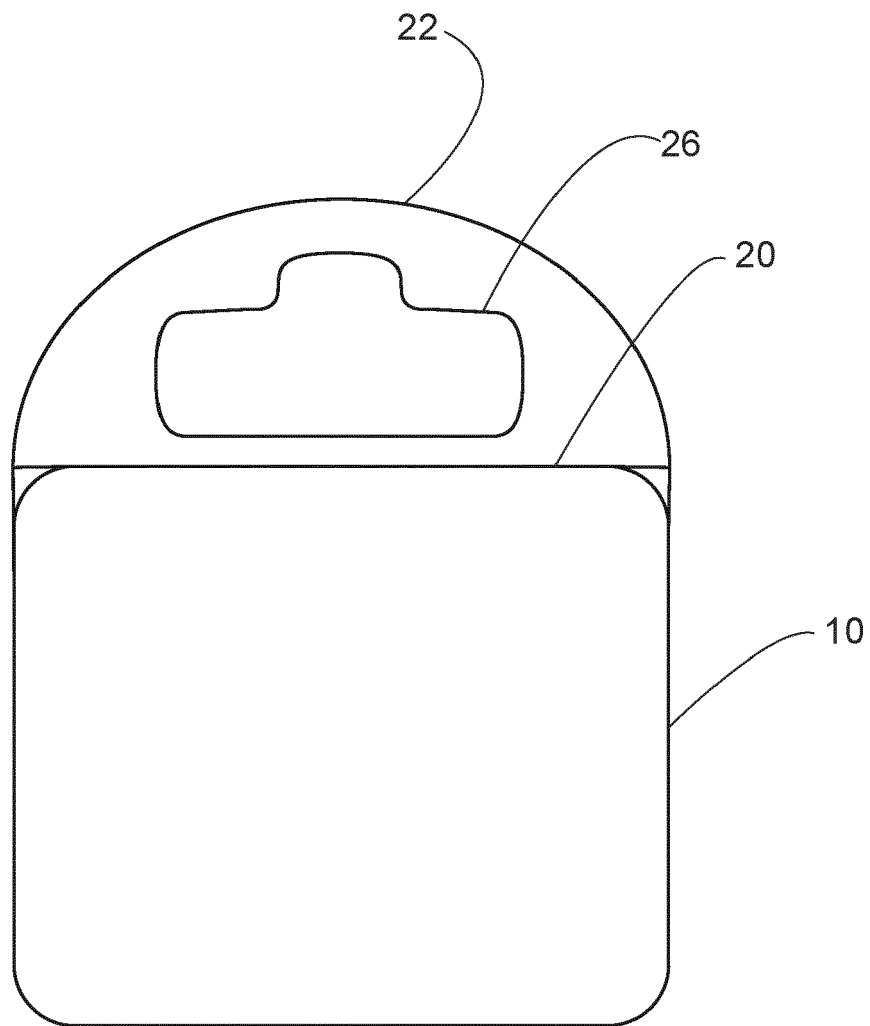
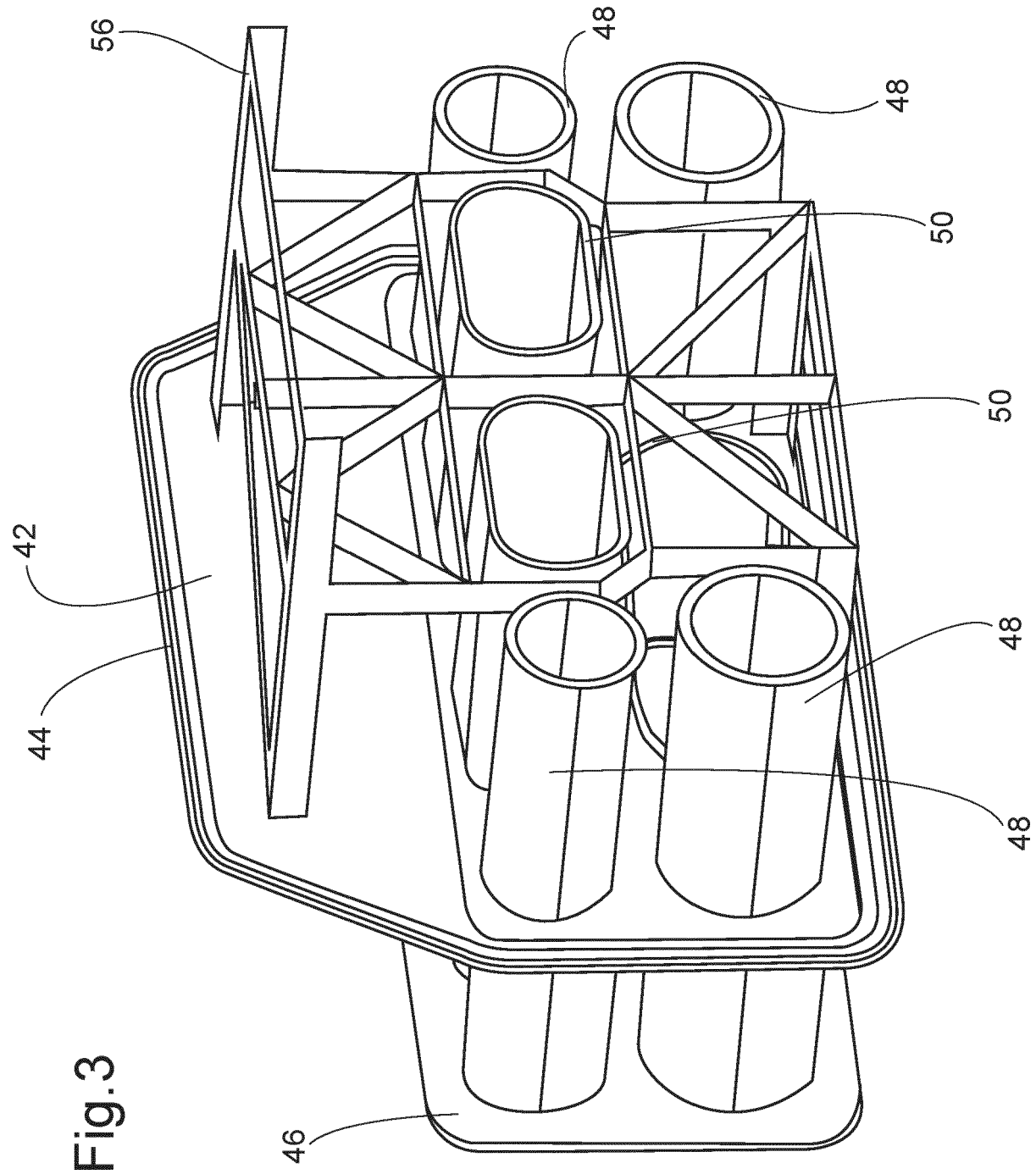


Fig.2





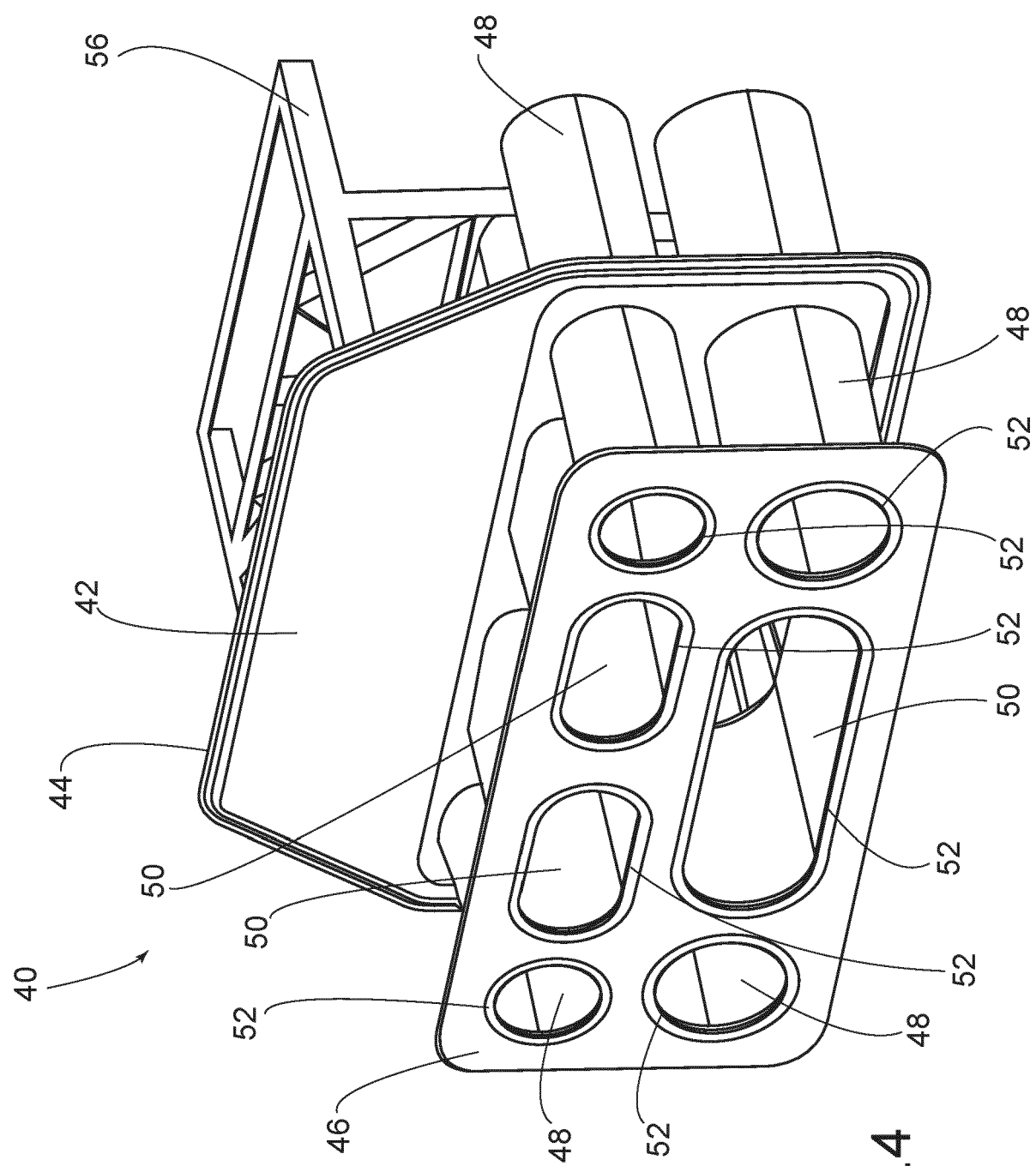


Fig.4



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Application Number

EP 22 30 6807

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Place of search Munich		Date of completion of the search 2 May 2023	Examiner Crama, Yves
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**ANNEX TO THE EUROPEAN SEARCH REPORT
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