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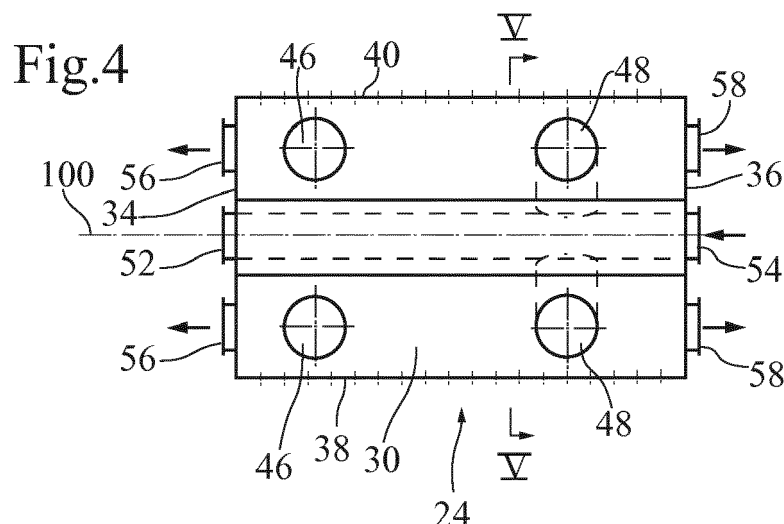
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(54) **Air distribution box and associated rail vehicle**

(57) An air distribution box (24) for directing supply air from an HVAC unit (14) located outside a car body (12) of a rail vehicle to a passenger area (26) inside the car body (12) and for directing return air from the passenger area (26) to the HVAC unit (14) has at least a top wall (30), a bottom wall (32), front, rear and side walls (34, 36, 38, 40). The air distribution box (24) is provided with one or more return air ducts (50) extending between one or more return inlets (52, 54) through at least one of

the front, rear and side walls (34, 36, 38, 40) and one or more return outlets (48) through the top wall (30), one or more supply inlets (46) through the top wall (30) and one or more supply outlets (56, 58) through at least one of the front, rear and side walls (34, 36, 38, 40). The top wall (30), bottom wall (32), front, rear and side walls (34, 36, 38, 40) define a supply air path inside the air distribution box (24) between the one or more supply inlets (46) and the one or more supply outlets (56, 58).



Description

TECHNICAL FIELD OF THE INVENTION

[0001] This invention relates to an interface between a heating, ventilation and/or air conditioning (HVAC) unit located outside a rail vehicle and the inside of the rail vehicle, in particular a passenger area of the rail vehicle.

BACKGROUND ART

[0002] KR100791448 discloses a ventilation system for a building, which includes a ventilation unit connected to a ducting inside the building via a box-like structure, which defines a split chamber. A partition wall extends in the split chamber from an upper part to a lower part to divide the split chamber into an air supply chamber and an exhaust chamber. At least two or more air supply ducts are connected with the air supply chamber. At least one or more exhaust ducts are connected with the exhaust chamber. A plurality of air supply ports are connected with the air supply ducts to supply external air into a room. A plurality of exhaust ports are connected with the exhaust chamber to exhaust polluted air from the room to the outside. The air supply ducts and the exhaust duct are formed so as not to cross each other in a ceiling to prevent generation of an overlapped part. The supply exhaust ports connecting the box-like structure with the ducting on the one hand and those connecting the box-like structure with the ventilation unit on the other hand are located on opposite sides of the box-like structure. Such a structure, however, is not adapted to a rail vehicle.

[0003] Accordingly, there is a need for a standardised and compact interface structure between an HVAC unit located outside a rail vehicle and the ducting inside the vehicle.

SUMMARY OF THE INVENTION

[0004] According to one aspect of the invention, there is provided an air distribution box for directing supply air from an HVAC unit located outside a car body of a rail vehicle to a passenger area inside the car body and for directing return air from the passenger area to the HVAC unit, the box having at least a top wall, a bottom wall, front, rear and side walls, wherein the box is provided with one or more return air ducts extending between one or more return inlets through at least one of the front, rear and side walls of the box and one or more return outlets through the top wall of the box, one or more supply inlets through the top wall of the box and one or more supply outlets through at least one of the front, rear and side walls, wherein the top wall, bottom wall, front, rear and side walls of the box define a supply air path between the supply inlet and the supply outlet and the supply air path surrounds the one or more return air ducts. No ducts are used to direct the supply air to the supply air outlets and as a result space is saved and the construction sim-

plified. The box is able to withstand the internal pressure, which is higher in the supply air path than in the surrounding passenger area.

[0005] The one or more return outlets may include at least two opposite return outlets located on opposite sides of a vertical median plane of the air distribution box, and preferably on opposite side of a vertical longitudinal median plane.

[0006] The one or more return ducts may include at least two return ducts located on opposite sides of a vertical median plane, preferably a vertical longitudinal median plane, of the air distribution box and extending parallel to the median plane.

[0007] The one or more return ducts may comprise at least one return duct located on a vertical median plane, preferably a vertical longitudinal median plane, of the air distribution box and extending in a longitudinal direction of the air distribution box.

[0008] At least one of the return ducts may include a L-shaped or T-shaped portion between the return inlet and return outlet.

[0009] The one or more return inlets may include at least two opposite return inlets through two respective opposite walls from the front, rear and side walls, the two opposite return inlets being connected to a common return duct. The two opposite walls are preferably the front and rear walls.

[0010] The one or more return inlets may all be located on a single wall or on two opposite walls from the front, rear and side walls, preferably on the front and/or rear walls.

[0011] The one or more supply outlets may all be located on a single wall or on two opposite walls from the front, rear and side walls, preferably on the front and/or rear walls.

[0012] At least one of the inlets or outlets can be closed with a plug if in a particular configuration it is not needed.

[0013] The bottom wall preferably includes a trapdoor.

[0014] At least one of the bottom wall and front, rear, and side walls may include through holes to supply air in the passenger area.

[0015] The top wall may include a recess extending between two opposite walls from the front, rear and side walls, which can be used as a passage for electrical cables.

[0016] As the supply air surrounds the return duct in the air distribution box, an additional heat exchange effect may be achieved if the supply air and return air have different temperatures. This heat exchange effect may or may not be desired. It can be enhanced if the exchange surface of the return duct is increased, e.g. if the duct is corrugated. It can be minimised if the return duct is provided with a heat insulation coating.

[0017] According to another aspect of the invention, there is provided a rail vehicle comprising a vehicle body, a HVAC unit located on a roof of the vehicle body and supply and return passageways between the HVAC unit and an air distribution box as described hereinbefore,

located in a ceiling above a passenger area inside the vehicle body, wherein the one or more supply inlets and the one or more return outlets of the air distribution box are connected to the supply and return passageways, respectively. The one or more supply outlets of the air distribution box are preferably connected to a supply ducting of the vehicle body. The one or more return inlets of the air distribution box are preferably connected to a return ducting of the vehicle body. The top wall of the air distribution box may include a recess extending between two opposite walls from the front, rear and side walls, and the rail vehicle further comprises electric cables extending through the recess.

DESCRIPTION OF THE FIGURES

[0018] Other advantages and features of the invention will 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:

- Fig. 1 is a cross-section of an upper part of a car body of a rail vehicle;
- Fig. 2 is a side view of an air distribution box according to a first embodiment of the invention, located in a ceiling of the car body of Fig. 1;
- Fig. 3 is a front view of the air distribution box of Fig. 2;
- Fig. 4 is a top view of the air distribution box of Fig. 2;
- Fig. 5 is a cross-section along the line V-V of Fig. 4;
- Fig. 6 is a detail in the zone VI of Fig. 5;
- Fig. 7 is a top view of the rail vehicle of Fig. 1;
- Fig. 8 is a top view of an alternative arrangement of an air distribution box in a rail vehicle according to a second embodiment of the invention;
- Fig. 9 is a top view of an alternative arrangement of an air distribution box in a rail vehicle according to a third embodiment of the invention;
- Fig. 10 is a side view of an air distribution box according to a fourth embodiment of the invention;
- Fig. 11 is a front view of the air distribution box of Fig. 10;
- Fig. 12 is a top view of the air distribution box of Fig. 10;
- Fig. 13 is a cross-section along the line XIII-XIII of Fig. 12.

[0019] Corresponding reference numerals refer to the same or corresponding parts in each of the figures.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

[0020] Referring to Figure 1, a rail vehicle 10 comprises a vehicle body 12, a HVAC unit 14 located on a roof 16 of the vehicle body and supply (18) and return (20) passageways between the HVAC unit and an inside 22 of the vehicle body 12.

[0021] An air distribution box 24 is located in a ceiling 25 above a passenger area 26 of the vehicle body 12, directly below the HVAC unit 14, and fixed to the roof structure 16 via attachment brackets 28. The air distribution box 24 is connected to the supply (18) and return (20) passageways for directing supply air from the HVAC unit 14 through the roof 16 to the passenger area 26 and for directing return air from the passenger area 26 to the HVAC unit 14.

[0022] The air distribution box 24, which is illustrated in more detail in Figs. 2 to 5, has the general shape of a cuboid with a top wall 30, a bottom wall 32, a front wall 34, a rear wall 36 and side walls 38, 40. The top wall 30 has a longitudinal recess 42, which extends from the front wall 34 to the rear wall 36 at mid distance between the side walls 38, 40, and forms a cable duct to accommodate electrical cables 44. The top wall 30 is provided with two supply inlets 46 symmetrically located on two sides of a median longitudinal vertical plane 100 of the air distribution box 24, and two return outlets 48, also symmetrically positioned on the two sides of the median longitudinal vertical plane 100. The two return outlets 48 are connected, each via an 90° bend, to a central return duct 50 extending longitudinally in the air distribution box 24 between a front return inlet 52 through the front wall 34 of the air distribution box 24 and a rear return inlet 54 through the rear wall 36 of the air distribution box 24. The front wall 34 is provided with two supply outlets 56 on each side of the central front return inlet 52. Similarly, the rear wall 36 is provided with two supply outlets 58 on each side of the central rear return inlet 54. The walls 30, 32, 34, 36, 38, 40 of the air distribution box 24 define an air chamber 60 inside the air distribution box 24, which surrounds the return duct 50 and provides an air path between the supply inlets 46 and supply outlets 56, 58. As illustrated in Fig. 5, the bottom wall 32 preferably includes a trapdoor 62 to access the chamber within the air distribution box 24 for maintenance purposes. A row of through holes 64, illustrated in Fig. 6, may be provided in the side walls to provide additional supply outlets from the chamber 60 to the part of the passenger area 26 directly below, e.g. a vestibule. At least some of the through holes 64 can be closed, e.g. by plugs.

[0023] As illustrated in Fig. 7, the supply (46) and return (52, 54) inlets and supply (56, 58) and return (48) outlets are preferably provided with collars or flanges 66 or other mechanical couplings for connection with a supply air

ducting **68** provided e.g. in the side walls of the car body **12** and with a return air ducting **70** provided e.g. in the ceiling **25** of the car body **12**.

[0024] Pressurised supply air from the HVAC unit **14** enters the vehicle **10** through the supply passageways **18** and is directed through the supply inlets **46** into the chamber **60** within the air distribution box **24**. The air pressure in the chamber **60** is higher than in the passenger area **26** and the supply air exits the air distribution box **24** via the supply outlets **56**, **58** which are connected with the supply ducting **68** for distributing the supply air in the passenger area **26** and, if provided via the additional outlets **64**. Return air sucked by the HVAC unit **14** follows a path from the passenger area **26** through the return air ducting **70**, the return inlets **52**, **54** the return duct **50**, the return outlet **48** and return passageway **20** to the HVAC unit **14**. The supply ducting **68** may include a front portion **68F** connected to the supply outlets **56** of the front wall **34** for distributing supply air to a front portion **26F** of the passenger area **26** and a rear portion **68R** connected to the rear supply outlets **58** for distributing supply air to a rear portion **26R** of the passenger area **26**. In such a case, the HVAC unit **14** and distribution box **24** are preferably located at an intermediate location close to a centre position between the ends of the car body **12**.

[0025] Alternatively, according to a second embodiment illustrated in Fig. **8**, the HVAC unit **14** and distribution box **24** may be located close to one end of the car body, e.g. the rear end, in which case the supply outlets **58** and return inlet **54** through the rear wall **36** can be plugged with appropriate plugs **72**.

[0026] According to a third embodiment illustrated in Fig. **9**, the supply outlets **56**, **58** are provided on two opposite side walls **38**, **40** of the air distribution box while the return inlets **52**, **54** are provided on the front wall **34** and rear wall **36**.

[0027] According to another embodiment, the supply outlets **56**, **58** and return inlets **52**, **54** can be provided on the side walls **38**, **40** to be connected to right and left side portions of the supply ducting and of the return ducting.

[0028] The air distribution box **24** illustrated in Figs. **10** to **13** is provided with two parallel return ducts **50** extending longitudinally on both sides of the median longitudinal vertical plane **100** each with one front return inlet **52** through the front wall **34**, one rear return inlet **54** through the rear wall **36**, and one return outlet **48** through the top wall **30**, connected to the return duct **50** via a T-shaped branch inside the air distribution box **24**. The walls of the air distribution box **24** define a supply chamber **60** that surrounds the two return ducts **50** and provides an air path between two supply inlets **46** through the top wall **30**, one rectangular supply outlet **56** through the front wall **34** and one rectangular supply outlet **58** through the rear wall **36**.

Claims

1. An air distribution box (24) for directing supply air from a HVAC unit (14) located outside a car body (12) of a rail vehicle to a passenger area (26) inside the car body (12) and for directing return air from the passenger area (26) to the HVAC unit (14), the air distribution box (24) having at least a top wall (30), a bottom wall (32), front (34), rear (36) and side walls (38, 40), **characterised in that** the air distribution box (24) is provided with one or more return air ducts (50) extending between one or more return inlets (52, 54) through at least one of the front (34), rear (36) and side walls (38, 40) and one or more return outlets (48) through the top wall (30), one or more supply inlets (46) through the top wall (30) and one or more supply outlets (56, 58) through at least one of the front (34), rear (36) and side walls (38, 40), wherein the top wall (30), bottom wall (32), front (34), rear (36) and side walls (38, 40) define a supply air path inside the air distribution box (24) between the one or more supply inlets (46) and the one or more supply outlets (56, 58), wherein the supply air path surrounds the one or more return air ducts (50).
2. The air distribution box (24) of claim 1, **characterised in that** the one or more return outlets (48) include at least two opposite return outlets (48) located on opposite sides of a vertical median plane (100) of the air distribution box (24).
3. The air distribution box (24) of any one of the preceding claims, **characterised in that** the one or more return ducts (50) include at least two return ducts (50) located on opposite sides of a vertical median plane (100) of the air distribution box (24) and parallel to the median plane (100).
4. The air distribution box (24) of any one of the preceding claims, **characterised in that** the one or more return air ducts (50) comprise at least one return air duct (50) located in a vertical median plane (100) of the air distribution box (24) and extending in a longitudinal direction of the air distribution box (24).
5. The air distribution box of any one of the preceding claims, **characterised in that** at least one of the return ducts (50) includes a L-shaped or T-shaped portion.
6. The air distribution box (24) of any one of the preceding claims, **characterised in that** the one or more return inlets (52, 54) include at least two opposite return inlets through two respective opposite walls (34, 36) from the front, rear and side walls, the two opposite return inlets (52, 54) being connected to a common return air duct (50).

7. The air distribution box (24) of any one of the preceding claims, **characterised in that** the one or more return inlets (52, 54) are all located on a single wall or on two opposite walls from the front, rear and side walls (34, 36, 38, 40). 5
8. The air distribution box (24) of any one of the preceding claims, **characterised in that** the one or more supply outlets (56, 48) are all located on a single wall or on two opposite walls from the front, rear and side walls (34, 36, 38, 40). 10
9. The air distribution box (24) of any one of the preceding claims, **characterised in that** at least one of the inlets or outlets is closed with a plug (72). 15
10. The air distribution box (24) of any one of the preceding claims, **characterised in that** the bottom wall (32) includes a trapdoor (62). 20
11. The air distribution box (24) of any one of the preceding claims, **characterised in that** at least one of the bottom wall and front, rear, and side walls (34, 36, 38, 40) includes supply holes (64). 25
12. The air distribution box of any one of the preceding claims, **characterised in that** the top wall (30) includes a recess (42) extending between two opposite walls from the front, rear and side walls (34, 36, 38, 40). 30
13. A rail vehicle (10) comprising at least one car body (12), a HVAC unit (14) located on a roof (16) of the vehicle body, **characterised in that** it further comprises an air distribution box (24) according to any one of the preceding claims located in a ceiling (25) above a passenger area (26) of the vehicle body (12), wherein the one or more supply inlets (46) and the one or more return outlets (48) of the air distribution box (24) are connected to the HVAC unit via supply (18) and return (20) passageways, respectively. 35 40
14. The rail vehicle of the preceding claim, **characterised in that** the one or more supply outlets (56, 58) of the air distribution box (24) are connected to a supply ducting (68) of the vehicle body (12). 45
15. The rail vehicle of any one of claims 13 or 14, **characterised in that** the one or more return inlets (52, 54) of the air distribution box (24) are connected to a return ducting (70) of the vehicle body (12). 50
16. The rail vehicle of any one of claims 13 to 15, **characterised in that** the top wall (30) of the air distribution box (24) includes a recess (42) extending between two opposite walls from the front (34), rear (36) and side walls (38, 40), and the rail vehicle (10) 55
- further comprises electric cables (44) extending through the recess (42).

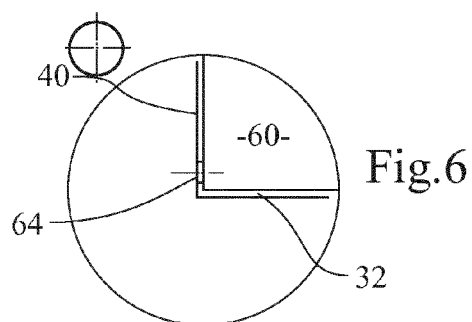
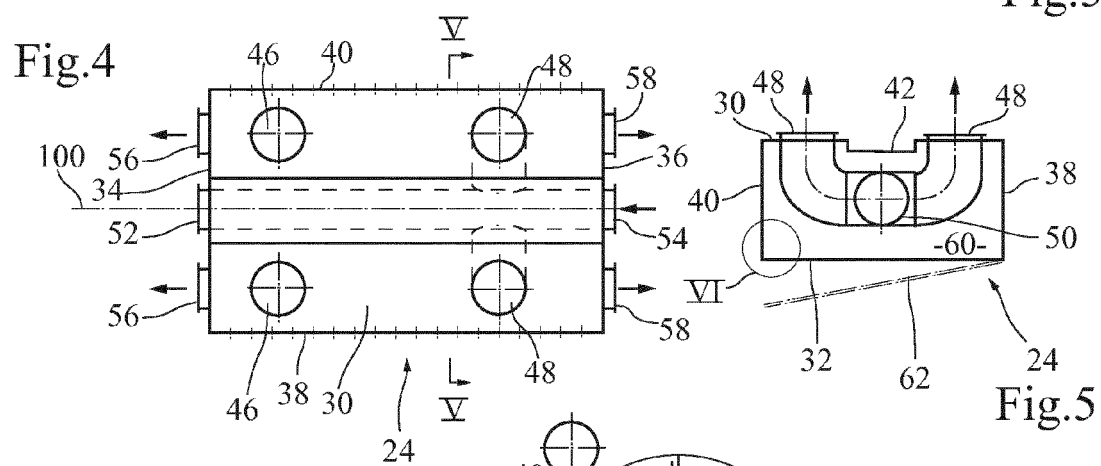
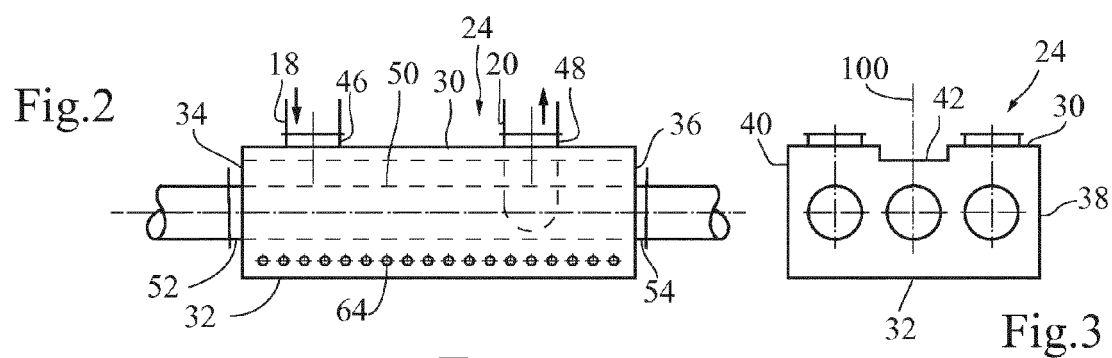
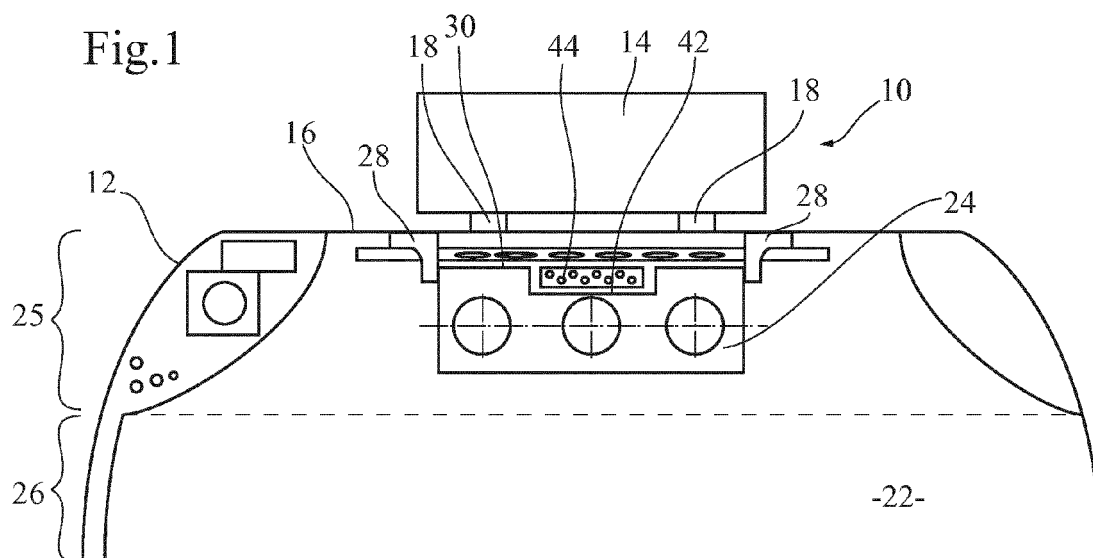


Fig.7

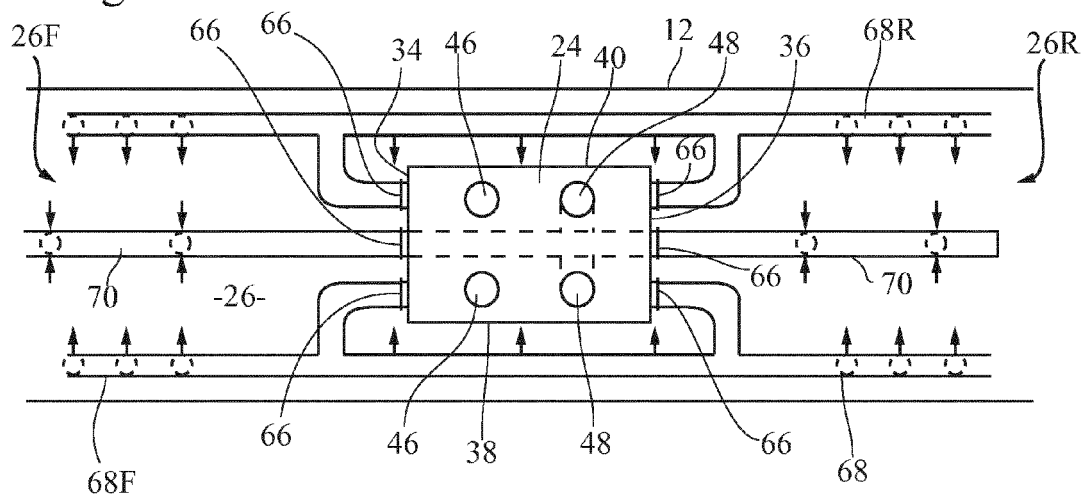


Fig.8

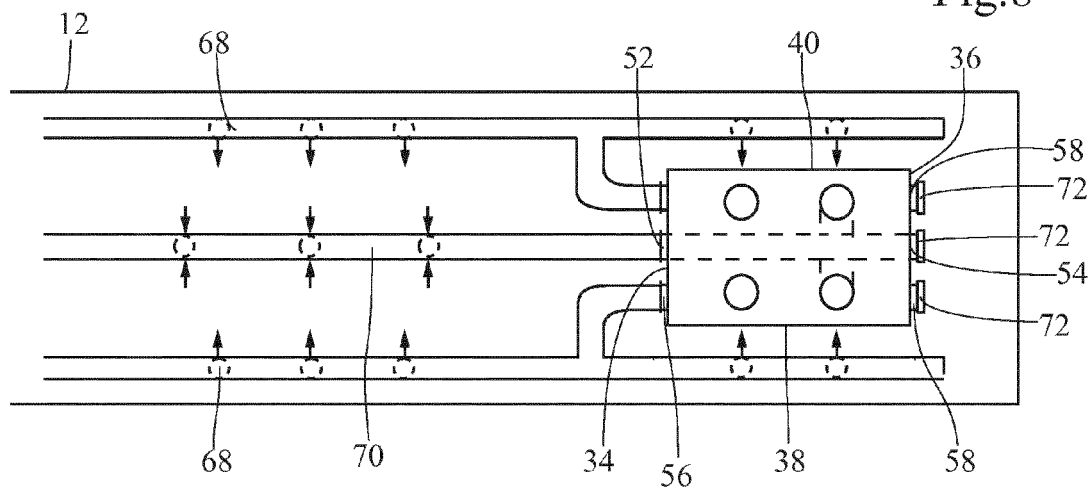


Fig.9

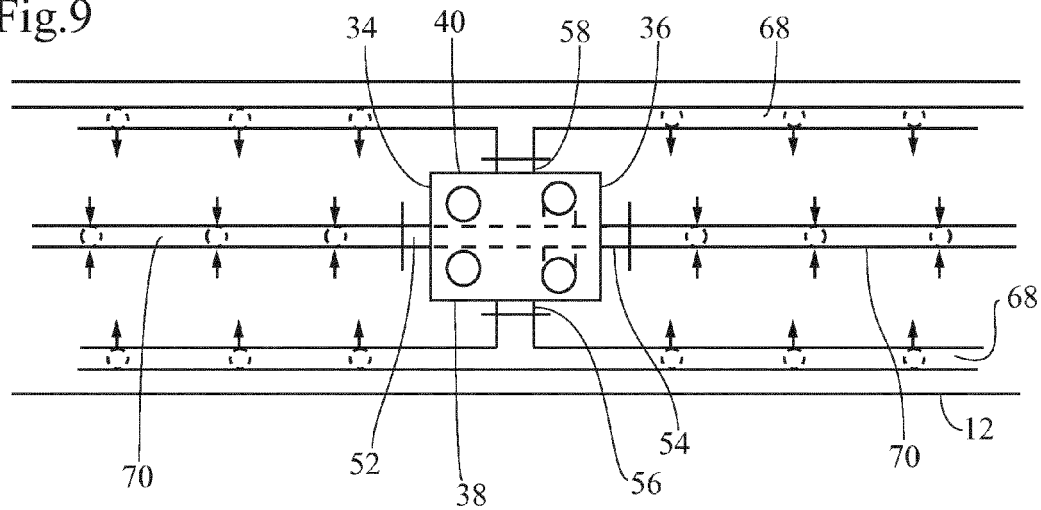


Fig.10

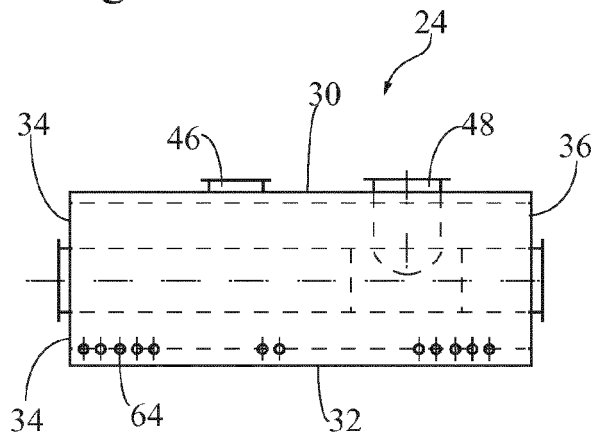


Fig.11

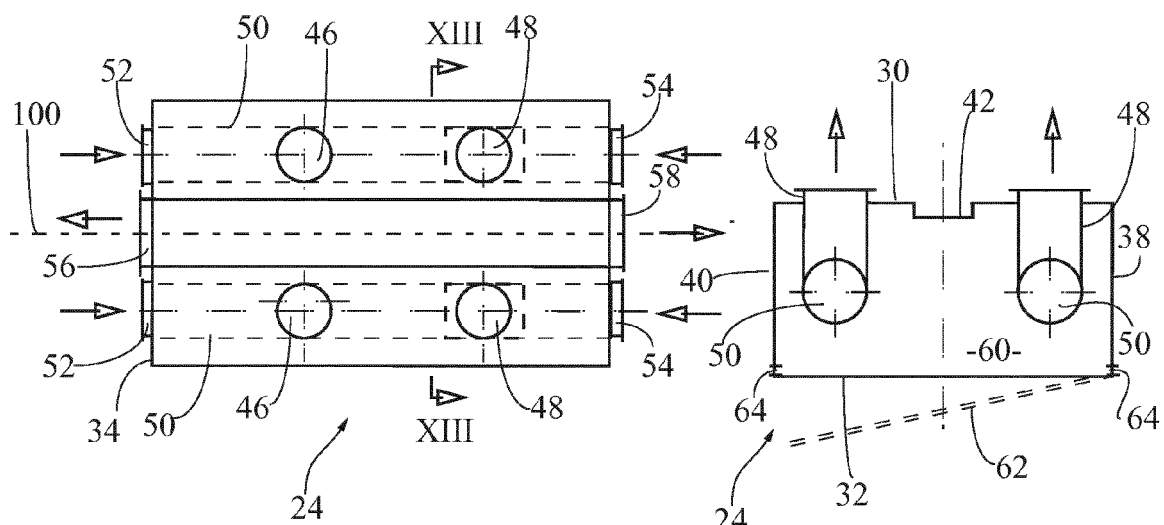
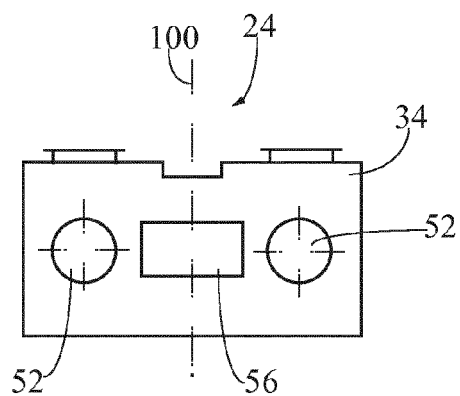


Fig.12

Fig.13



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Application Number
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Place of search Munich		Date of completion of the search 20 January 2015	Examiner Awad, Philippe
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