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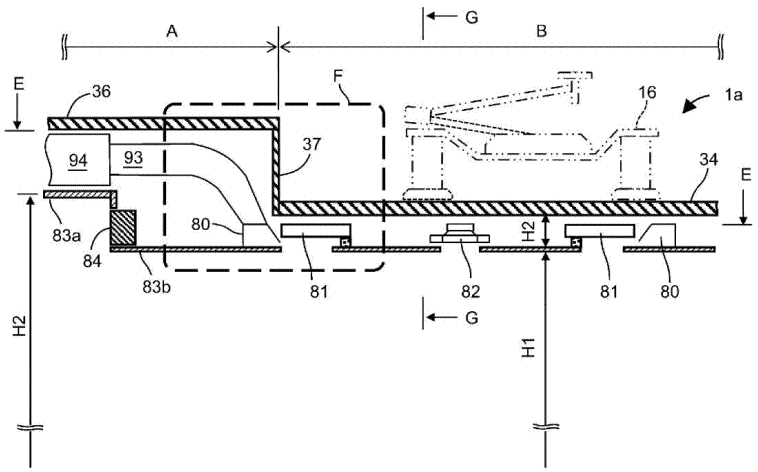
(54) RAILWAY VEHICLE PROVIDED WITH CEILING MODULE

(57) A railway vehicle includes a high roof structure body (36) and a low roof structure body (34), and conditioned air generated by an air conditioner is supplied to inside of the vehicle through an air conditioning duct (80) via air conditioning ducts (92, 93). This air conditioning duct (80) is made up of a circular channel material having an opening surface toward a ceiling panel (83b) arranged below the low roof structure body (34) and the ceiling panel (83b) provided to cover this opening surface. In addition, an ejection port for ejecting air in a substantially horizontal direction toward a center portion of the air conditioning duct (80) so as to cross a flow direction of the conditioned air is provided between the channel material and the ceiling panel (83b).

FIG. 4



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Description

Technical Field

[0001] The present invention relates to a railway vehicle in which a duct for supplying conditioned air whose temperature and humidity are conditioned by an air conditioner is disposed on a ceiling and particularly relates to a railway vehicle having a low roof portion or a railway vehicle that cannot secure a satisfactory ceiling height due to a loading gauge or increase in speed.

Background Art

[0002] Generally, a duct serving as a channel of supply of conditioned air conditioned by an air conditioner, a lighting device, a support portion supporting straps, a luggage rack, broadcast equipment, and the like are disposed on a ceiling portion of a railroad car representing the railway vehicle.

[0003] PTL 1 discloses a ceiling structure with which a manufacturing time of a ceiling portion can be reduced and appearance of a ceiling can be improved. In this ceiling structure, air conditioning ducts, ceiling lamps, speakers, and the like are provided as a plurality of units, and those units are attached to a support portion provided on a lower surface of a roof structure body. In addition, lower surfaces of the respective units are flush with each other so that a flat ceiling surface is obtained.

Citation List

Patent Literature(s)

[0004] PTL 1: JP-UM-B-60-9096

Summary of Invention

Technical Problem(s)

[0005] Among railway vehicles represented by railroad cars, there is a vehicle in which a floor surface height of a railway vehicle is set to be substantially the same as an upper surface height of a platform and a power collection device for obtaining electric power from an overhead line is disposed on a roof structure body of the railway vehicle. Such a vehicle has a low ceiling portion in which the power collection device is disposed in a recessed portion provided in the roof structure body so as to obtain a maximum ceiling height within a low vehicle height in view of a loading gauge, reduction in air resistance at the time of running at a high speed, and reduction in a vehicle weight and a ceiling portion is lowered in accordance with this recessed portion.

[0006] In a case where a configuration disclosed in PTL 1 is applied to the low ceiling portion, a protruding portion is further provided on the low ceiling portion due to attachment of each unit, and therefore a height of the ceiling is further lowered. Therefore, a passenger who sits in a seat under the low ceiling portion may feel uncomfortable, e.g., may feel a sense of being oppressed due to the height of the ceiling.

[0007] Further, in a case where a conditioned air duct for supplying conditioned air from an air conditioner to a passenger room is disposed on the low ceiling portion, a passenger may feel uncomfortable because conditioned air ejected from the conditioned air duct toward the passenger room may be directly ejected toward a body of the passenger.

[0008] Furthermore, in the low ceiling portion, the conditioned air duct, a lighting device, and broadcast equipment are attached in a limited space between a lower surface of the roof structure body in which the recessed portion is provided and a low ceiling panel, and therefore it is problematic in that a manufacturing cost is increased and assembly work becomes complicated.

[0009] In view of this, an object of the invention is to provide a railway vehicle that does not make passengers uncomfortable, can be produced at a low manufacturing cost, can be assembled by simple work, and, in addition, has a low ceiling portion offering excellent comfort and having excellent appearance. Solution to Problem(s)

[0010] In order to solve the above problems, a railway vehicle according to the invention includes: an air conditioner for generating conditioned air whose temperature and humidity are conditioned; and a duct for supplying the conditioned air to inside of the vehicle, in which: the duct is made up of a channel material having an opening surface toward a ceiling panel arranged below a roof structure body of the railway vehicle, and the ceiling panel provided to cover the opening surface; and, in the duct, an ejection port that crosses a flow direction of the conditioned air flowing through the duct and via which the conditioned air is ejected in a substantially horizontal direction is provided between the channel material and the ceiling panel.

Advantageous Effects of Invention

[0011] According to the invention, it is possible to provide a railway vehicle that does not make passengers uncomfortable, can be assembled by simple work at a low cost, and has a ceiling portion having excellent appearance.

Brief Description of Drawings

[0012]

[Fig. 1] Fig. 1 is a conceptual diagram of a multiple-car train including railroad cars having a low roof portion.
[Fig. 2] Fig. 2 is a cross-sectional view (C-C cross-section in Fig. 1) of a low roof portion, which crosses a longitudinal direction of a railroad car in Example 1 of the invention.
[Fig. 3] Fig. 3 is a horizontal sectional view (D-D cross-section in Fig. 2) of a high ceiling portion and a low ceiling portion of a railroad car.
[Fig. 4] Fig. 4 is a cross-sectional view (E-E cross-section in Fig. 2) of a connecting portion of a high roof portion and a low roof portion, which crosses a width direction of a railroad car.
[Fig. 5] Fig. 5 is an enlarged cross-sectional view (F portion in Fig. 4) of a connecting portion of a high roof portion and a low roof portion.
[Fig. 6] Fig. 6 is a cross-sectional view (G-G cross-section in Fig. 4) of an end portion in a width direction of a low roof portion, which crosses a longitudinal direction of a railroad car.
[Fig. 7] Fig. 7 is a horizontal sectional view (corresponding to Fig. 3) of a high ceiling portion and a low ceiling portion in Example 2.
[Fig. 8] Fig. 8 is a cross-sectional view (H-H cross-section in Fig. 7) of an end portion in a width direction of the low ceiling portion in Example 2, which crosses a longitudinal direction of a railroad car.

Description of Embodiments

[0013] A form for implementing the invention will be described with reference to the drawings.
[0014] Note that a railway vehicle is a general term for vehicles operated along laid railways and includes a railroad car, a monorail car, a streetcar, a vehicle for a new transportation system, and the like, and, hereinafter, examples of the invention will be described by exemplifying a railroad car as such a railway vehicle.

[Examples]

[Example 1]

[0015] Fig. 1 is a conceptual diagram of a multiple-car train including railroad cars having a low ceiling portion. A multiple-car train 1 is made up of first cars 1a and intermediate cars 1b, and a power collection device 16 for obtaining electric power from an overhead line 2 is mounted on a roof structure body of the first car 1a near the intermediate car 1b. Further, an air conditioner 17 for supplying conditioned air obtained by conditioning a temperature and humidity of air to a passenger room is mounted on a roof structure body of each vehicle.
[0016] The first car 1a includes an auxiliary power supply device 10 for outputting electric power to be supplied to an air conditioner, broadcast equipment, lighting equipment, and the like, a main transformer 12 for adjusting a voltage of electric power obtained from the overhead line 2, and the like under a floor thereof. In the intermediate car 1b, a generator unit 15 that is made up of an internal-combustion engine and a generator and outputs satisfactory electric power to allow a multiple-car vehicle to autonomously run, a main converter device 14 for controlling a main motor included in a bogie, and the like are disposed under a floor thereof.
[0017] The roof structure body of the first car 1a has, within a range from a part including a driver's seat to a part before the power collection device 16, a high roof portion (general portion) A having the same height as that of the intermediate car 1b and, within a range in which the power collection device 16 is mounted, a low roof portion B having a recessed portion for disposing the power collection device 16.
[0018] Fig. 2 is a cross-sectional view (C-C cross-section in Fig. 1) of the low roof portion, which crosses a longitudinal direction of the railroad car.
[0019] The first car 1a is a hexahedron including an underframe serving as a floor surface 7, side structure bodies 32 erected in both end portions in a width direction (railroad tie direction) of the underframe, end structure bodies or head structure bodies (not illustrated) erected in end portions in a longitudinal direction (rail direction) of the underframe, and a low-roof structure body 34 connected to upper end portions 35 of the side structure bodies 32 and the end structure bodies or head structure bodies. The end portions 35 in a height direction of the roof structure body have substantially

triangular spaces in both side portions in a width direction of the low-roof structure body 34.

[0020] Further, the first car 1a has a high-roof structure body 36 within a range of the high roof portion A and the low-roof structure body 34 within a range of the low roof portion B, and the intermediate car 1b only has the high-roof structure body 36. Note that the high-roof structure body 36 and the low-roof structure body 34 are connected by a connecting plate 37 (see Fig. 5).

[0021] Various kinds of devices (see Fig. 1) attached under the floor are disposed on a lower surface of an underframe 6, and those devices are covered by side skirts 25 hanging from end portions in the width direction of the underframe 6.

[0022] A height H4 of the floor surface 7 from a track 4 is set on the basis of a height of a representative platform of a route on which the multiple-car vehicle 1 is operated, and seats 40 and tables (not illustrated) are arranged on an upper surface of the floor surface 7 in a passenger room space having a height H1 from the floor surface 7 to a ceiling panel 83b of the low roof portion B and a height H3 therefrom to a ceiling panel 83a of the high roof portion A (see Fig. 1).

[0023] Fig. 3 is a horizontal sectional view (D-D cross-section in Fig. 2) of the high ceiling portion and the low ceiling portion of the railroad car. The first car 1a has a vestibule 75 through which passengers and the like get on/get off the railroad car on a side adjacent to the intermediate car 1b, and a toilet unit 26, side sliding doors 71 to be used to get on/get off the railroad car, a gangway serving as a passage to an adjacent vehicle, and the like are disposed in this vestibule 75.

[0024] The air conditioner 17 is placed on an upper surface of the high-roof structure body 36 (see Fig. 1), and a conditioned air duct 94 for supplying conditioned air from the air conditioner 17 is provided in a middle portion in a width direction (railroad tie direction) inside (below) the high-roof structure body 36. A conditioned air duct 80 that is connected to the conditioned air duct 94 via a connecting duct 93 and supplies conditioned air to the passenger room and a conditioned air duct 89 that is directly connected to the conditioned air duct 94 and supplies conditioned air to an upper space of the vestibule 75 are provided inside the low roof portion B. Both the conditioned air ducts 94 and 89 are provided in a plane along the longitudinal direction of the first car 1a.

[0025] Exhaust air to be discharged from the passenger room having the high roof portion A and the low roof portion B of the first car 1a to the outside of the vehicle is discharged by an exhaust air blower of the air conditioner 17 via an exhaust air intake port provided in the ceiling panel below the air conditioner 17. Further, exhaust air from the vestibule 75 and the toilet unit 26 having the low roof portion B is sent to the exhaust air intake port through an exhaust air duct 86 provided from the ceiling portion of the toilet unit 26 to the ceiling portion of the high roof portion A and is then emitted to the outside of the vehicle by the exhaust air blower of the air conditioner 17.

[0026] Fig. 4 is a cross-sectional view (E-E cross-section in Fig. 2) of a connecting portion of the high roof portion A and the low roof portion B, which crosses the width direction of the railroad car, and Fig. 5 is an enlarged cross-sectional view (F portion in Fig. 4) of the connecting portion of the high roof portion A and the low roof portion B.

[0027] As illustrated in Fig. 5, conditioned air to be sent to the passenger room having the low roof portion B is supplied through the conditioned air duct 94 provided between the high-roof structure body 36 on which the air conditioner 17 is placed and the ceiling panel 83a, the connecting duct 93 having one end portion connected to this conditioned air duct 94, and the conditioned air duct 80 connected to the other end portion of the connecting duct 93.

[0028] The connecting duct 93 is a flow channel (duct) smoothly bending in the height direction at a connecting portion of the high-roof structure body 36 and the low-roof structure body 34, and the conditioned air duct 80 forms a flow channel having a circular shape including a substantially rectangular shape by using the ceiling panel 83b positioned below the low-roof structure body 34.

[0029] Note that the ceiling panel 83b is extended on the high roof portion A side toward a part in the vicinity of a connecting portion of the connecting duct 93 and the conditioned air duct 94. Further, a heat insulating material 85 for preventing entering/exiting of heat between inside of the vehicle and outside of the vehicle is attached to the whole surfaces of the low-roof structure body 34 and the high-roof structure body 36, the surfaces being positioned on the vehicle interior side.

[0030] The conditioned air duct 80 is made up of a channel material having a vertical piece 80a, a horizontal piece 80b, and an inclined piece 80c and having an opening surface toward the ceiling panel 83b (for example, a channel-shaped material having a C cross-sectional shape) and the ceiling panel 83b. The opening surface (opening portion) of a flow channel thereof is formed to have a C-channel shape by the vertical piece 80a, the horizontal piece 80b, and the ceiling panel 83b that is substantially in parallel to the horizontal piece 80b.

[0031] A horizontal end portion 80ce is extended in parallel to the ceiling panel 83b in a lower end portion of the inclined piece 80c, and an ejection port 87 of conditioned air for ejecting conditioned air in a horizontal direction toward a center portion of the circular conditioned air duct 80 is provided between the horizontal end portion 80ce and the opening portion provided in the ceiling panel 83b.

[0032] The ejection port 87 is provided along an edge on the inner side (center portion side) of the flow channel (duct) formed by the circular conditioned air duct 80. As indicated by an arrow 99, conditioned air diverges in a direction crossing a flow direction of conditioned air flowing through the connecting duct 93 and flows into the conditioned air duct 80. The conditioned air is ejected in a substantially horizontal direction toward the center portion of the conditioned air duct 80

while flowing along the circular conditioned air duct 80.

[0033] A lighting device 81 (See Fig. 3) is provided in a circular shape to be adjacent to the ejection port 87 of the conditioned air duct 80 along an inner circumferential side thereof, and an outer circumferential edge of the lighting device 81 is close to an inner circumferential edge of the horizontal end portion 80ce.

[0034] The lighting device 81 includes, in a horizontal direction, a light source such as an LED and a diffusion plate 88 for diffusing light emitted from the light source. Further, broadcast equipment (speaker) 82 (see Fig. 4) is attached in a center portion of the lighting device 81.

[0035] The diffusion plate 88 is arranged substantially in parallel to the horizontal end portion 80ec forming the ejection port 87 and guides conditioned air ejected from the ejection port 87 in a substantially horizontal direction.

[0036] A procedure for assembling a ceiling of the low roof portion B will be described with reference to Fig. 5.

[0037] First, the channel material made up of the vertical piece 80a, the horizontal piece 80b, and the inclined piece 80c and the ceiling panel 83b are connected by outwork, and therefore a ceiling module 92 including the conditioned air duct 80 is fabricated.

[0038] Next, one end portion of the connecting duct 93 is connected to the conditioned air duct 94 fixed to the high-roof structure body 36 in advance. Note that a packing 90a for preventing air leakage is attached to a circumferential edge of the other end portion of the connecting duct 93.

[0039] Further, the lighting device 81, the broadcast equipment 82, and the like are fixed to a lower surface of the low-roof structure body 34, and a packing 90b is attached to a lower surface of the diffusion plate 88.

[0040] The ceiling module 92 is positioned, and the ceiling module 92 (ceiling panel 83b) is fixed to a support portion 95 extending below the low-roof structure body 34 while an upper surface thereof is being pushed against the packing 90a and the packing 90b from below.

[0041] Note that, in a case of fabricating the ceiling module 92, the broadcast equipment 82, the lighting device 81, and the like may be attached in advance to be integrally provided.

[0042] Fig. 6 is a cross-sectional view (G-G cross-section in Fig. 4) of an end portion in a width direction of the low roof portion, which crosses the longitudinal direction. The low-roof structure body 34 of the low roof portion B is made up of an end-portion inclined surface 34a that is inclined downward from the upper end portion 35 of the side structure body 32 and a horizontal portion 34b connected to the end-portion inclined surface 34a. The power collection device 16 and the like are provided on the horizontal portion 34b.

[0043] A space 91 surrounded by the upper end portion 35 of the side structure body 32 and the end-portion inclined surface 34a has the same height as that of the high roof portion A even within the range of the low roof portion B and is therefore comparatively high. By using this, it is possible to provide the exhaust air duct 86 and the conditioned air duct 89 (See Fig. 3) communicating with the conditioned air duct 94 arranged in the high roof portion A.

[0044] Further, a slit 96 may be provided in a part of the ceiling panel 83b forming the circular conditioned air duct 80, and therefore part of conditioned air to be supplied from the conditioned air duct 80 to the inside of the passenger room may be supplied to the inside of the passenger room via the slit 96, and the other part of the conditioned air may be supplied to the inside of the passenger room via the discharging port 87.

[0045] With the above-mentioned configuration, conditioned air flowed into the conditioned air duct 80 is ejected in the substantially horizontal direction from a gap between the horizontal end portion 80ce and the ceiling panel 83b toward the center portion of the conditioned air duct 80 so as to cross a longitudinal direction of the conditioned air duct 80 (flow direction of conditioned air) while flowing through the circular conditioned air duct 80 in the longitudinal direction thereof, flows along a lower surface of the diffusion plate 88 forming the lighting device 81, and thereafter flows downward.

[0046] Therefore, conditioned air ejected from the ejection port 87 does not directly blow against a passenger who sits in a seat in the passenger room belonging to the low roof portion B, and therefore the passenger is not made uncomfortable.

[0047] Furthermore, the conditioned air duct 80 is fabricated by combining a C-channel shape opening flow channel and the ceiling panel 83b, and therefore it is possible to minimize a clearance H2 (see Fig. 4) in the height direction between the low-roof structure body 34 and the ceiling panel 83b provided therebelow and secure a large ceiling height dimension H1 of the low roof portion. Thus, a distance between the ejection port 87 of conditioned air and a passenger is increased, and therefore a ceiling height is secured and feeling of spaciousness is obtained. In addition, ejected wind is ejected along the horizontal direction and thereafter moves downward, and therefore it is possible to reduce discomfort caused by directly sending ejected wind to a passenger and improve comfort.

[0048] Further, the duct is formed by covering one surface of the channel material with the ceiling panel 83b, and therefore it is possible to fabricate the light-weight ceiling module 92 with a small manufacturing man-hour by using a small number of components, as compared to a case where an independent duct is arranged separately from the ceiling panel 83b. Furthermore, the ceiling module 92 including the conditioned air duct only needs to be fixed to the low roof portion B, and therefore it is possible to construct a ceiling with a small manufacturing man-hour.

[0049] Meanwhile, the exhaust air duct 86 and the conditioned air duct 89 having a large cross-sectional area can be housed in the spaces 91 between the upper end portions 35 of the side structure bodies 32 and the end-portion inclined

surfaces 34a, and therefore it is possible to reduce flow rates of exhaust air and conditioned air flowing through those ducts. As a result, it is possible to reduce pressure loss and fluid sound of the ducts and power consumption of the air blower and prevent noise generated inside the ducts.

[0050] Note that the invention is not only applied to a single railroad car having both sections, i.e., the high roof portion (general portion) A and the low roof portion B as in this example, but the above-mentioned effect exhibits also in a case where the invention is applied to, for example, a railroad car (railway vehicle) only having a roof portion that cannot secure a satisfactory ceiling height in a relationship with a loading gauge.

[Example 2]

[0051] Fig. 7 is a horizontal sectional view (corresponding to Fig. 3) of a high ceiling portion and a low ceiling portion in Example 2, and Fig. 8 is a cross-sectional view (H-H cross-section in Fig. 7) of an end portion in a width direction of the low ceiling portion in this example, which crosses a longitudinal direction.

[0052] Description of matters common to Examples 1 and 2 is omitted, and a different configuration will be mainly described.

[0053] In this example, a conditioned air duct 90 has one end connected to the connecting duct 93 and has the other closed end 90a and forms sides of a substantially rectangular shape in a planar view.

[0054] A shape of the conditioned air duct 90 in a planar view is different from the shape thereof in Example 1. However, the conditioned air duct 90 is the same as the conditioned air duct in Example 1 in that, for example, the conditioned air duct 90 is formed by combining a C-channel member having an opening portion and the ceiling panel 83b and the conditioned air duct 90 has the ejection port 87 for ejecting conditioned air in the horizontal direction to supply the conditioned air to the inside of the passenger room.

[0055] Further, in this example, as illustrated in Fig. 7, two lines of lighting devices 81a are provided on the ceiling panel 83b along a longitudinal direction of the conditioned air duct 90 the first car 1a on the outside of the conditioned air duct 90 in the width direction.

[0056] A diffusion plate is not arranged on the ejection port 87 side from the conditioned air duct 90 toward the inside, and therefore a straightening plate 97 for guiding the flow 99 of conditioned air is arranged downstream of the ejection port 87 of the conditioned air duct 80.

[0057] As in Example 1 described above, the ceiling module 92 (see Fig. 5) is fabricated by fixing a C-channel opening flow channel to the ceiling panel 83b to form the conditioned air duct 80 and fixing the lighting devices 81a to the ceiling panel 83b. This ceiling module 92 is lifted upward from the lower surface of the low-roof structure body 34, is positioned, and is thereafter fixed to the low-roof structure body 34 via the support portion 95.

[0058] With the above-mentioned configuration, conditioned air that has flowed into the conditioned air duct 80 is ejected in the substantially horizontal direction from the gap between the horizontal end portion 80ce and the ceiling panel 83b while flowing through the circular conditioned air duct 80, flows along the straightening plate 97, and thereafter flows downward. Therefore, conditioned air ejected from the ejection port 87 does not directly blow against a passenger in the passenger room belonging to the low roof portion B, and therefore it is possible to prevent the passenger from being made uncomfortable.

[0059] Furthermore, the conditioned air duct 80 is fabricated by combining the C-channel opening flow channel and the ceiling panel 83b, and therefore it is possible to reduce a dimension H2 (see Fig. 4) in the height direction of the ceiling portion of the low roof portion B and increase the ceiling height dimension H1 of the low roof portion. Thus, a distance between the ejection port 87 of conditioned air and a passenger can be long, and therefore it is possible to reduce discomfort caused by an influence of ejected wind and improve comfort. Further, it is possible to fix the ceiling module including the conditioned air duct to the low roof portion B with a small work man-hour, and therefore a manufacturing cost can be reduced.

[0060] Although not illustrated, a terminal end portion 90b of the conditioned air duct 90 provided in the width direction of the first car 1a may be omitted, and there may be provided the conditioned air duct 90 that is extended in the width direction from the other end portion of the connecting duct 93 and then changes its direction to the longitudinal direction and is extended in the direction. With this configuration, conditioned air to the passenger room having the low roof portion B can be supplied by the ceiling panel 83b including the conditioned air duct 90 having a simpler configuration.

[0061] According to the invention, conditioned air from the air conditioner only needs to be ejected in the horizontal direction to the inside of the passenger room via the ejection port while flowing through the air conditioning duct of the ceiling module in the longitudinal direction thereof, and a shape and the like thereof can be variously selected depending on a specification or form of the railroad car.

Reference Signs List

1	multiple-car vehicle	1a	first car

(continued)

1b	intermediate car	2	overhead line
4	track	7	floor surface
8	high floor surface		
10	auxiliary power supply device		
12	main transformer	14	main converter
15	generator unit	16	power collection device
17	air conditioner	25	side skirt
26	toilet unit	32	side structure body
34	low roof structure body		
34a	end-portion inclined surface		
34b	horizontal portion		
35	upper end portion of side structure body (end portion in width direction of roof structure body)		
36	high roof structure body	37	connecting plate
40	seat	71	side sliding door
75	vestibule	85	heat insulating material
86	exhaust air duct	89	conditioned air duct
80, 90	conditioned air duct (low roof structure body)		
81	lighting evice	82	broadcast equipment
83	ceiling panel	84	information display device
85	heat insulating material	91	space
92	ceiling module	93	connecting duct
94	conditioned air duct (high roof structure body)		
95	support portion		
96	slit	97	straightening plate
99	flow of conditioned air		
A	high roof portion (general portion)		
B	low roof portion		
H1	low-roof-portion ceiling height		
H2	high-roof-portion ceiling height		
H3	low-roof-portion ceiling space		
H4	floor surface height		

Claims

1. A railway vehicle, comprising:

an air conditioner for generating conditioned air whose temperature and humidity are conditioned; and
a duct for supplying the conditioned air to inside of the vehicle, wherein:

the duct is made up of

a channel material having an opening surface toward a ceiling panel arranged below a roof structure body of the railway vehicle, and
the ceiling panel provided to cover the opening surface; and

in the duct, an ejection port that crosses a flow direction of the conditioned air flowing through the duct and via which the conditioned air is ejected in a substantially horizontal direction is provided between the channel material and the ceiling panel.

2. The railway vehicle according to claim 1, wherein
the duct has a circular shape or a substantially rectangular shape in an overhead view.

3. The railway vehicle according to claim 1, wherein
the channel material and the ceiling panel below the roof structure body are integrally provided to serve as a ceiling module.

4. The railway vehicle according to claim 1, wherein
a straightening plate for guiding the conditioned air ejected from the ejection port is arranged downstream of the ejection port.

5. The railway vehicle according to claim 3, further comprising:

a lighting device arranged inside the duct and downstream of the ejection port; and
a diffusion plate for diffusing light emitted from the lighting device, wherein
the diffusion plate serves as the straightening plate.

6. The railway vehicle according to claim 3, wherein
the ceiling module is obtained by integrally providing a lighting device and broadcast equipment.

7. The railway vehicle according to claim 1, wherein
a slit for ejecting part of the conditioned air downward is provided in the ceiling panel forming the duct.

FIG. 1

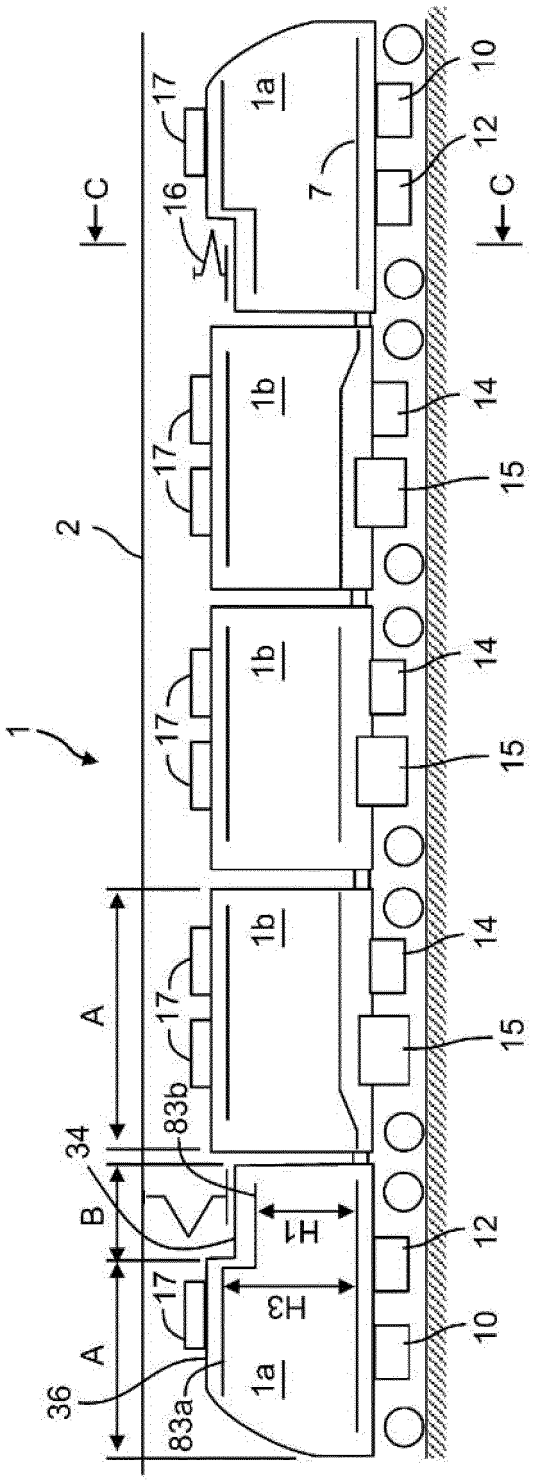


FIG. 2

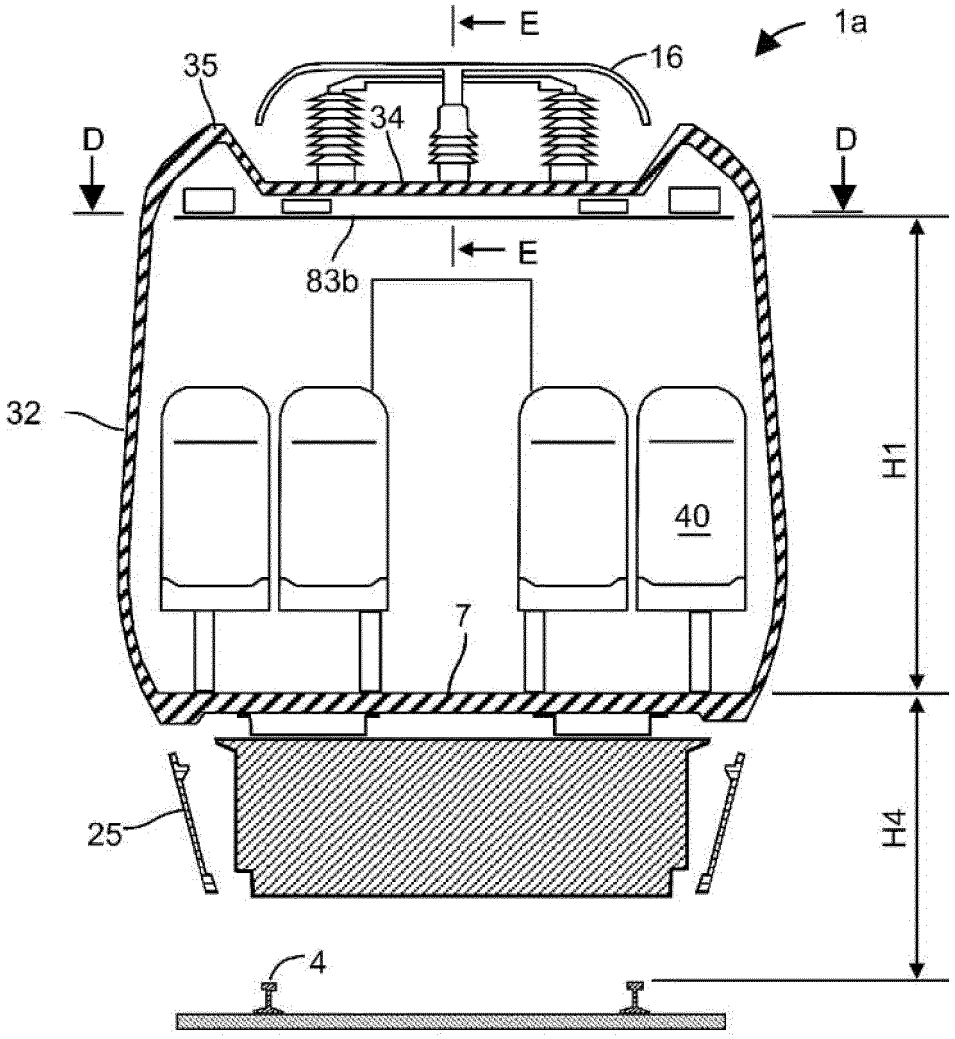


FIG. 3

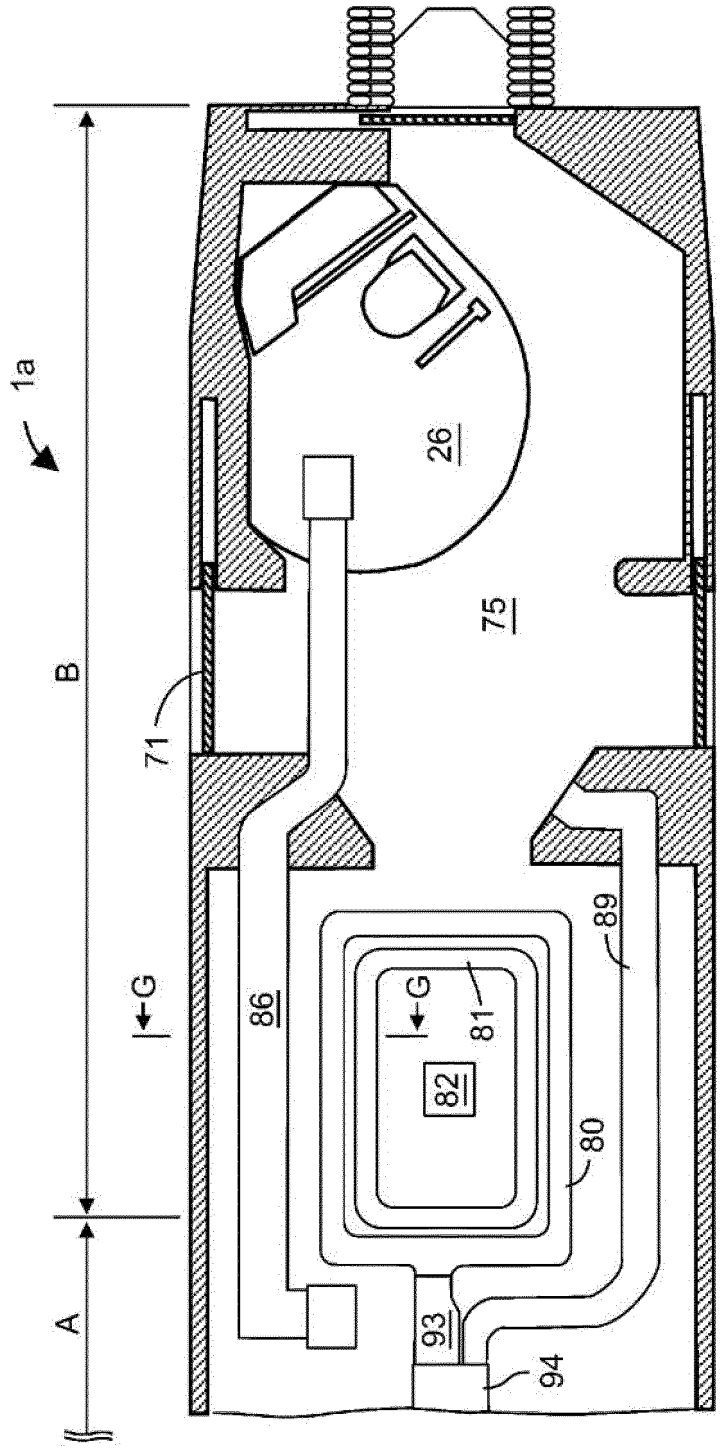


FIG. 4

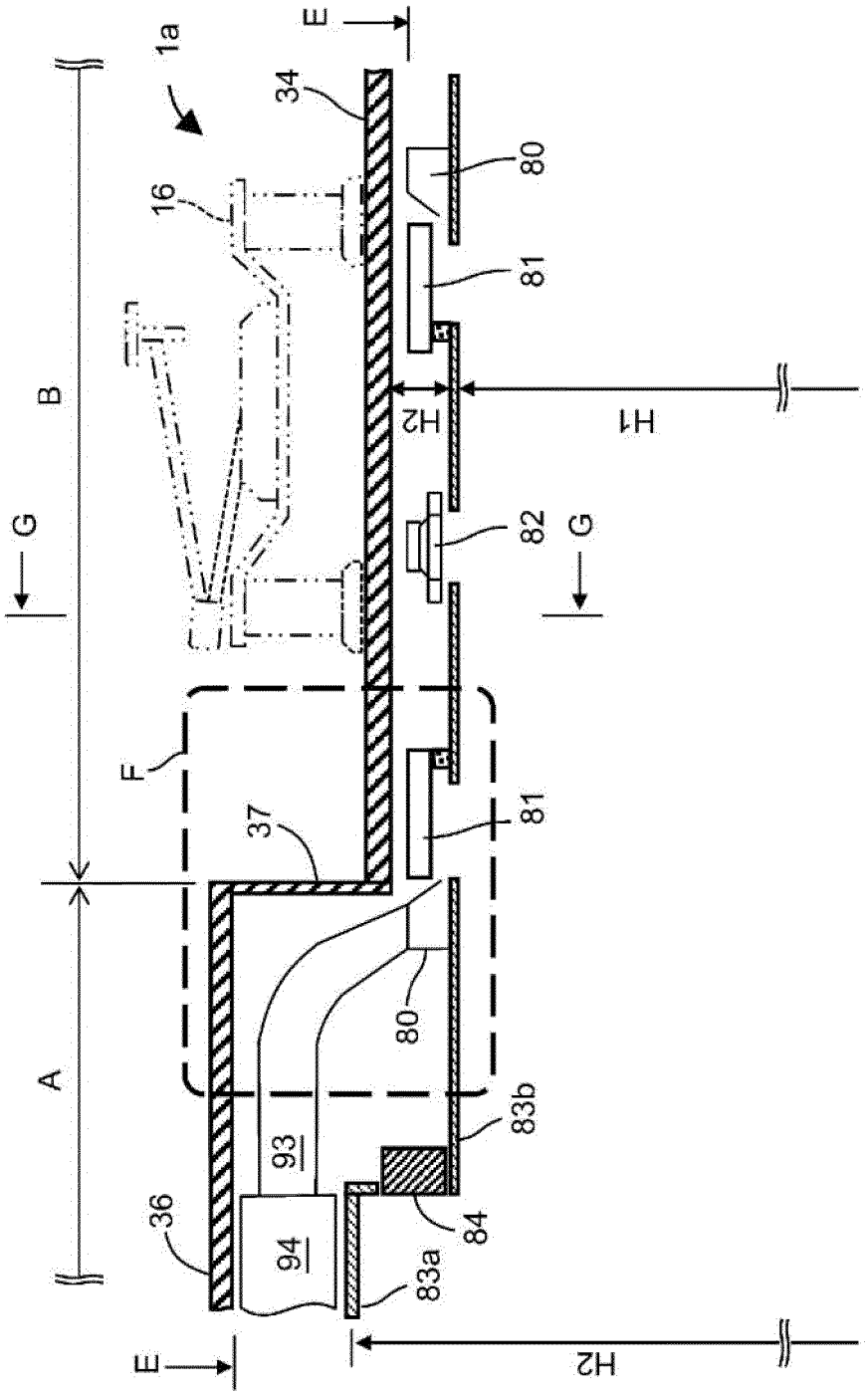
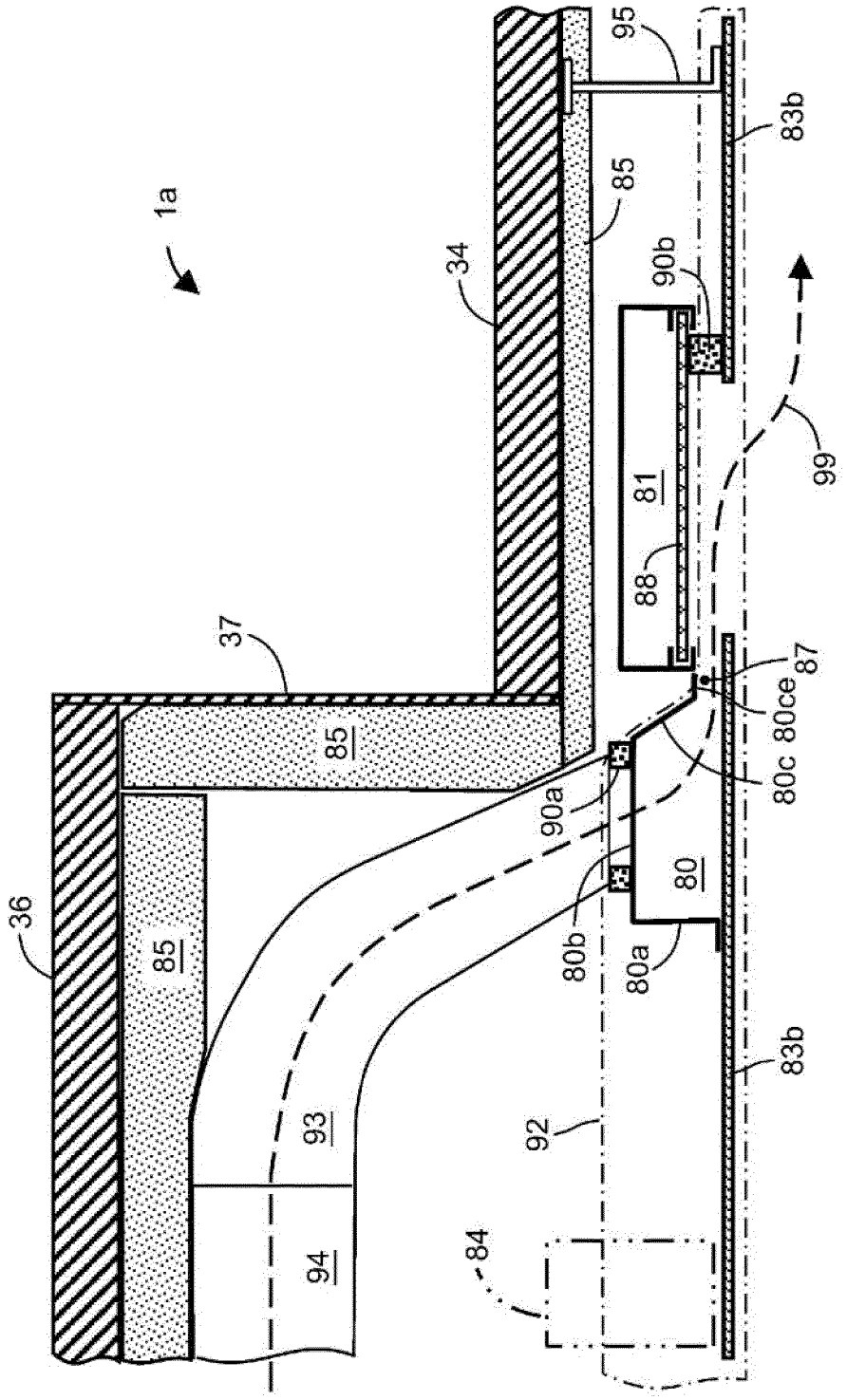


FIG. 5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90b
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83b
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92
94
84

FIG. 6

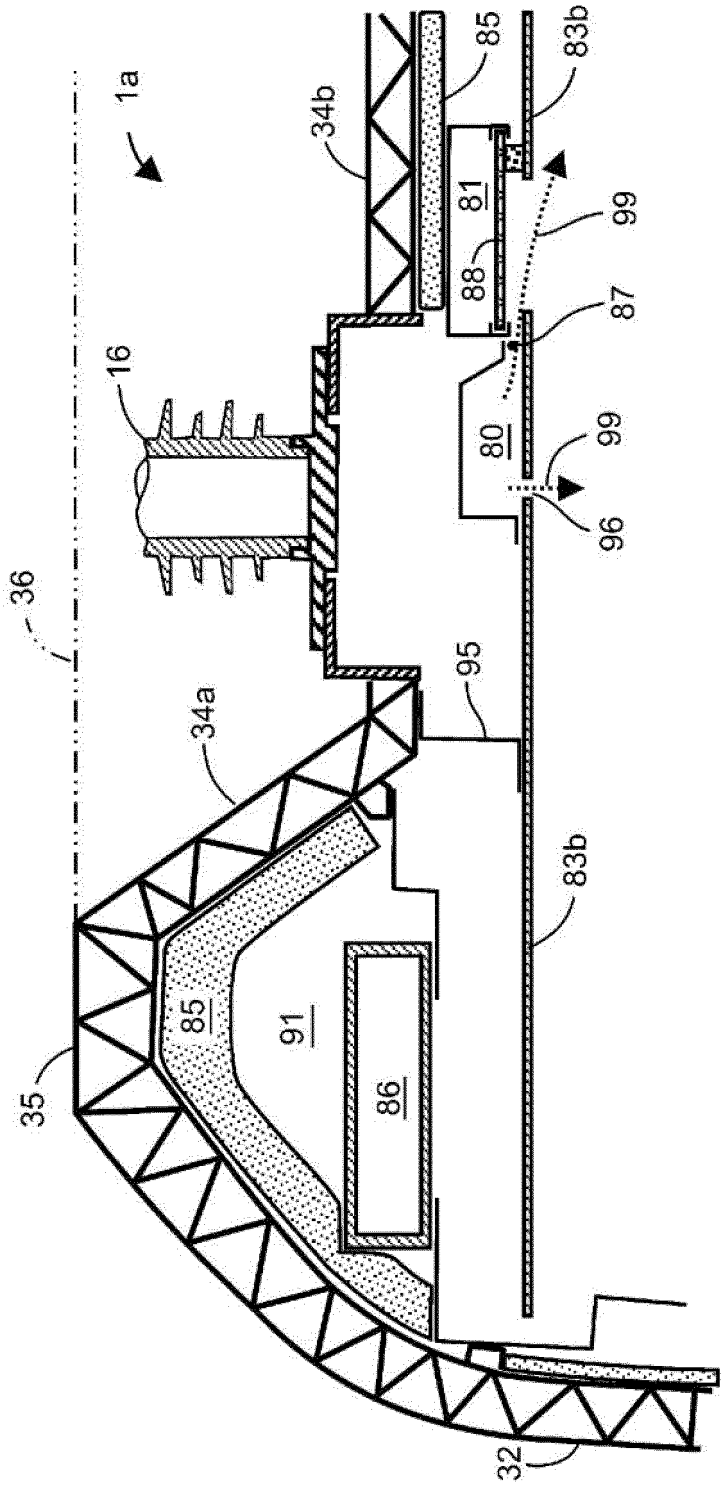


FIG. 7

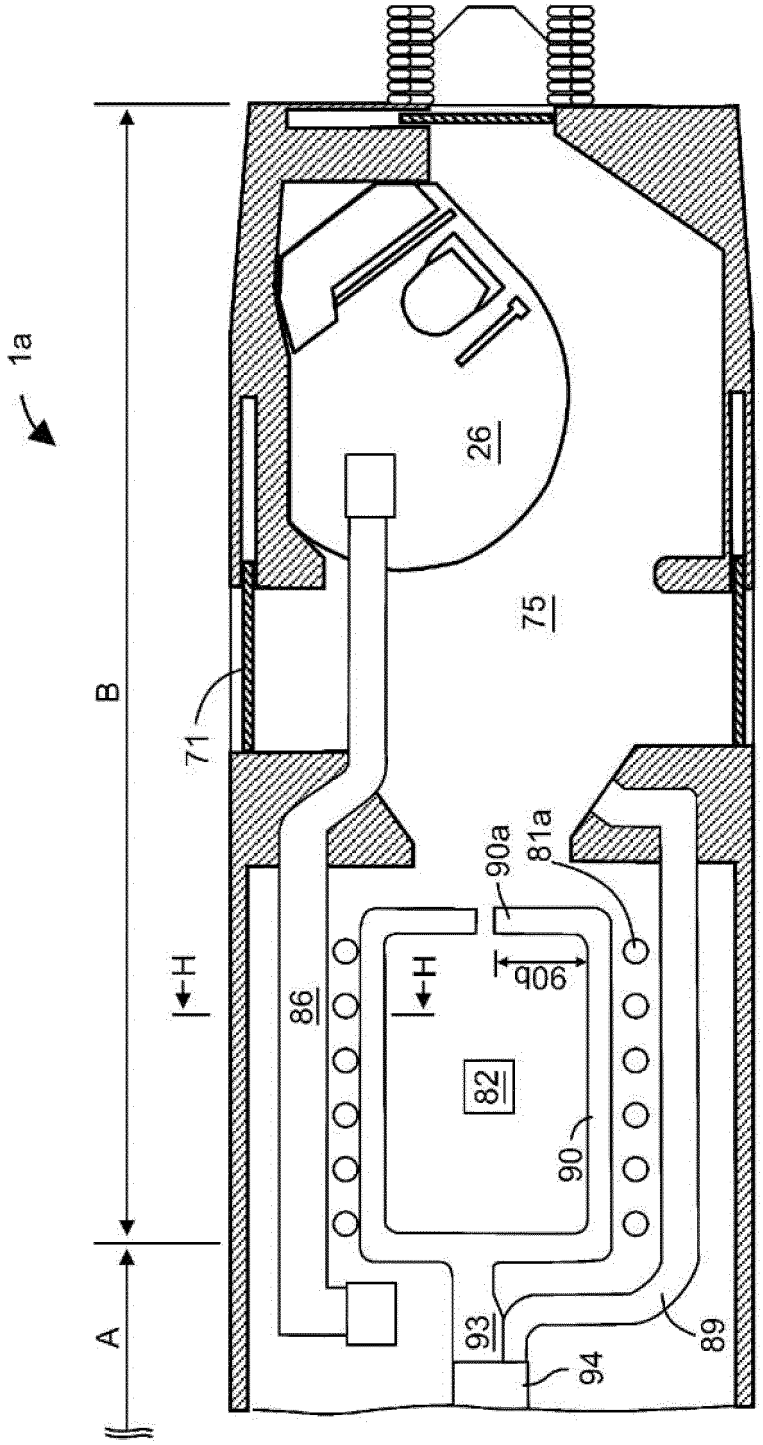
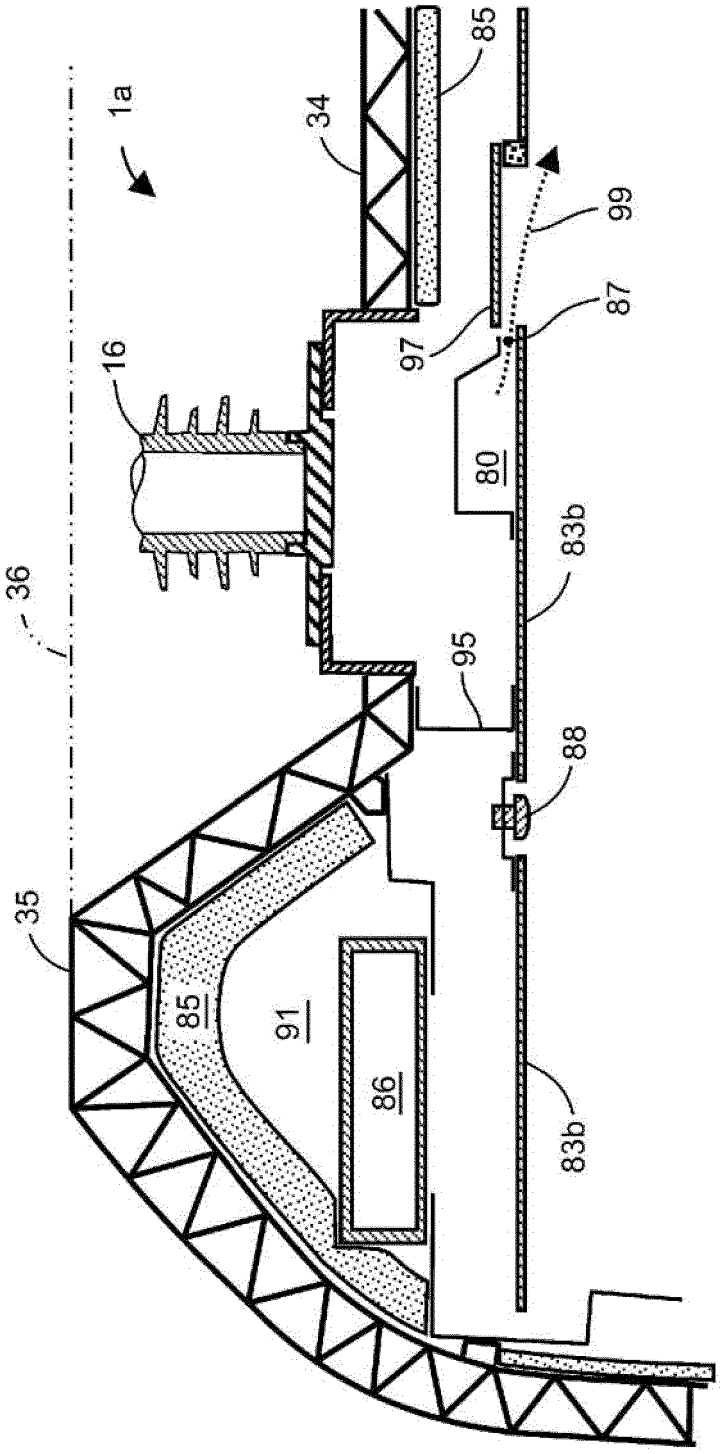


FIG. 8



INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2015/063630

A. CLASSIFICATION OF SUBJECT MATTER
B61D27/00(2006.01)i, *B60H1/00*(2006.01)i

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
B61D27/00, B60H1/00

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
Jitsuyo Shinan Koho 1922-1996 Jitsuyo Shinan Toroku Koho 1996-2015
Kokai Jitsuyo Shinan Koho 1971-2015 Toroku Jitsuyo Shinan Koho 1994-2015

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X Y A	WO 2015/056347 A1 (Hitachi, Ltd.), 23 April 2015 (23.04.2015), paragraphs [0012] to [0027], [0037] to [0041]; fig. 1 to 4, 7 (Family: none)	1-3,7 6 4-5
Y	JP 2007-137405 A (Hitachi, Ltd.), 07 June 2007 (07.06.2007), paragraph [0013]; fig. 1 & US 2006/0207471 A1 & EP 1702825 A2 & KR 10-2006-0101248 A & CN 101428625 A	6
Y	JP 60-9096 Y2 (Hitachi, Ltd.), 01 April 1985 (01.04.1985), entire text; fig. 2 to 5 & JP 54-109211 U	6

☒ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
22 July 2015 (22.07.15)	04 August 2015 (04.08.15)
Name and mailing address of the ISA/ Japan Patent Office 3-4-3,Kasumigaseki,Chiyoda-ku, Tokyo 100-8915,Japan	Authorized officer Telephone No.

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INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2015/063630

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	JP 63-227459 A (Hitachi, Ltd.), 21 September 1988 (21.09.1988), entire text; all drawings (Family: none)	1-7
A	JP 2011-207459 A (Hitachi, Ltd.), 20 October 2011 (20.10.2011), paragraph [0026]; fig. 6 (Family: none)	2
A	Microfilm of the specification and drawings annexed to the request of Japanese Utility Model Application No. 75277/1986(Laid-open No. 187255/1987) (Hitachi, Ltd.), 28 November 1987 (28.11.1987), entire text; fig. 1 to 2 (Family: none)	4-5

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