(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) **EP 3 168 103 A1**

(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
17.05.2017 Bulletin 2017/20

(51) Int Cl.:
B61D 15/06 *(2006.01)* ***B61D 17/06*** *(2006.01)*
B61G 11/16 *(2006.01)*

(21) Application number: **15194102.8**

(22) Date of filing: **11.11.2015**

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR
Designated Extension States:
BA ME
Designated Validation States:
MA MD

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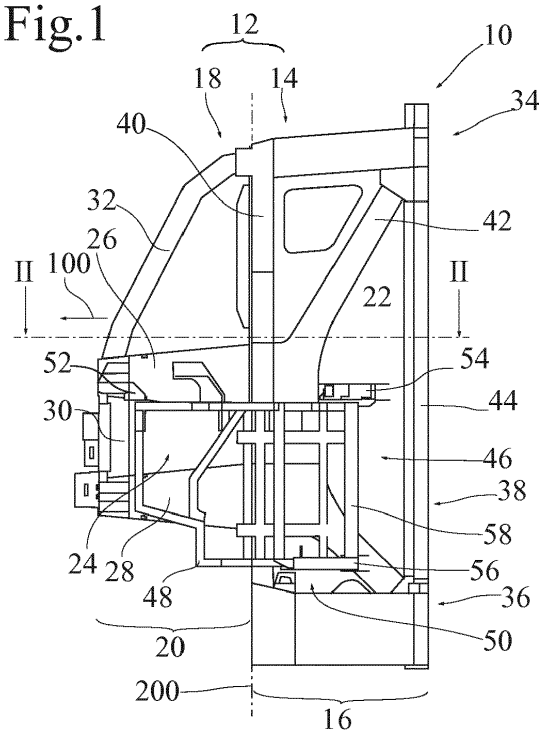
(54) DRIVER'S CABIN OF A RAIL VEHICLE

(57) A driver's cabin (10) of a rail vehicle comprises a driver's cabin structure (12) comprising a crash-resistant structure (14) surrounding an inner survival space (22) and an energy-absorbing structure (18) located in front of the crash-resistant structure (14) and surrounding an inner crushable space (24). A driver's desk structure (46) is located inside the driver's cabin structure (12) and attached to the driver's cabin structure (12). The driver's desk structure (46) comprises a deformable framework of profiles (48) located in the inner crushable space (22) of the driver's cabin (10) and at least one crash-resistant crossbeam (54, 56) fixed to the crash-resistant structure (14) and located behind the deformable framework of profiles (48), in the inner survival space (22).

Fig.1



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Description

TECHNICAL FIELD OF THE INVENTION

[0001] The present invention relates to a driver's cabin of a rail vehicle.

BACKGROUND ART

[0002] Crashworthiness standards for railway vehicle bodies, and more specifically for the driver's cabin, usually require the provision of a survival space for the driver. This survival space must keep its integrity during a collision even in the presence of significant peak-forces. Local plastic deformation and local buckling are acceptable if it is demonstrated that they are sufficiently limited, so as not to significantly reduce the passenger and driver survival spaces. The deformation of the structure should not cause any vehicle equipment or parts (e.g. driver's desk, windscreens, etc.) to enter the designated survival space during the collision scenarios. The structure immediately ahead of the driver's survival space should, as far as practical, not fail in a manner that itself creates a hazard (e.g. exposed fracture surfaces and protrusions should be avoided).

[0003] To meet these requirements in a driver's cabin with a driver's desk, one option is to accommodate the driver's desk into a crash-resistant cell located behind the front energy-absorbing structure, so as to make sure that the driver's desk will not be subjected to deformations. This solution, however, is space consuming.

[0004] The standard provides that it is acceptable for the survival space to be provided in a compartment immediately adjacent to the driving position, provided that there is immediate access to it. In this respect, it has been proposed in US 8,141,497, to provide a sliding-type structure comprising the driver's desk as well as various shock absorbers located in front of a survival space. When the vehicle is involved in a collision, the driver must leave the desk at once to find shelter in the survival space. The sliding-type structure moves backwards towards the survival space. The shock absorbers are collapsed to absorb the shock energy while the driver's desk is moved backwards without substantial deformation. The driver is safe only insofar as he has had time to leave the desk.

SUMMARY OF THE INVENTION

[0005] The invention aims to provide a driver's cabin for a rail vehicle, which meets high crashworthiness requirements with a compact structure.

[0006] According to a first aspect of the invention, there is provided a driver's cabin of a rail vehicle defining a front direction and comprising

- a driver's cabin structure comprising a crash-resistant structure surrounding an inner survival space of the driver's cabin and an energy-absorbing structure located in front of the crash-resistant structure and surrounding an inner crushable space of the driver's cabin, and
- a driver's desk structure located inside the driver's cabin structure and attached to the driver's cabin structure, wherein the driver's desk structure comprises a deformable framework of profiles at least partially, and preferably totally located in the inner crushable space of the driver's cabin and at least one crash-resistant crossbeam fixed to the crash-resistant structure and located, with respect to the front direction, behind the deformable framework of profiles, preferably in the inner survival space.

[0007] This arrangement takes advantage of the space available in the inner crushable space surrounded by the energy-absorbing structure to house a deformable part of the driver's desk structure and, thanks to the crash-resistant crossbeam, prevents the deformable part of the driver's desk from penetrating the inner survival space. In the event of a frontal collision, the deformable framework of profiles will undergo a controlled deformation and will collapse, while the crash-resistant crossbeam will remain stable, i.e. substantially without deformation. The driver does not have to leave the driving position to find shelter in a remote part of the driver's cabin or outside the driver's cabin. The driver's cabin is compact, which means that more room is available for the passenger or cargo area.

[0008] In the present application, the terms "crash-resistant" shall be used to characterise a structure or a structural component such as a crossbeam, that does not undergo a gross plastic deformations or general buckling during a frontal impact on the driver's cabin.

[0009] Preferably, the crash-resistant crossbeam is located at a rear end, preferably a rear upper end, of the driver's desk structure. Thus, the crash-resistant crossbeam is ideally located to prevent the deformable part of the driver's desk from penetrating the inner survival space. Preferably, the crash-resistant crossbeam is located in the inner survival space.

[0010] According to one embodiment, the crash-resistant crossbeam is located, with respect to the front direction, in front of abutments of the crash-resistant structure, and is connected to the crash-resistant structure such that during a frontal collision the crash-resistant crossbeam bears against the abutments of the crash-resistant structure. Thanks to the crash-resistant crossbeam and associated abutments of the crash-resistant structure, the driver's desk does not fully collapse and does not encroach into the survival space. The motion of the crash-resistant crossbeam itself is limited or prevented by the abutments. The survival space of the driver, acc. to EN 15227, can be located near the driver seat and desk without injuring the driver.

[0011] According to one embodiment, the abutments include at least two abutments each facing a respective

end of the crash-resistant crossbeam.

[0012] According to a preferred embodiment, the abutments are formed by safety brackets of the crash-resistant structure. The safety brackets can be welded, bolted or riveted to another structural element, e.g. a beam of the crash-resistant structure.

[0013] According to a preferred embodiment, the crash-resistant crossbeam is connected to the safety brackets by longitudinal connections, each comprising an elongate shaft extending in the front direction. During a frontal impact, such longitudinal connections will be subjected to compression load, or no load at all if the crash-resistant crossbeam bears directly against the abutments.

[0014] According to an embodiment, the safety brackets vertically support the crash-resistant crossbeam. The longitudinal connection may include a L-shaped corner bracket to vertically support the crash-resistant crossbeam.

[0015] Preferably, the deformable framework of profiles of the driver's desk structure comprises connections and/or profiles provided with structural weaknesses. These structural weaknesses ensure a controlled collapse of the deformable framework.

[0016] According to one embodiment, the deformable framework of profiles is attached to the energy-absorbing structure, preferably via welded, bolted and/or riveted connections, in such a way that during a frontal collision, the deformable framework of profiles is crushed as a result of a deformation of the energy-absorbing structure.

[0017] According to a preferred embodiment the driver's desk structure comprises a crash-resistant framework of profiles at least partially located in the inner survival space, and comprising the crash-resistant crossbeam and further crash-resistant profiles. Preferably, the at least one crash-resistant crossbeam is an upper crash-resistant crossbeam located at a rear upper end of the driver's desk structure, and the crash-resistant framework of profiles includes a lower crash-resistant crossbeam located below the upper crash-resistant crossbeam, preferably at a lower rear end of the driver's desk structure, and preferably located, with respect to the front direction, in front of lower abutments of the crash-resistant structure, the lower abutments being preferably formed by lower safety brackets. The lower crash-resistant crossbeam contributes to the protection of the inner survival space. Attachment brackets can be provided for attaching and vertically supporting a lower part of the crash-resistant framework of profiles to an underframe of the crash-resistant structure. Preferably, the energy-absorbing structure is fixed to the crash-resistant structure.

[0018] According to a preferred embodiment, non structural components of the driver's desk are housed in the driver's desk structure, preferably in a free space within the deformable framework of profiles, preferably at least partially in the inner crushable space of the driver's cabin. The space available in front of the survival area is optimally used for functional components of the driver's cabin. These non structural components may include wiring and instruments, which will be crushed in the event of a frontal collision. Non structural components of the driver's desk can also be housed at least partially in a free space within the crash-resistant framework of profiles of the driver's desk structure.

[0019] Preferably, a panelling is fixed to the driver's desk structure in the survival space, preferably between the driver's desk structure and a driver's space of the driver's cabin. The panelling will prevent ingress of non-structural components of the driver's desk into the survival space.

BRIEF DESCRIPTION OF THE FIGURES

[0020] 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 examples only and represented in the accompanying drawings in which:

- figure 1 is a side view of a driver's cabin according to one embodiment of the invention;
- figure 2 is a top view of the driver's cabin of figure 1;
- figure 3, is an isometric view of a part of the driver's cabin of figure 1;
- figure 4 is a side view of the driver's cabin of figure 1, after a frontal collision; and
- figure 5 is a top view of the driver's cabin of figure 1, after a frontal collision.

[0021] Corresponding reference numerals refer to the same or corresponding parts in each of the figures.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

[0022] With reference to Figures **1** to **3,** a driver's cabin **10** of a rail vehicle has a driver's cabin structure **12** for supporting an outer shell (not shown) of the driver's cabin **10.** The driver's cabin structure **12** comprises a crash-resistant structure **14** located in a survival zone **16** of the driver's cabin **10** and an energy-absorbing structure **18** located, with respect to a front direction **100** of the driver's cabin **10,** in front of the crash-resistant structure **14** in a crushable zone **20** of the driver's cabin **10.** In the drawings, the survival zone **16** and the crushable zone **20** have been arbitrarily separated by a vertical transverse plane **200** perpendicular to the front direction **100,** but the actual boarder between the two zones can be non planar.

[0023] The crash-resistant structure **14** surrounds an inner survival space **22** of the driver's cabin **10,** while the

energy-absorbing structure **20** surrounds an inner crushable space **24** of the driver's cabin **10.**

[0024] The energy-absorbing structure **18** includes a frame made of frame members which may include but are not limited to, girders, hollow-box girders, beams, struts, energy-absorbing struts, structural subassemblies, energy-absorbing elements and/or components. The frame members can be made of including but not limited to, steel, mild steels, fibreglass, aluminium, carbon fibre, laminates thereof, or any other such material, subassembly or component that is suitable for the purpose of the frame. The frame members may include, in particular, upper and/or lower energy-absorbing side sills **26, 28,** a front energy-absorbing cross member **30** and front energy-absorbing pillars **32.**

[0025] The crash-resistant structure **14** can be divided into portions, namely a roof portion **34,** an underframe portion **36** and side portions **38** and includes a frame made of two or more crash-resistant frame members **40, 42, 44** within the side portions **38** connected to one or more crash-resistant frame members within the roof and underframe portions to form a safety box that is substantially non deformable in a frontal collision. The crash-resistant frame members may include but are not limited to, girders, hollow-box girders, beams, struts, or structural subassemblies. The frame members can be made of including but not limited to, steel, mild steels, fibreglass, aluminium, carbon fibre, laminates thereof, or any other such material, subassembly or component that is suitable for the purpose of the frame.

[0026] Preferably, the crash-resistant frame members of the crash-resistant structure comprise a doorframe (not shown) for an escape exit, which can be e.g. a door or window allow not only the occupants to escape after an impact, but also to allow rescuers and/or other personnel to aid the occupants if required. Alternatively or additionally, a doorframe can be provided in the roof portion and/or in the underframe portion for alternative or additional escape exits.

[0027] The energy-absorbing structure **14** can be welded, bolted, riveted or otherwise attached to the crash-resistant frame members **40** of the side portions **38** of the crash-resistant structure **14** as well as to roof portion **34** and underframe portion **36** by any suitable fasteners (not shown). The fasteners are preferably releasable to constitute a predefined repair interface if, after a light collision with an obstacle, it becomes necessary to remove and replace the energy-absorbing structure while the crash-resistant structure is intact. The crash-resistant structure **14** can be integral with the structure of the main section of a car body of the rail vehicle, or attached to the main section via an attachment interface.

[0028] A driver's desk structure **46** is located inside the driver's cabin structure 12 and attached to the driver's cabin structure **12.** The driver's desk structure **46** comprises a front portion formed by a deformable framework of profiles **48,** in particular metallic profiles, at least partially, and preferably totally located in the inner crushable space **24** of the driver's cabin **10,** and a rear portion formed by a crash-resistant framework of profiles **50,** in particular metallic profiles, located, with respect to the front direction, behind the deformable framework of profiles **48,** at least partially in the inner survival space **22.**

[0029] The deformable framework of profiles **48** of the driver's desk structure **46** is attached to the energy-absorbing structure **18,** preferably via crash zone brackets **52,** or more generally via welded, bolted and/or riveted connections, and comprises connections and/or profiles provided with structural weaknesses, e.g. sharp angles, holes and/or weak material arrangement.

[0030] The crash-resistant framework of profiles **50** comprises an upper rear crash-resistant crossbeam **54** located in the inner survival space **22** at a rear upper end of the driver's desk structure **46,** a lower rear crash-resistant crossbeam **56** located in the inner survival space **22** at a rear lower end of the driver's desk structure **46,** as well as further crash-resistant profiles **58**, including e.g. uprights, longitudinal and/or diagonal profiles. The upper and lower rear crash-resistant crossbeam **54**, **56** can be straight or curved as illustrated in the figures, depending on the inner design of the driver's cabin **10** and are place in front of a driver's seat (not shown) fixed to a pedestal **59** or more generally to an attachment interface integral with the underframe portion **36.**

[0031] The crash-resistant structure **14** is provided with two upper safety brackets **60,** each facing a respective left or right associated end of the upper crash-resistant crossbeam **54**, and with two lower safety brackets **62,** each facing a respective left or right associated end of the lower crash-resistant crossbeam **56**. Each safety bracket **60, 62** forms an abutment face that faces the front direction and the associated end of the upper or lower crash-resistant crossbeam **54**, **56**. The ends of the upper and lower crash-resistant crossbeams **54**, **56** are connected to the associated safety brackets **60, 62** by means of longitudinal connections **64, 66,** preferably comprising an elongate shaft extending in the front direction **100,** preferably bolts, rivets or screws. Additional safety brackets may be provided at different heights and positions inside the survival space to secure the crash-resistant framework of profiles **50.** The safety brackets **60, 62** can be integral with frame members **40, 42, 44** of the side portions **38** of the crash-resistant structure **14.** They may also be welded, bolted, riveted or otherwise attached to frame members **40, 42, 44** of the side portions **38.**

[0032] Attachment brackets **64** are provided for attaching and vertically supporting a lower part of the crash-resistant framework of profiles **50** to the underframe portion **36** of the crash-resistant structure **14.** The safety brackets **60, 62** vertically support the upper and lower crash-resistant crossbeams **54**, **56**.

[0033] Non structural components (not shown) of the driver's desk can be housed in and fixed to the driver's desk structure **46,** e.g. in a free space within the deformable framework of profiles **48,** preferably at least partially

in the inner crushable space **24** of the driver's cabin, and/or in a free space within the crash-resistant framework of profiles **50.**

[0034] A panelling (not shown) is fixed to the driver's desk structure **46** in the survival space **22,** preferably between the crash-resistant framework of profiles **50** and a driver's space of the driver's cabin. The panelling covers the parts of the driver's desk structure **46** that are located in the survival space **22.**

[0035] During a frontal collision, the energy-absorbing structure **18** is bent and crushed and moves towards the crash-resistant structure **14** of the driver's cab as illustrated in figures **4** and **5**. The deformable framework of profiles **48,** which is attached to the energy-absorbing structure **18,** is crushed. Parts of the collapsed deformable framework of profiles **48** and of the collapsed non structural components initially housed in the deformable framework of profiles **48** may enter the free space within the crash-resistant framework of profiles **50.** The crash-resistant framework of profiles **50,** on the other hand, remains stable. In particular, the upper and lower crash-resistant crossbeams **54**, **56** remain attached to the safety brackets **60, 62** via the longitudinal connections which, because they are in the general direction of the applied forces, should not fail. Even in a worse case scenario in which the longitudinal connections fail, the upper and lower crash-resistant crossbeams bear against the safety brackets of the crash-resistant structure. The panelling contributes to prevent non-structural components from entering the driver's space.

[0036] The deformations of the driver's desk structure **46** take place in a controlled manner and in a predefined area without degrading the performance of the energy-absorbing structure **18.** Thanks to the upper and lower safety brackets **60, 62** and upper and lower crash-resistant crossbeams **54**, **56**, the driver's desk structure **46** is safely attached to the side portions of the crash-resistant structure **14** of the driver's cabin **10.** The part of the driver's desk that is located in the survival space **22** remains stable and does not translate into the driver's space **22** in a manner that can injure the driver. The driver does not have to leave the driving position to find shelter in a remote part of the driver's cabin or outside the driver's cabin.

Claims

1. A driver's cabin (10) of a rail vehicle defining a front direction (100) and comprising

- a driver's cabin structure (12) comprising a crash-resistant structure (14) surrounding an inner survival space (22) of the driver's cabin (10) and an energy-absorbing structure (18) located in front of the crash-resistant structure (14) and surrounding an inner crushable space (24) of the driver's cabin (10), and
- a driver's desk structure (46) located inside the driver's cabin structure (12) and attached to the driver's cabin structure (12),

characterised in that the driver's desk structure (46) comprises a deformable framework of profiles (48) at least partially, and preferably totally located in the inner crushable space (22) of the driver's cabin (10) and at least one crash-resistant crossbeam (54, 56) fixed to the crash-resistant structure (14) and located, with respect to the front direction (100), behind the deformable framework of profiles (48), preferably in the inner survival space (22).

2. The driver's cabin (10) of claim 1, wherein the crash-resistant crossbeam (54, 56) is located at a rear end, preferably a rear upper end, of the driver's desk structure (46).

3. The driver's cabin (10) of any one of the preceding claims, wherein the crash-resistant crossbeam (54, 56) is located in the inner survival space (22).

4. The driver's cabin (10) of any one of the preceding claims, wherein the crash-resistant crossbeam (54, 56) is located, with respect to the front direction, in front of abutments (60, 62) of the crash-resistant structure (14), and is connected to the crash-resistant structure (14) such that during a frontal collision the crash-resistant crossbeam (54, 56) bears against the abutments (60, 62) of the crash-resistant structure (14).

5. The driver's cabin (10) of claim 4, wherein the abutments (60, 62) include at least two abutments each facing a respective end of the crash-resistant crossbeam (54, 56).

6. The driver's cabin (10) of any one of claims 4 to 5, wherein the abutments are formed by safety brackets (60, 62) of the crash-resistant structure.

7. The driver's cabin (10) of claim 6, wherein the crash-resistant crossbeam (54, 56) is connected to the safety brackets (60, 62) by longitudinal connections (64, 66), each comprising an elongate shaft extending in the front direction.

8. The driver's cabin (10) of claim 6 or claim 7, wherein the safety brackets (60, 62) vertically support the crash-resistant crossbeam (54, 56).

9. The driver's cabin (10) of any one of the preceding claims, wherein the deformable framework of profiles (48) of the driver's desk structure (46) comprises connections and/or profiles provided with structural weaknesses.

10. The driver's cabin (10) of any one of the preceding claims, wherein the deformable framework of profiles (48) is attached to the energy-absorbing structure (18), preferably via welded, bolted and/or riveted connections (52), in such a way that during a frontal collision, the deformable framework of profiles (48) is crushed as a result of a deformation of the energy-absorbing structure (18).

11. The driver's cabin (10) of any one of the preceding claims, wherein the driver's desk structure (46) comprises a crash-resistant framework of profiles (50) at least partially located in the inner survival space (22), and comprising the crash-resistant crossbeam (54, 56) and further crash-resistant profiles (58).

12. The driver's cabin (10) of claim 11, wherein the at least one crash-resistant crossbeam is an upper crash-resistant crossbeam (54) located at a rear upper end of the driver's desk structure (46), and the crash-resistant framework of profiles (50) includes a lower crash-resistant crossbeam (56) located below the upper crash-resistant crossbeam (54), preferably at a lower rear end of the driver's desk structure (46), and preferably located, with respect to the front direction, in front of lower abutments (62) of the crash-resistant structure (14), the lower abutments being preferably formed by lower safety brackets (62).

13. The driver's cabin (10) of claim 11 or claim 12, further comprising attachment brackets (56) for attaching and vertically supporting a lower part of the crash-resistant framework of profiles (50) to an underframe (36) of the crash-resistant structure (14).

14. The driver's cabin (10) of any one of the preceding claims, wherein the energy-absorbing structure (18) is fixed to the crash-resistant structure (14).

15. The driver's cabin (10) of any one of the preceding claims, wherein non structural components of the driver's desk are housed in the driver's desk structure (46), preferably in a free space within the deformable framework of profiles (48), preferably at least partially in the inner crushable space (24) of the driver's cabin (12).

16. The driver's cabin (10) of any one of the preceding claims, further comprising a panelling fixed to the driver's desk structure (46) in the survival space (22), preferably between the driver's desk structure (46) and a driver's space of the driver's cabin (10).

Fig.1

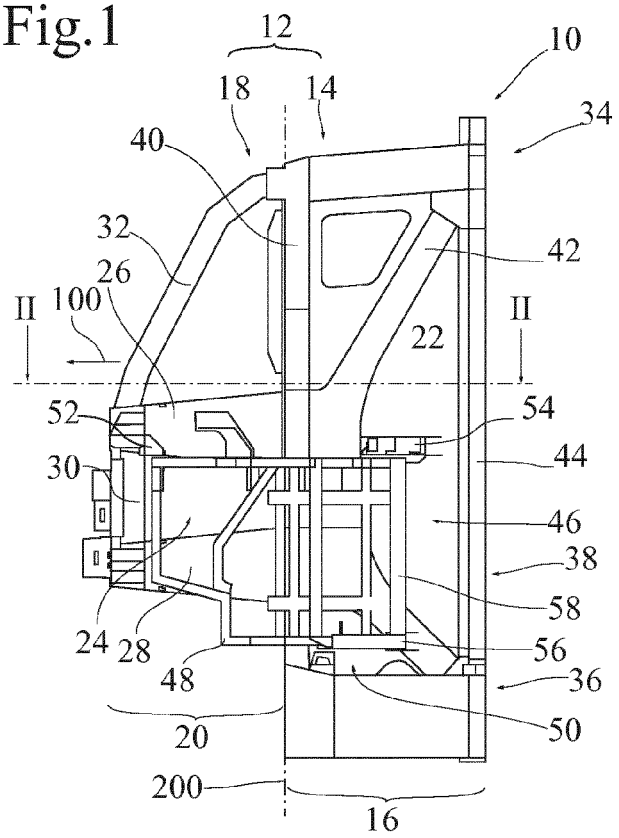


Fig.4

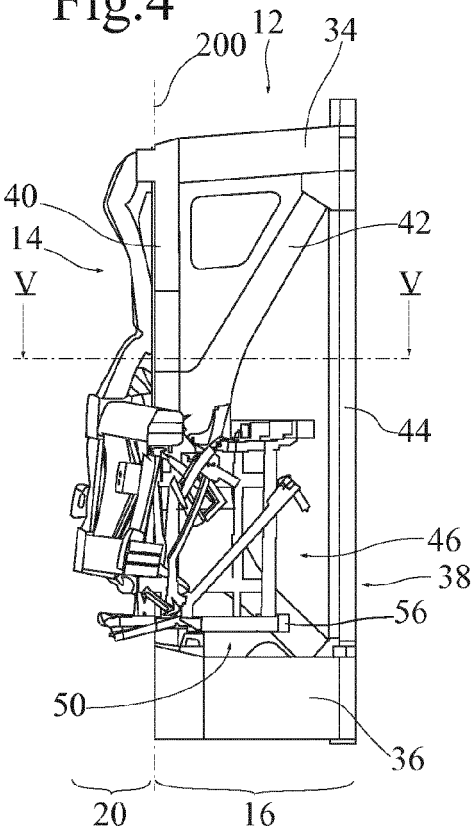


Fig.2

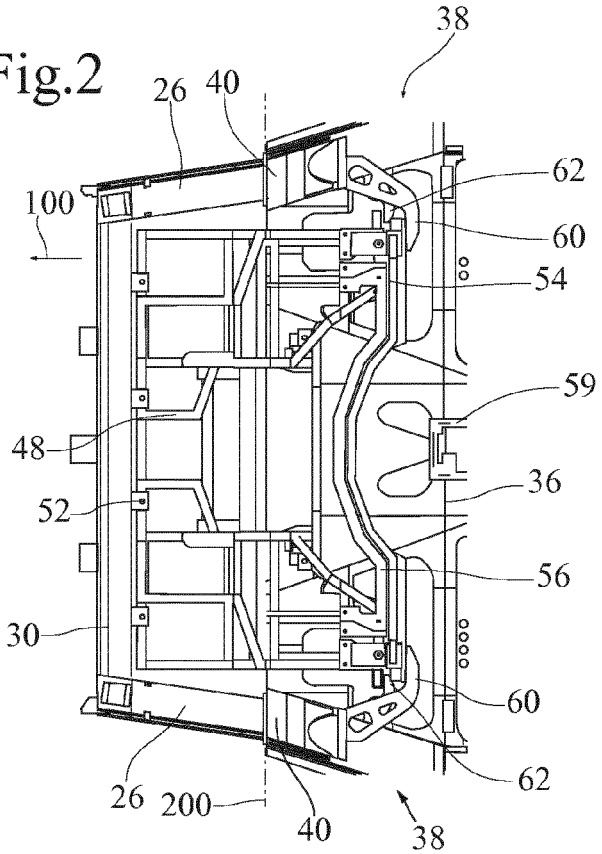


Fig.5

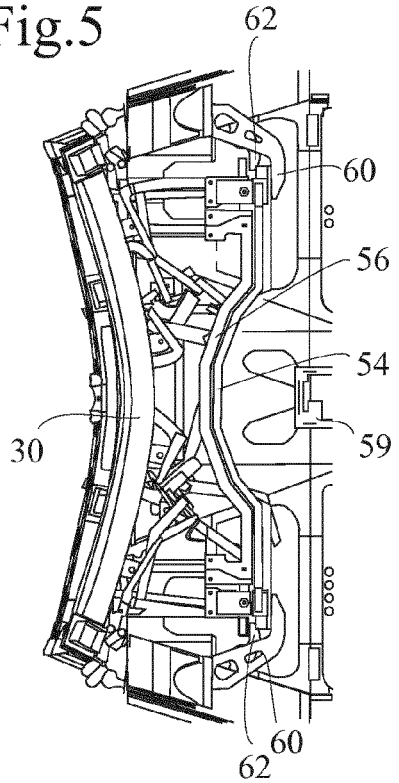
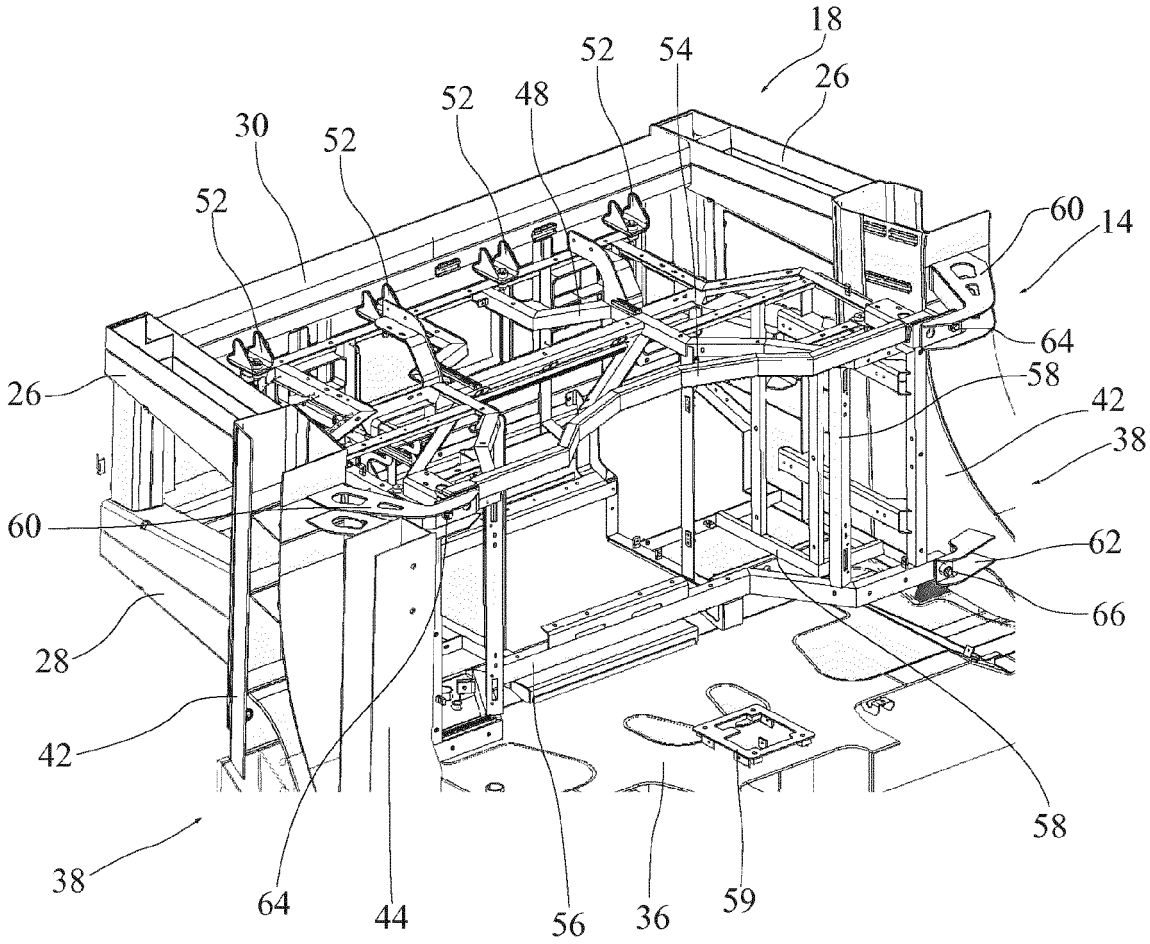


Fig.3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EUROPEAN SEARCH REPORT

Application Number
EP 15 19 4102

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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	15 April 2016	Lendfers, Paul

CATEGORY OF CITED DOCUMENTS

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ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 15 19 4102

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
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