(19) DANMARK

(10) **DK/EP 4178699 T3**

Patent- og
Varemærkestyrelsen

(12) # Oversættelse af europæisk patentskrift

(51) Int.Cl.: ***A 63 G 7/00 (2006.01)***

(45) Oversættelsen bekendtgjort den: **2024-11-11**

(80) Dato for Den Europæiske Patentmyndigheds
bekendtgørelse om meddelelse af patentet: **2024-08-07**

(86) Europæisk ansøgning nr.: **21732867.3**

(86) Europæisk indleveringsdag: **2021-06-10**

(87) Den europæiske ansøgnings publiceringsdag: **2023-05-17**

(86) International ansøgning nr.: **EP2021065682**

(87) Internationalt publikationsnr.: **WO2022008161**

(30) Prioritet: **2020-07-08 DE 102020118049**

(84) Designerede stater: **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**

(73) Patenthaver: **Ingenieurbüro Stengel GmbH, Nesselwanger Str. 24, 81476 München, Tyskland**

(72) Opfinder: **STENGEL, Werner, , 81477 München, Tyskland**

(74) Fuldmægtig i Danmark: **Inspicos P/S, Agern Allé 24, 2970 Hørsholm, Danmark**

(54) Benævnelse: **TRUSS-TYPE RAIL AND ROLLER COASTER ARRANGEMENT COMPRISING SAME**

(56) Fremdragne publikationer:
EP-A1- 2 156 870
WO-A1-2015/049162
DE-A1- 102016 123 928
DE-U1- 202015 001 425

Truss-type rail and roller coaster arrangement comprising same

[0001] The present invention relates to a truss-type rail for a roller coaster or similar fairground ride, with two rail tubes which can be driven on directly with a car arrangement and a chord tube which cannot be driven on, and vertical framework profiles which connect the rail tubes and the chord tube to each other in a stiffening manner and which comprise vertical diagonal profiles which run diagonally between the chord tube and the respective rail tube, alternately rising and falling. In addition, the invention relates to a roller coaster arrangement comprising a car arrangement and at least one truss-type rail of the aforementioned kind.

[0002] Such rails and arrangements are known from the prior art. For example, a variety of different rail systems exist to guide the car arrangement of a roller coaster, consisting of one or more cars, along a given track geometry. These rail systems include for example rails made of wood or steel, with one or more rail profiles, of any shape, whereby the load-bearing capacity of the rail or the individual rail profiles, also referred to hereinafter as rail tubes, can be improved by stiffening using framework profiles.

[0003] The present invention relates to a common embodiment of a rail which is designed as such a truss-type rail, and usually consists of two rail tubes which can be driven on directly and a third chord tube which cannot be driven on. The rail tubes and the chord tubes are usually designed with the same diameter, and moreover are usually designed as tubes or similar round profiles. In order to stiffen the rail tubes and chord tubes, framework profiles are used which run between the individual tubes and brace these. In this context, it is relevant that the framework profiles are arranged in such a way that they do not obstruct the free movement of the wheels or other parts of the train along the rail and in particular the rail tubes. These framework profiles comprise vertical framework profiles with vertical diagonal profiles and post profiles, as well as horizontal framework profiles with horizontal diagonal profiles and transverse profiles. The bracing on such truss-type rails has the posts and/or transverse profiles in the normal section of the rail, i.e. in the bulkhead plane, and the vertical diagonal profiles and horizontal diagonal profiles in the fields between these “bulkheads”. In addition to these so-called 3-chord truss-type rails, there are also 4-chord truss-type rails with two rail tubes which can be driven on directly and two chord tubes which cannot be driven on which are also connected to each other in a stiffening manner via framework profiles, whose statics and driving dynamics are not comparable to a 3-chord truss-type rail. However, the invention is directed to a 3-chord truss-type rail, in particular to a truss-type rail consisting of two rail tubes which can be driven on directly and a third single or sole chord tube which cannot be driven on, i.e. to a truss-type rail with a total of three rail tubes.

[0004] In a common embodiment of such truss-type rails, a right and a left rail tube are connected in a stiffening manner by means of transverse profiles. A chord tube is coupled to the rail tubes via post profiles, the post profiles being connected to the transverse profiles mentioned above. In common designs, vertical diagonal profiles run diagonally between the individual post profiles. Horizontal diagonal profiles run in the rail plane between the individual transverse profiles. The fact that, in these embodiments of truss-type rails, the vertical diagonal profiles are guided into the post profiles and the horizontal diagonal profiles into the transverse profiles has a manufacturing background, as this ensured reliable stability of the truss-type rails with relatively simple production methods. According to current standards, the wall thicknesses of the lower profiles should be greater than those of the profiles placed thereon. However, in the case of a step-by-step construction, this leads to very thick wall thicknesses of the lower profiles.

[0005] A further disadvantage of these designs is the substantial number of welded joints in total as well as the large number of individual vertical framework profiles, such as post profiles.

[0006] An arrangement for a track system is for example known from the document WO 2015/049162 A1 with a total of eight vertical framework profiles which are connected to a chord tube in a connection area or truss node. This results in a high number of welded joints on the chord tube and leads to additional material consumption due to the numerous posts and vertical diagonal profiles.

[0007] Furthermore, an arrangement for a steel truss-type rail is known from the utility model DE 20 2015 001 425 U1 in which post profiles are omitted in the connection area of vertical diagonal profiles on the rail tube. This arrangement is shown in Figs. 8A and 8B and is also described in detail later. However, as can be seen from Figs. 8A and 8B, post profiles are also necessary in this arrangement at the connection areas of the vertical diagonal profiles on a chord tube in order to ensure a load-bearing behaviour complying with applicable standards. Furthermore, in this known arrangement, a rail joint is part of a truss node.

[0008] The object of the present invention is therefore to provide an improved truss-type rail which can be produced with comparable global load-bearing behaviour with low welding volume and reduced material expenditure as well as an improved butt joint situation.

[0009] This object is achieved by a truss-type rail according to claim 1 and a roller coaster arrangement according to claim 14. Advantageous embodiments and further developments of the invention are set out in the dependent claims.

[0010] In particular, this object is achieved by a truss-type rail for a fairground ride with two rail tubes which can be driven on directly with a car arrangement, a chord tube which cannot be driven on and vertical framework profiles which connect the rail tubes and the chord tube to each other in a stiffening manner and which comprise vertical diagonal profiles which run diagonally between the chord tube and the respective rail tube, alternately rising and falling, whereby no further vertical framework profile and in particular no post profile is connected to the chord tube in at least one connection area or truss node of the vertical diagonal profiles.

[0011] In addition, this object is also achieved by a roller coaster arrangement comprising a car arrangement and at least one truss-type rail of the aforementioned type, which is described in more detail below.

[0012] Within the scope of the invention, a steel truss-type rail is understood to mean any truss-type rail which is made of a metallic material or similar statically effective material. However, the invention is not intended to be limited to steel truss-type rails, for example a use of materials that have similar material properties to steel is also conceivable, for example aluminium, fibre composites based on carbon fibres, glass fibres, nylon fibres, ceramic fibres, aramid fibres or natural fibres. Wood composites are also conceivable for use in truss-type rails. Within the scope of the invention, a truss-type rail is understood to be a rail whose rail tubes and chord tubes are stiffened by means of framework profiles such as the vertical framework profiles and horizontal framework profiles described above, whereby these framework profiles are preferably loaded mainly as normal rods. However, it is also understood to refer to those rail arrangements in which the framework profiles are also subjected to bending loads due to a substantially flexurally rigid connection of the framework profiles to the rail tube or chord tube. A rail tube or tube is understood to be any type of tube with a cross-sectional geometry that is suitable for load transfer. This is preferably understood to mean closed-walled beams and, above all, tubes with a circular cross-section. However, other tube geometries can also be used. These are also included under the term “tube” within the scope of the invention. These include, among other things, rectangular profiles, box profiles or similar closed profiles, but also open profiles such as T-profiles, I-profiles, multi-layer or multi-element profiles, etc.

[0013] According to the invention, in the truss-type rail described here, in at least one connection area of the vertical diagonal profiles to the chord tube, no further vertical framework profile is connected thereto. At least one means in particular that at least one connection area of the truss-type rail must fulfil this condition. Contrary to the prejudice known in the prior art, namely that vertical post profiles are statically indispensable, at least in the connection area of the vertical diagonal profiles to the chord tube, post profiles are dispensed with here in the at least one connection area. This has several advantages.

[0014] On the one hand, the number of connections in the at least one connection area on the chord tube is reduced. For example, this reduces the welding volume, which is associated quadratically with the square wall thickness of the welded profiles. On the other hand, material costs are reduced, since other vertical framework profiles such as post profiles are dispensed with. The result is therefore reduced material costs and a reduced overall weight of the rail.

[0015] In this connection, in the at least one connection area, preferably only four vertical diagonal profiles are connected to the chord tube as vertical framework profiles.

[0016] This results in another advantageous arrangement for a truss-type rail for a fairground ride with two rail tubes which can be driven on directly with a car arrangement, a chord tube which cannot be driven on and vertical framework profiles which connect the rail tubes and the chord tube to each other in a stiffening manner and which comprise vertical diagonal profiles which run diagonally between the chord tube and the respective rail tube, alternately rising and falling, whereby, according to the invention, a reduced number of connected vertical framework profiles is provided in at least one connection area or at least one truss node on the chord tube. By reducing the number, more space is created in the truss node. This in turn makes it possible to design vertical framework profiles with larger diameters. If the tube diameter is larger, the wall thickness can be reduced due to the increased rigidity. This further reduces the welding volume, which as described above is associated quadratically with the wall thickness, and saves weight. In the structure according to the invention with in particular only four vertical framework profiles that lead into a connection area, a ratio of tube diameter (D) to wall thickness t, hereinafter referred to as the D/t ratio, can be greater than 6, or greater than 7, or greater than 8, or greater than 9, or greater than 10, or greater than 11, or greater than 12.

[0017] In the at least one connection area, the connecting seams of the vertical diagonal profiles connected to the chord tube can have a minimum distance from each other which is always less than the diameter of the vertical diagonal profiles in the connection area. This can reduce the occurrence of additional bending moments at the connecting seams under loading and thus enable improved load-bearing and bending behaviour of the truss-type rail.

[0018] The truss-type rail can be made of steel and the connecting seam can be a weld.

[0019] Preferably, in a field section of the truss-type rail, in all connection areas of the vertical diagonal profiles to the chord tube, no further vertical framework profile, in particular a post profile, is connected thereto. The field section can have two connection areas on the chord tube.

[0020] Furthermore, post profiles can be provided in a support section of the truss-type rail in the connection area of the vertical diagonal profiles to the chord tube or to the respective rail tube which run substantially orthogonally between the chord tube and the respective rail tube and are connected directly to the chord tube and to the rail tube. Within the scope of the invention, orthogonally means in particular that the post profiles are connected substantially perpendicularly to at least one tube of the truss-type rail, viewed in the side view of the truss-type rail. Orthogonally also preferably means that the post profiles are arranged substantially in the bulkhead plane of the truss-type rail. The post profiles can reduce the span of the rail tubes. Furthermore, the post profiles can improve load transfer from the rail tubes to the support pillars in the support section.

[0021] In a butt section of the truss-type rail, it can be the case that the respective rail tube has no vertical framework profile and in particular no post profile connected thereto. By dispensing with the post profile at a butt joint, the occurrence of shear forces, bending moments and torsional forces can be reduced, since the butt joint is no longer located on a truss node. This makes it possible to further improve the butt joint situation.

[0022] It is possible to connect the vertical diagonal profiles directly to the chord tube and directly to the rail tube. The direct connection of the vertical diagonal profiles to the rail tube eliminates the need for a post profile, which according to the prior art served to connect the rail tube. Due to the direct connection of the rail tubes to the vertical diagonal profiles, loads are transferred to the chord tube via the vertical diagonal profiles, so that the post profile, as an unstrained member, is of little importance.

[0023] Therefore, preferably in at least one connection area of the vertical diagonal profiles to the respective rail tube, no further vertical framework profile, in particular a post profile, is connected. Preferably, a post profile is thus dispensed with, which further reduces the amount of material and welding required and also improves the overall impression of the truss-type rail.

[0024] Preferably, the rail tubes are connected to each other in a stiffening manner via horizontal framework profiles.

[0025] The horizontal framework profiles comprise transverse profiles which run substantially orthogonally between the rail tubes, whereby the transverse profiles are directly connected to the rail tubes. The transverse profiles preferably run in the area of the connection points of the vertical diagonal profiles into the rail tubes.

[0026] The vertical diagonal profiles can therefore be connected directly to a transverse profile in the connection area on the respective rail tube.

[0027] The horizontal framework profiles may also preferably comprise horizontal diagonal profiles which run diagonally between the rail tubes and which are directly connected to at least one transverse profile, preferably two transverse profiles, near the rail tubes.

[0028] Preferably, the vertical framework profiles are connected to or coupled with the rail tubes, for example via the transverse profiles, in such a way that a running gear clearance for a running gear assembly of the car arrangement is formed on the top, bottom and outside of the rail tube. The top side is defined here as the space above a plane formed by the rail tubes which faces away from the chord tube. In particular, the direct connection of vertical diagonal profiles to the rail tubes allows the running gear assembly clearance to be influenced.

[0029] As already mentioned, the invention also relates to a roller coaster arrangement comprising a car arrangement and at least one truss-type rail of the aforementioned type, which is described in detail in the following. Preferably, the car arrangement in this context has at least one running gear assembly which embraces at least one rail tube of the steel truss-type rail on the top, bottom and outside. All the designs, distinctive features and advantages of the steel truss-type rail mentioned here can be transferred to such a roller coaster arrangement and vice versa.

[0030] Further embodiments of the invention are disclosed in the dependent claims.

[0031] The invention is described in the following with reference to an embodiment which is explained in more detail by the accompanying drawings.

[0032] In each case schematically:

[0033] Fig. 1 shows a schematic view of a roller coaster arrangement with a truss-type rail and a car arrangement according to the invention;

[0034] Fig. 2A shows an isometric view of an embodiment of the truss-type rail;

[0035] Fig. 2B shows a top view of the embodiment according to Fig. 2A;

[0036] Fig. 2C shows a side view of the embodiment according to Fig. 2A;

[0037] Fig. 3 shows a detail view of the connecting seams in the connection area of the vertical diagonal profiles in an embodiment of the truss-type rail according to the invention;

[0038] Fig. 4A shows a side view of a field section of an embodiment of the truss-type rail according to the invention;

[0039] Fig. 4B shows an isometric detail view of support sections of an embodiment of the truss-type rail;

[0040] Fig. 4C shows an isometric detail view of a butt section of an embodiment of the truss-type rail according to the invention;

[0041] Fig. 5A shows an isometric view of another embodiment of the truss-type rail;

[0042] Fig. 5B shows a top view of the embodiment according to Fig. 5A;

[0043] Fig. 5C shows a side view of the embodiment according to Fig. 5A;

[0044] Fig. 5D shows an isometric view of an embodiment of the truss-type rail;

[0045] Fig. 5E shows a top view of the embodiment according to Fig. 5D;

[0046] Fig. 5F shows a side view of the embodiment according to Fig. 5D;

[0047] Fig. 6A shows an isometric view of another embodiment of the truss-type rail;

[0048] Fig. 6B shows a top view of the embodiment according to Fig. 6A;

[0049] Fig. 6C shows a side view of the embodiment according to Fig. 6A;

[0050] Fig. 7A shows an isometric view of another embodiment of the truss-type rail;

[0051] Fig. 7B shows a top view of the embodiment according to Fig. 6A;

[0052] Fig. 7C shows a side view of the embodiment according to Fig. 7A

[0053] Fig. 8A shows an isometric view and Fig. 8B a side view of a steel truss-type rail according to the prior art; and

[0054] Fig. 9 shows a side view of a steel truss-type rail without post profiles.

[0055] In the following, the same reference signs are used for identical and identically functioning components.

[0056] In Fig. 8A and Fig. 8B, a steel truss-type rail 100 known from the prior art is shown in isometric view and side view. This steel truss-type rail 100 has vertical post profiles 118b in connection areas 120 of vertical diagonal profiles 118a on a chord tube 116. An assumption prevailing in the prior art is that these vertical post profiles 118b are statically necessary at least in the connection area 120 on the chord tube 116. However, a steel truss-type rail 100' according to the invention which does not have these post profiles 118b, as illustrated in Fig. 9 and as described with reference to the following embodiments of the truss-type rail 10 according to the invention, has several advantages with regard to manufacturing costs, material costs or material weights. In addition, the omission of the post profiles, as shown in Fig. 9, offers the possibility of attaching the vertical diagonal profiles 118a in the connection area 120 to the chord tube 116 at a small distance from each other, so that the four vertical diagonal profiles 118a can converge on a point, so to speak, in the connection area 120, as illustrated in Fig. 2C and Fig. 3 in the connection area 20 in the further truss-type rail 10 according to the invention.

[0057] Fig. 1 shows a roller coaster arrangement 30 or similar fairground ride comprising at least one truss-type rail 10 according to the invention, which will be described in detail later with reference to Figs. 2 to Fig. 7. A car arrangement 32 can have a running gear assembly 33 with running wheels which embraces at least one rail tube of the truss 10 on the top, bottom and outer sides. The running gear assembly is shown schematically in Fig. 1 and can have different designs. The truss-type rail 10 is stabilised by support pillars 34.

[0058] The roller coaster arrangement 30 is usually made of a material that enables a high level of operational safety in order to ensure that the passengers are carried safely. Steel, for example, can be advantageous as a material for the roller coaster arrangement 30, but wood can also be used

[0059] Fig. 2A shows an isometric view of an embodiment of the truss-type rail 10. The truss-type rail 10 comprises two rail tubes 12, 14 which can be driven on directly with the car arrangement 32 and a chord tube 16 which cannot be driven on. In addition, the truss-type rail 10 has vertical framework profiles 18 which connect the rail tubes 12, 14 and the chord tube 16 to each other in a stiffening manner. The vertical framework profiles 18 are connected to the rail tubes 12, 14 in such a way that a running gear clearance for the running gear assembly 33 of the car arrangement 32 is formed on the top, bottom and outside of the rail tube 12, 14. The vertical framework profiles 18 comprise vertical diagonal profiles 18a which run diagonally between the chord tube 16 and the respective rail tube 12, 14, alternately rising and falling. An angle α between the vertical diagonal profiles 18a, as illustrated in Fig. 2C, can lie in a range of 30° to 60°, and can preferably be 45° or lower. In this way, loads transferred into the rail tubes 12, 14 are safely transferred into the chord tube 16 by activating the vertical diagonal profiles 18a.

[0060] According to the invention, in at least one connection area 20 of the vertical diagonal profiles 18a to the chord tube 16, no further vertical framework profile 18 connected thereto. Dispensing with further vertical framework profiles 18 such as vertical post profiles 18b (Fig. 4B), which can be seen in particular in the side view of the truss-type rail 1 shown in Fig. 2C, means that the number of welded joints in the connection area 20 on the chord tube 16 are reduced and material costs are saved.

[0061] However, the truss-type rail 10 according to the invention is not limited to the above embodiment. In another embodiment of the truss-type rail 10 for a fairground ride with two rail tubes 12, 14 which can be driven on directly with a car arrangement and a chord tube 16 which cannot be driven on and vertical framework profiles 18 which connect the rail tubes 12, 14 and the chord tube 16 with each other in a stiffening manner and which comprise vertical diagonal profiles 18a which run diagonally between the chord tube 16 and the respective rail tube 12, 14, alternately rising and falling, according to the invention, in a butt section BS of the truss-type rail on the respective rail tube, no vertical framework profile can be connected thereto.

[0062] Preferably, in the connection area 20, only four vertical diagonal profiles 18a are connected to the chord tube 16 as vertical framework profiles 18, as can be seen from the plan view of the truss-type rail 10 shown in Fig. 2B.

[0063] The vertical diagonal profiles 18a can be connected directly to the chord tube 16 and to the rail tube 12, 14. In at least one connection area 22 of the vertical diagonal profiles 18a to the respective rail tube 12, 14, it is possible that no further vertical framework profile 18 is connected thereto. In particular, in the connection area 22 of the vertical diagonal profiles 18a to the respective rail tube 12, 14, it is possible that no post profile 18b (as shown in Fig. 4B) which runs substantially orthogonally between the chord tube 16 and the respective rail tube 12, 14 is connected. Preferably, only two vertical diagonal profiles 18a are connected to a respective rail tube 12, 14 as vertical framework profiles 18 in the connection area 22. The direct connection to the rail tubes 12, 14 makes it possible to dissipate loads through the vertical diagonal profiles 18a without additional post profiles 18b. The truss-type rail 10 can therefore have sections without post profiles 18b in the connection areas 20 on the chord tube 16 and in the connection areas 22 on the rail tubes 12, 14.

[0064] The rail tubes 12, 14 can be connected to each other in a stiffening manner by means of horizontal framework profiles 24. The horizontal framework profiles 24 comprise transverse profiles 24a which run substantially orthogonally between the rail tubes 12, 14, as illustrated in Fig. 2A. The transverse profiles 24a are preferably connected directly to the rail tubes 12, 14.

[0065] In the embodiment shown in Fig. 2A to Fig. 2C, the rail tube profiles 12, 14, the vertical diagonal profiles 18a, the chord tube 16 and the transverse profiles 24a are designed as round profiles. Of course, it is also possible to choose other cross-sectional shapes, whereby the round cross-section is preferable to a square cross-section.

[0066] Furthermore, a tube diameter of the respective profiles can lie in the range of 130 to 190 mm, or in a range of 110 to 170 mm. The wall thickness of the profiles can range from 12 to 25 mm. A ratio of tube diameter D to wall thickness t (D/t ratio) is usually in a range of 5 to 20. For a “thick” tube, for example with a diameter of 70 mm and a wall thickness of 10 mm, the D/t ratio is equal to 7. For a “slim” tube, for example with a diameter of 88 mm and a wall thickness of 5 mm, the D/t ratio is about 17. It is true that the wall thickness can decrease as the tube diameter increases, i.e. the larger the tube diameter, the greater the D/t ratio can be. An advantage of the roller coaster arrangement 30 according to the invention and the truss-type rail 10 is that, due to the reduced number of connected framework profiles, more space is created in the truss node and the framework profiles can therefore be designed with a larger diameter and lower wall thickness. This saves weight and further reduces the amount of welding involved. In particular, the D/t ratio can be greater than 6, or greater than 7, or greater than 8, or greater than 9, or greater than 10, or greater than 11, or greater than 12.

[0067] The arrangement according to the invention of the vertical diagonal profiles 18a in conjunction with the horizontal framework profiles 24 makes it possible to ensure a global load-bearing behaviour and a global rigidity in compliance with current standards. By eliminating the post profiles 18b, material and weight can be saved and the manufacturing process can be simplified.

[0068] Fig. 3 shows a detail view of the truss-type rail 10, in particular of the connection area 20 on the chord tube 16. In the connection area 20, due to the lack of a post profile 18b, connecting seams, which are illustrated by the hatched areas, may have a minimum distance d from each other which is always less than three times, twice or one times the diameter of the vertical diagonal profiles 18a in the connection area 20. In this connection, an eccentricity of the vertical diagonal profiles 18a on the chord tube 16 in relation to a line of action of a force resulting from the application of a load can be kept low. This can reduce the occurrence of additional bending moments at the connecting seams and thus increase the load capacity of the truss-type rail 10. For example, in the example shown in Fig. 3, this line of action can refer to the centre point of the minimum distance d between the connecting seams. In other words, by dispensing with further vertical framework profiles 18, in particular the post profiles 18b, a span width or bearing span of the truss-type rail 10 in which the truss-type rail 10 has to withstand a load applied by a car arrangement 32 can be increased. In particular, the occurrence of secondary bending moments at the connecting seams can be at least partially compensated for by a low eccentricity, i.e. by the minimum distance between the attached framework profiles in a truss node. This at least partially compensates for the reduced local load-bearing behaviour resulting from the omission of the post profiles 18b due to the increased stiffening caused by the vertical diagonal profiles 18a, which are connected to the chord tube 16 with a minimum distance d from each other. According to the invention, this stiffening is facilitated in that, due to the reduced number of connected framework profiles in the truss node, more space is available for the connection of the in particular four diagonal profiles, and these can thus be designed with a larger diameter and a larger D/t ratio.

[0069] Preferably, in at least one connection area 20, the connecting seams of the vertical diagonal profiles 18a connected to the chord tube 16 or the circumferential outer edge area of the vertical diagonal profiles 18a in the connection area 20 may have a minimum distance d which is always less than three times, twice or one times the maximum diameter of the vertical diagonal profiles 18a in the connection area 20, and which in particular is less than 90%, or less than 80%, or less than 70%, or less than 60%, or less than 50%, or less than 40% of the maximum diameter of the vertical diagonal profiles 18a. Furthermore, the minimum distance d may be less than 500 mm, or less than 400 mm, or less than 300 mm, or less than 200 mm, or less than 150 mm, or less than 100 mm, or less than 50 mm. In addition, the distance between the centres of the tubes in the connection area 20 of the in particular four vertical diagonal profiles 18a may always be less than 800 mm, or less than 700 mm, or less than 600 mm, or less than 500 mm, or less than 400 mm, or less than 300 mm, or less than 200 mm. In addition, the distance between the centres of the tubes in the connection area 20 of the in particular four vertical diagonal profiles 18a may always be less than four times, or less than 3.5 times, or less than three times, or less than 2.5 times, or less than twice, or less than 1.5 times, or less than one times the maximum diameter of the vertical diagonal profiles 18a.

[0070] The truss-type rail 10 can be made of steel and the connecting seam can be a weld. However, other connecting seams are also conceivable, for example an adhesive bead or adhesive strip in the case of a non-metallic composite or fibre composite.

[0071] Furthermore, in a field section FS of the truss-type rail 10, in all connection areas 20 of the vertical diagonal profiles 18a to the chord tube 16 it may be the case that no further vertical framework profile 18 is connected thereto. However, it is also conceivable that, in a field section FS of the truss-type rail 10, in more than 10%, 20%, 30%, 40%, 50%, 60%, 70%, 80% or 90% of all connection areas 20 of the vertical diagonal profiles 18a to the chord tube 16, no further vertical framework profile 18 is connected thereto. The field section FS refers to a self-supporting section in which no supporting pillars or similar supports support a rail section of the truss-type rail 10. The field section FS also does not contain any rail connection area or butt ends of the truss-type rail. In particular, the field section FS thus refers to a section of the truss-type rail 10 of the roller coaster arrangement 30 which does not have a support section SS and no butt section BS, which are described in detail below. This is shown in Fig. 4A, in which the field area FS is illustrated by an arrow. In the example shown in Fig. 4A, the field area FS comprises two connection areas 20 on the chord tube 16 in which no post profiles 18b are connected to the chord tube 16. In other embodiments, more than 10%, more than 20%, more than 30%, more than 40%, more than 50%, more than 60%, more than 70%, more than 80%, and more than 90% of all connection areas 20 on the chord tube 16 in the entire truss-type rail track of the roller coaster arrangement 30 may have no further vertical framework profile 18 and in particular no post profile 18b.

[0072] Fig. 4B shows a schematic view of the truss-type rail 10 which shows a support section SS of the truss-type rail 10 in the connection area 20 of the vertical diagonal profiles 18a on the chord tube 16 or on the respective rail tube 12, 14. The truss-type rail 10 is represented in Figs. 4B and 4C in a highly simplified way, whereby the vertical diagonal profiles 18a connected to the rail tube 12 have been omitted for reasons of clarity. In the support section SS, which is illustrated by an arrow, post profiles 18b are provided which run substantially orthogonally between the chord tube 16 and the respective rail tube 12, 14 and are directly connected to the chord tube 16 and the rail tube 12, 14. According to the detail view of the truss-type rail 10 on the left in Fig. 4B, the post profiles 18b can be connected to the respective rail tube 12, 14 at the connection area 22 of the vertical diagonal profiles 18a. However, the post profiles 18b can also be connected to the connection area 20 of the vertical diagonal profiles 18a on the chord tube 16, which is shown in the detail view on the right in Fig. 4B. The post profiles 18b are stabilised by the supporting pillars 34 (Fig. 1) and supported by a ground surface (not shown). In one embodiment, in the support section SS of the truss-type rail 10, in the connection area 20 of the vertical diagonal profiles 18a on the chord tube 16, no further vertical framework profile 18, and in particular no post profile 18b, is connected thereto. The extension of the support section SS in the rail direction of the truss-type rail 10 corresponds at least to the width of the supporting support or support pillar 34. The support section SS may also extend along the truss-type rail 10 away from the support point on both sides of the support pillar 34, symmetrically to the support point of the support pillar 34, by 100 mm, 200 mm, 300 mm, 400 mm or 500 mm. Crucially, the support section SS covers a rail area of the truss-type rail 10 that is directly adjacent to the support or support pillar 34. On some roller coasters, a butt section BS, described below, may also coincide with a support section SS. In any case, however, a field section FS does not contain a butt section BS or a support section SS.

[0073] Fig. 4C shows an isometric detail view of the truss-type rail 10 illustrating the butt section BS of the truss-type rail 10. In this example, the butt section BS is represented by a circle. The butt section BS of the truss-type rail 10 is to be interpreted as an area of the truss-type rail 10 immediately adjacent to a butt end BE and extends in particular by a distance a away from the butt end BE. The distance a can be ten times, five times, three times, or twice the maximum diameter of the rail tube 12, 14. Furthermore, the distance a can be equal to 500 mm, 1000 mm or 1500 mm. It should be noted that, with the exception of the end sections shown in Fig. 4C, the end sections shown in Fig. 2A to Fig. 9 do not show any butt sections - the truss-type rail 10 was cut in the drawing at arbitrary ends. In the example shown in Fig. 4C, no vertical framework profile 18 and in particular no post profile 18b is connected to the butt section BS on the respective rail tube 12, 14. In other words, the butt section is not part of a truss node on the respective rail tube 12, 14 or embedded therein. The omission of the post profile 18b makes it possible to realise an abutment line on the respective rail tube 12, 14 in which no additional shear forces, bending moments, or torsional loads act on the butt joint. By reducing these secondary loads, tensile and compressive forces acting on the respective rail tubes 12, 14 are optimally transmitted via the butt joint. In addition, a running gear assembly clearance can be formed which allows optimal accommodation of the running gear assembly 33. Fig. 4C also shows a transverse profile 24a which is arranged at a distance from the butt section BS. However, this is not limiting. The transverse profile 24a may also be arranged on the butt section BS. The connection area 20 of the vertical diagonal profiles to the chord tube 16 can be located in the butt section BS, whereby in the connection area 20 of the in particular two vertical diagonal profiles 18a on the chord tube 16, no further vertical framework profile 18 and in particular no post profile 18b is connected thereto.

[0074] Fig. 5A to Fig. 5C show an embodiment of the truss-type rail 10 with vertical diagonal profiles 18a which are directly connected to the transverse profiles 24a. The direct connection to the transverse profiles 24a means that a low eccentricity can be achieved on the respective rail tube 12, 14 which reduces additional bending moments and torques at the connection areas 22. This is in particular advantageous if the truss-type rail 10 has a curved shape, as illustrated in Fig. 5D to Fig. 5F.

[0075] In Fig. 6A to Fig. 6C, the truss-type rail 10 is shown with horizontal diagonal profiles 24b which run diagonally between the rail tubes 12, 14 and which are directly connected to at least one transverse profile 24a, preferably two transverse profiles 24a near the rail tubes 12, 14. In this embodiment of the truss-type rail 10, the vertical diagonal profiles 18a are connected directly to the respective rail tube 12, 14. By means of the horizontal diagonal profiles 24b, the truss-type rail 10 can be additionally stabilised with regard to horizontal loads and torsional loads. Furthermore, the direct connection of the vertical diagonal profiles 18a to the respective rail tube 12, 14 and chord tube 16 means that further post profiles 18b can be dispensed with. This reduces the increase in wall thickness, since no intermediate step involving post profiles 18b or transverse profiles 24a needs to be carried out and, as described above, the vertical framework profiles can be formed with a larger diameter and lesser wall thickness.

[0076] Fig. 7A to Fig. 7C show a preferred embodiment of the truss-type rail 10 with horizontal diagonal profiles 24b which are connected to the respective rail tubes 12, 14 and which has vertical diagonal profiles 18a which are connected to the transverse profiles 24a. As described above, due to the direct connection of the vertical diagonal profiles 18a to the transverse profiles 24a, a low eccentricity on the respective rail tube 12, 14 can be realised. In this way, locally occurring bending moments can be further reduced. In conjunction with the arrangement according to the invention, which dispenses with the connection of further vertical framework profiles 18, in particular the post profiles 18b, on the chord tube 16, this results in a low lower eccentricity on the chord tube 16 and a low upper eccentricity on the respective rail tube 12, 14. The resulting reduction of local secondary stresses can make possible improved global load-bearing behaviour.

[0077] A local vertical load direction is understood to be the vertical load into or out of the seat in the local vehicle reference system of the car arrangement 32. This load direction represents the main load direction of the roller coaster arrangement 30 in the sense of the invention. This means that the greatest load components in terms of amount are to be expected in this direction. The invention relates to a roller coaster arrangement 30 in which the local vertical load direction is substantially perpendicular to a straight line through the left and right rail tube 12, 14 in the bulkhead plane. Viewed in the local vertical direction or main load direction, the chord tube 16 is therefore located between the two rail tubes 12, 14.

[0078] According to the invention, a truss-type rail 10 designed as a three-chord rail is thus provided for a fairground ride which has only two rail tubes 12, 14 which can be driven on directly with a car arrangement 32 and only one chord tube 16 which cannot be driven on, whereby the local vertical load or main load exerted on the truss-type rail 10 by the car arrangement 32 driving on the rail tubes 12, 14 always has a direction which is perpendicular or substantially perpendicular to the rail plane and/or parallel or substantially parallel to the bulkhead plane of the rail tubes 12, 14. In the local vertical load direction or main load direction, the chord tube 16 is always below or behind (where the load is directed into the seat) the rail plane of the rail tubes 12, 14. Furthermore, in the local vertical load direction or main load direction, the chord tube 16 is always below or behind (where the load is directed into the seat) both rail tubes 12, 14. Furthermore, in the local vertical load direction or main load direction, the chord tube 16 is always below or behind (where the load is directed into the seat) and between the two rail tubes 12, 14.

[0079] According to the invention, a roller coaster arrangement 30 is also provided which has a car arrangement 32 and at least one truss-type rail 10, whereby at least one truss-type rail 10 has the rail tube/chord tube arrangement described above reflecting the local vertical load direction.

PATENTKRAV

1. Gitterkonstruktionsskinne (10) til en forlystelse, med
   - to skinnerør (12, 14), hvorpå en vognindretning kan køre direkte,
   - et ikke-farbart båndrør (16), og
   - lodrette gitterkonstruktionsprofiler (18), der stift indbyrdes forbinder skinnerørene (12, 14) og båndrøret (16) og omfatter de lodrette diagonalprofiler (18a), der løber diagonalt, skiftevis stigende og faldende, mellem bånderøret (16) og det respektive skinnerør (12, 14), **kendetegnet ved, at** i mindst et tilslutningsområde (20) af de lodrette diagonalprofiler (18a) på båndrøret (16) er der ikke forbundet nogen yderligere lodret gitterkonstruktionsprofil (18).

2. Gitterkonstruktionsskinne (10) ifølge krav 1, **karakteriseret ved, at** der i det mindst ene tilslutningsområde (20) kun er fire lodrette diagonalprofiler (18a) forbundet til båndrøret (16) som lodrette gitterkonstruktionsprofiler (18).

3. Gitterkonstruktionsskinne (10) ifølge krav 1 eller 2, **karakteriseret ved, at** i det mindst ene tilslutningsområde (20) er tilslutningssømmene på de lodrette diagonalprofiler (18a), som er forbundet med båndrøret (16), hver arrangeret i en minimumsafstand (d) fra hinanden, hvilken minimumsafstand altid er mindre end tre gange diameteren af de lodrette diagonalprofiler (18a) i tilslutningsområdet (20).

4. Gitterkonstruktionsskinne (10) ifølge et af de foregående krav, **karakteriseret ved, at** der i et feltafsnit (FA) på gitterkonstruktionsskinnen (10) i alle tilslutningsområder (20) af de lodrette diagonalprofiler (18a) på båndrøret (16) er ingen yderligere lodrette gitterkonstruktionsprofiler (18) forbundet hermed.

5. Gitterkonstruktionsskinne (10) ifølge et af de foregående krav, **kendetegnet ved, at** der i et støtteafsnit (AA) på gitterkonstruktionsskinnen (10) i tilslutningsområdet (20) af de lodrette diagonalprofiler (18a) på båndrøret (16) eller på det respektive skinnerør (12, 14) er anbragt stolpeprofiler (18b), der løber i det væsentlige ortogonalt mellem båndrøret (16) og det respektive skinnerør (12, 14) og er direkte tilsluttet båndrøret (16) og skinnerøret (12, 14).

6. Gitterkonstruktionsskinne (10) ifølge et af de foregående krav, **kendetegnet ved, at** i der et stødafsnit (SA) på gitterkonstruktionsskinnen (10) på det respektive skinnerør (12, 14) ikke er forbundet nogen lodret gitterkonstruktionsprofil (18) dertil.

7. Gitterkonstruktionsskinne (10) ifølge et af de foregående krav, **kendetegnet ved, at** de lodrette diagonalprofiler (18a) er forbundet direkte til båndrøret (16) og direkte til skinnerøret (12, 14).

8. Gitterkonstruktionsskinne (10) ifølge et af de foregående krav, **kendetegnet ved, at** der i mindst et tilslutningsområde (22) af de lodrette diagonalprofiler (18a) på det respektive skinnerør (12, 14) ikke er forbundet en yderligere lodret gitterkonstruktionsprofil (18).

9. Gitterkonstruktionsskinne (10) ifølge et af de foregående krav, **kendetegnet ved, at** skinnerørene (12, 14) er stift forbundet med hinanden via vandrette gitterkonstruktionsprofiler (24).

10. Gitterkonstruktionsskinne (10) ifølge krav 9, **kendetegnet ved, at** de vandrette gitterkonstruktionsprofiler (24) omfatter tværprofiler (24a), der forløber i det væsentlige ortogonalt mellem skinnerørene (12, 14), hvor tværprofilerne (24a) er forbundet direkte med skinnerørene (12, 14).

11. Gitterkonstruktionsskinne (10) ifølge krav 10, **kendetegnet ved, at** de lodrette diagonalprofiler (18a) er forbundet direkte til en tværprofil (24a) i tilslutningsområdet (20) af det respektive skinnerør (12, 14).

12. Gitterkonstruktionsskinne (10) ifølge et af de foregående krav, **kendetegnet ved, at** de vandrette gitterkonstruktionsprofiler (24) omfatter horisontale diagonalprofiler (24b), der løber diagonalt mellem skinnerørene (12, 14), og som nær skinnerørene (12, 14) er forbundet direkte til mindst en tværprofil (24a), fortrinsvis to tværprofiler (24a).

13. Gitterkonstruktionsskinne (10) ifølge et af de foregående krav, **kendetegnet ved, at** de lodrette gitterkonstruktionsprofiler (18), når de er i brug, er forbundet med eller koblet til skinnerørene (12, 14) på en sådan måde, at der dannes et gitterkonstruktionsfrirum på toppen, bunden og ydersiden af skinnerøret (12, 14) til en gitterkonstruktion (33) af vognindretningen (32).

14. Gitterkonstruktionsskinne (10) ifølge et af de foregående krav, **kendetegnet ved, at** den lokale lodrette belastning, der under brug udøves på gitterkonstruktionsskinnen (10), når vognindretningen (32) kører på skinnerørene (12, 14), altid har en retning, der i det væsentlige er vinkelret på skinneplanet for skinnerørene (12, 14).

15. Rutsjebaneindretning (30) omfattende en vognindretning (32) og mindst en gitterkonstruktionsskinne (10) ifølge et af de foregående krav.

16. Rutsjebaneindretning (30) ifølge krav 15, **kendetegnet ved, at** vognindretningen (32) omfatter mindst en gitterkonstruktion (33), der omgiver mindst et skinnerør (12, 14) af gitterkonstruktionsskinnen (10) på toppen, bunden og ydersiden.

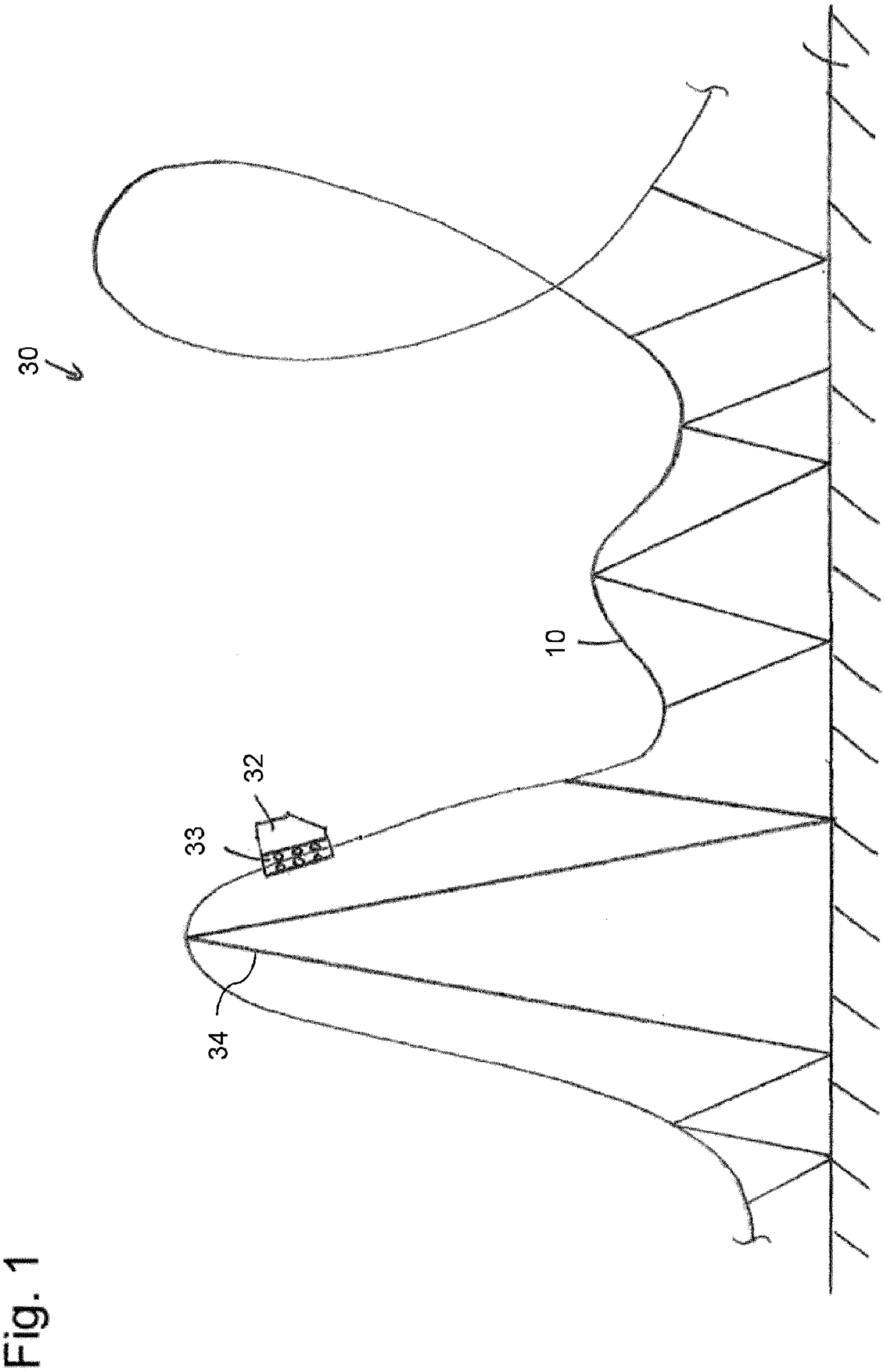

Fig. 1

Fig. 2A

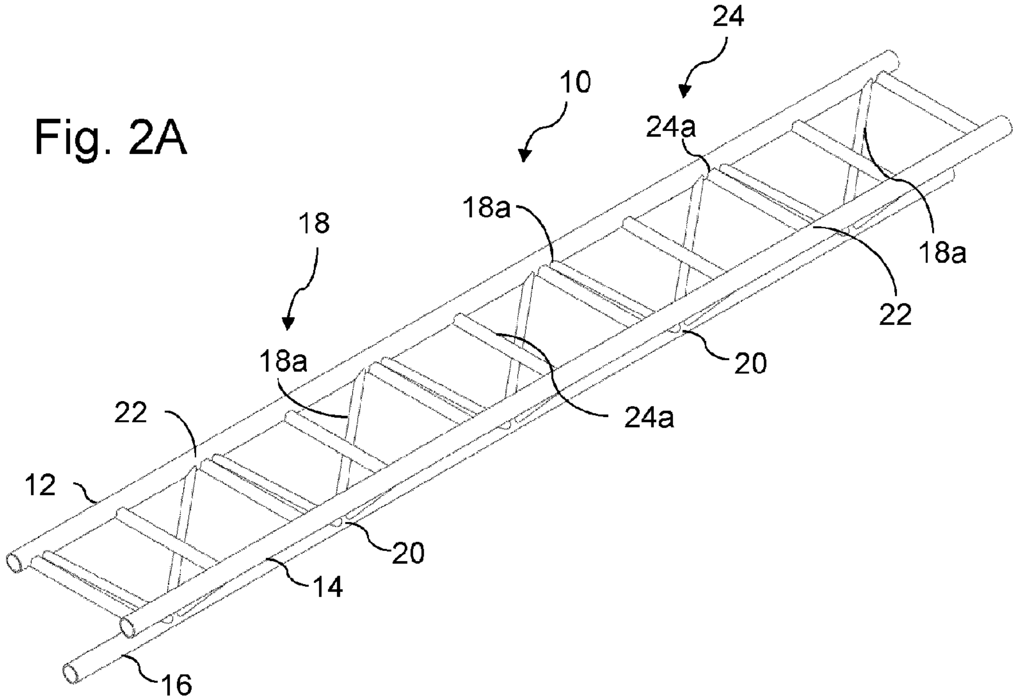

Fig. 2B

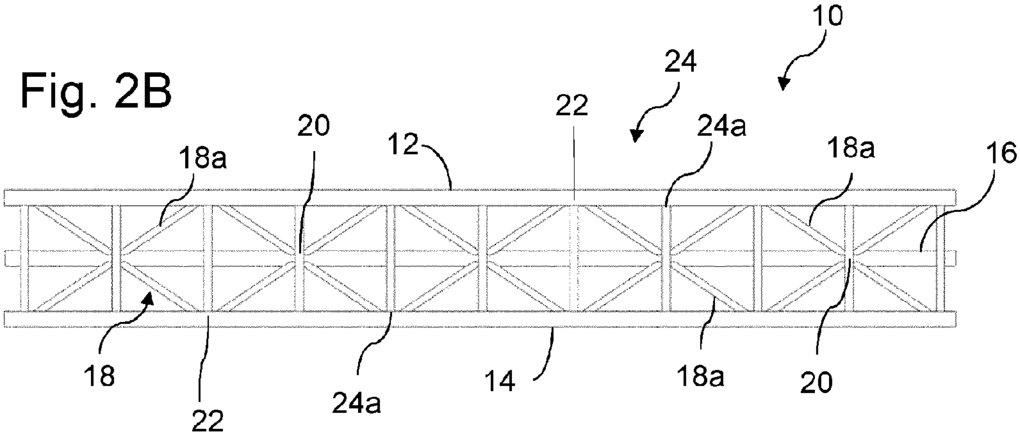

Fig. 2C

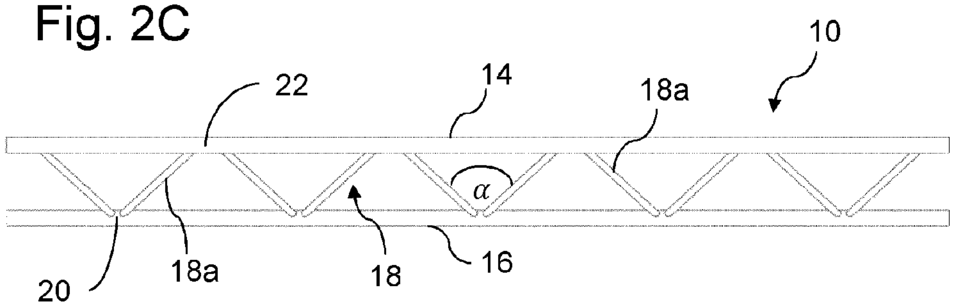

Fig. 3

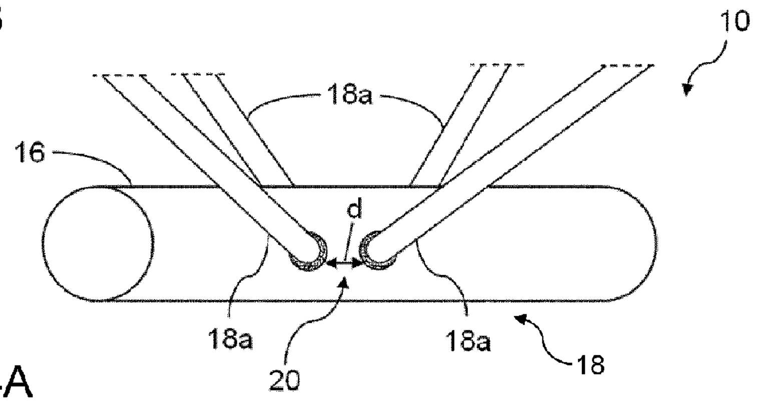

Fig. 4A

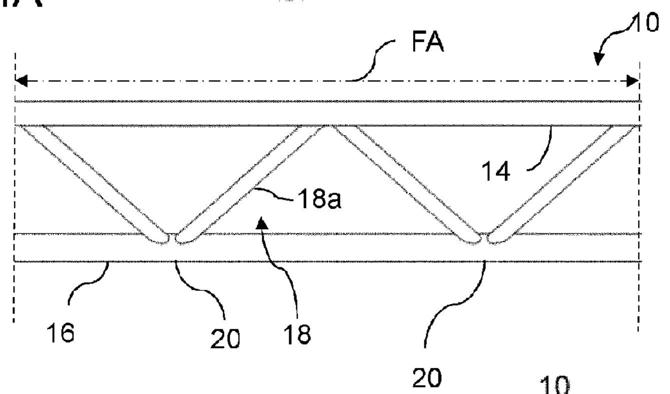

Fig. 4B

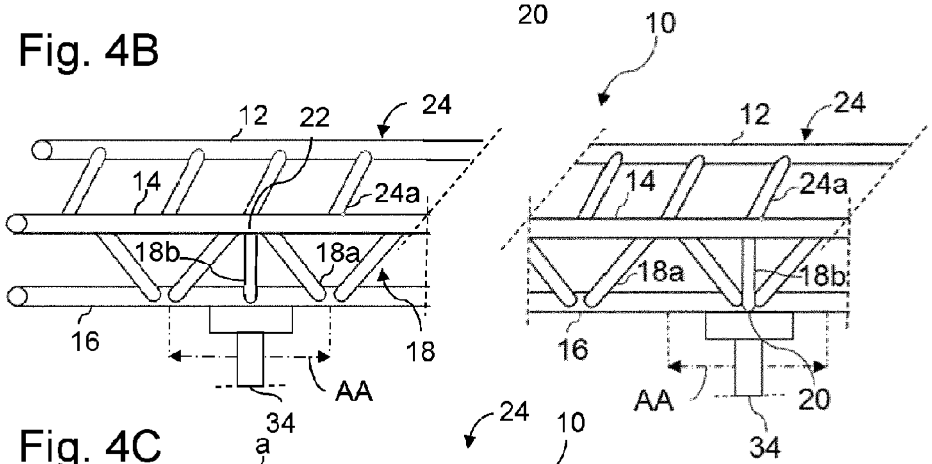

Fig. 4C

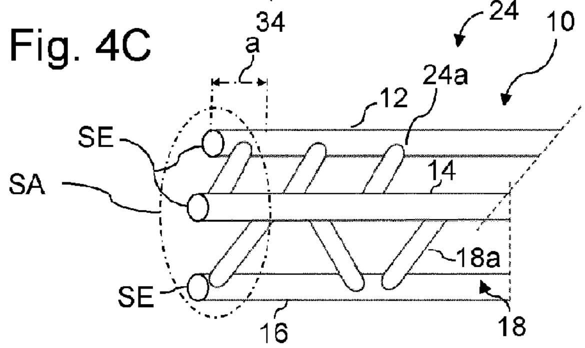

Fig. 5A

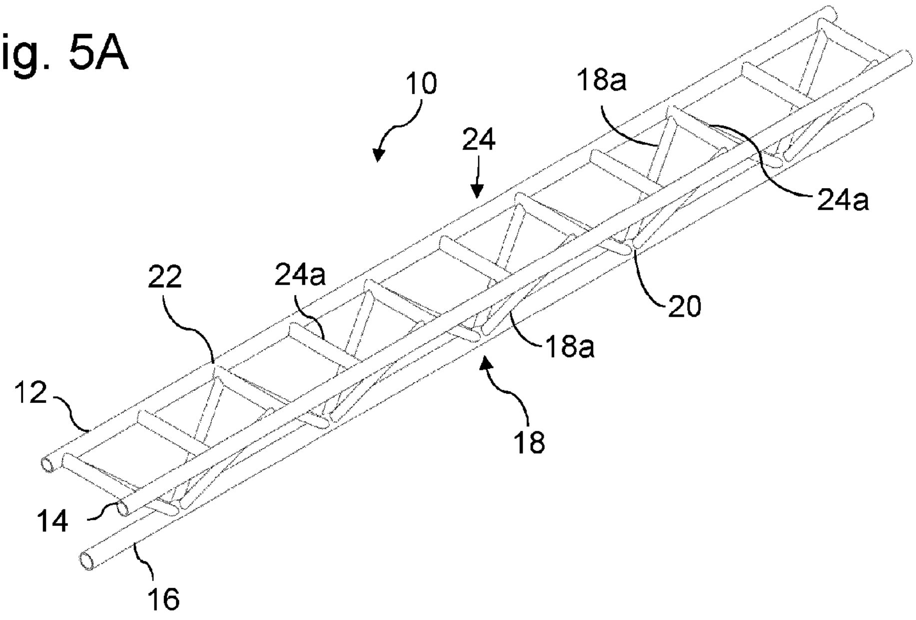

Fig. 5B

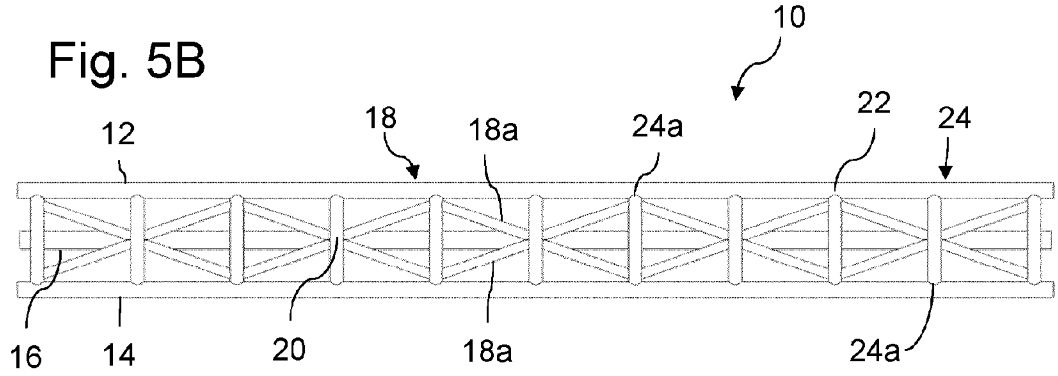

Fig. 5C

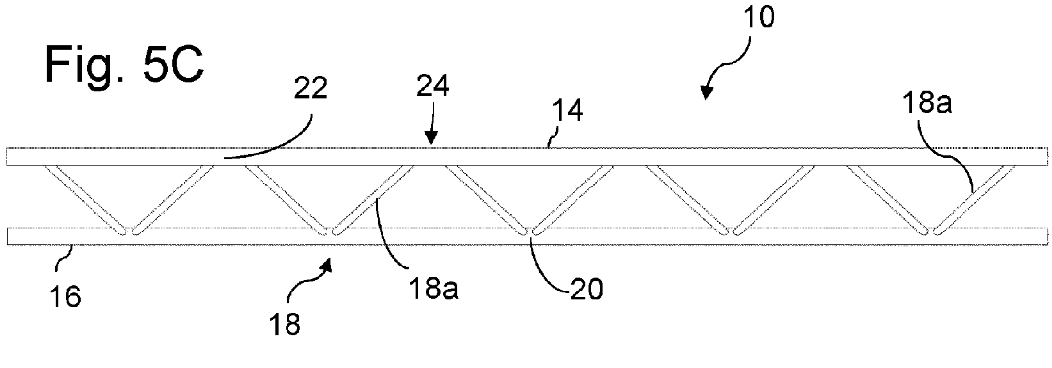

Fig. 5D

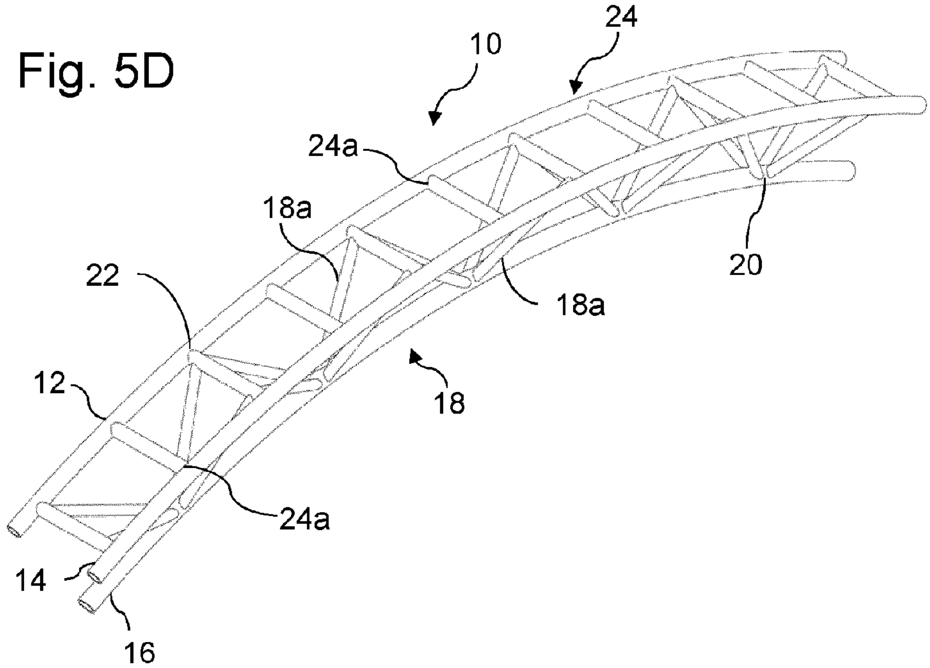

Fig. 5E

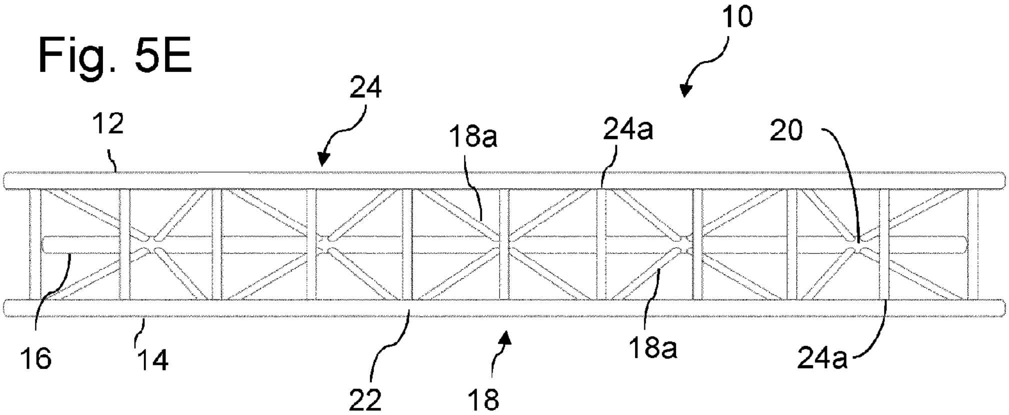

Fig. 5F

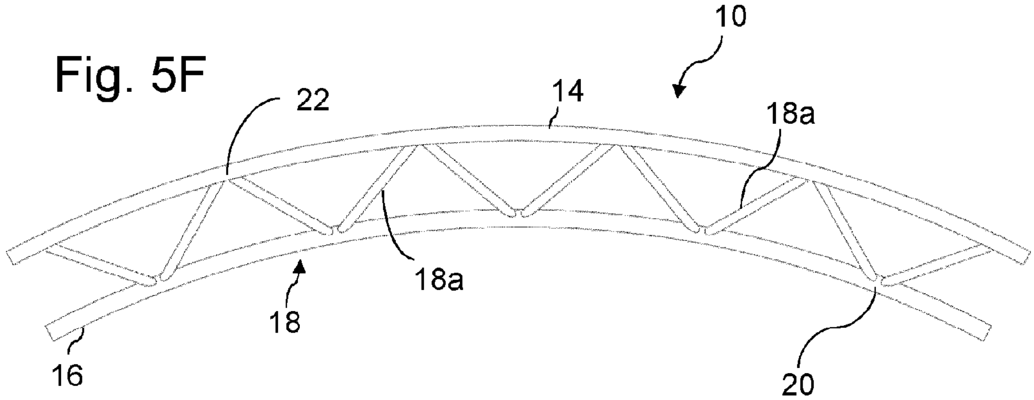

Fig. 6A

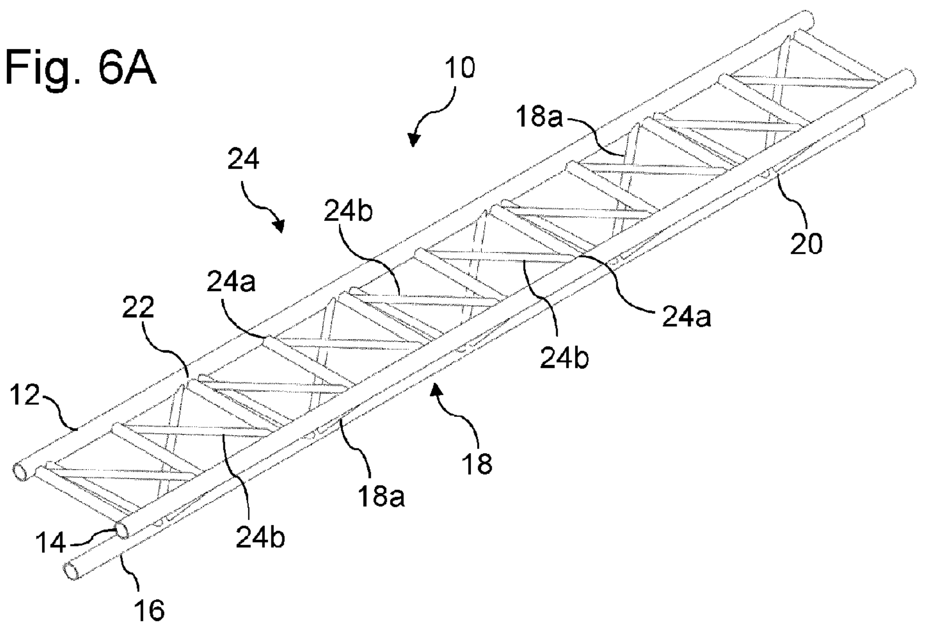

Fig. 6B

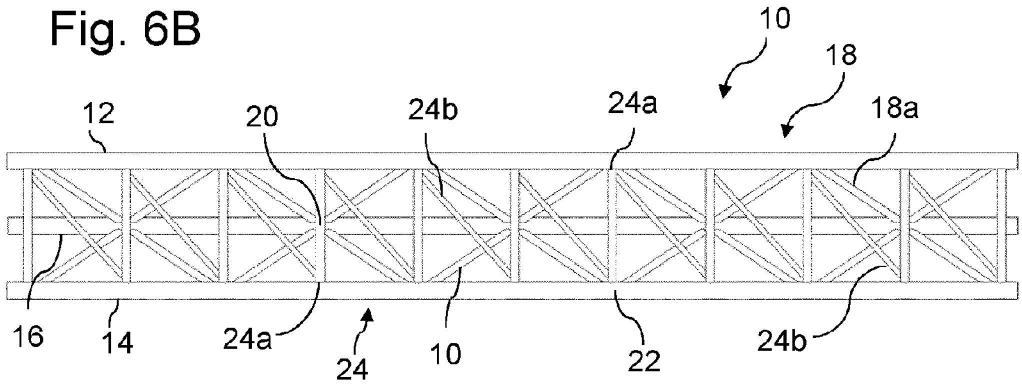

Fig. 6C

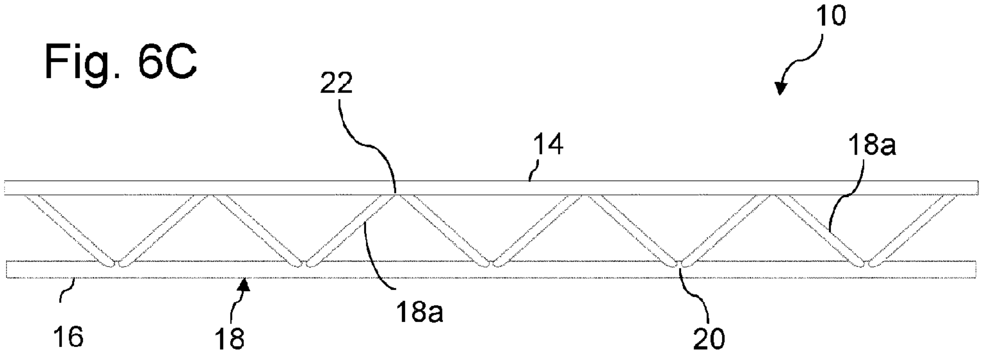

Fig. 7A

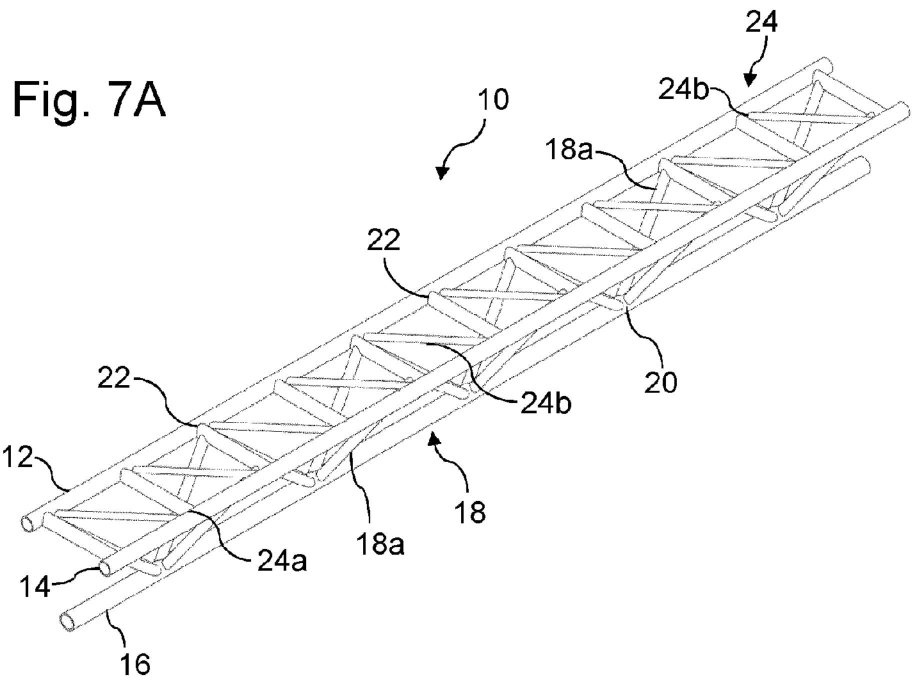

Fig. 7B

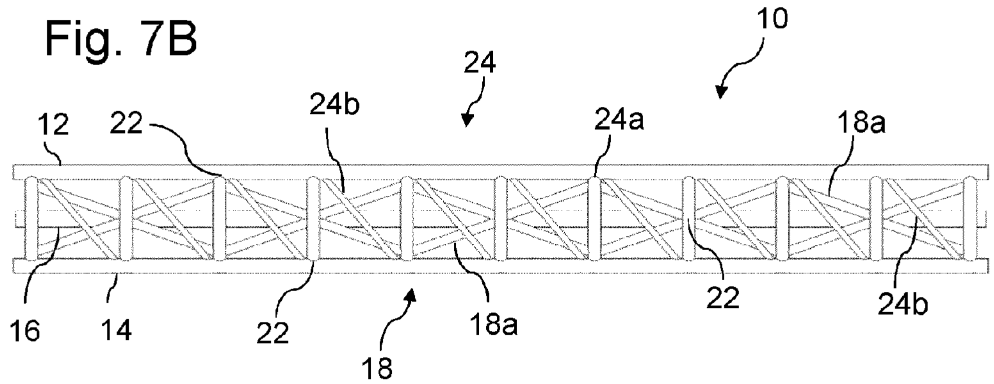

Fig. 7C

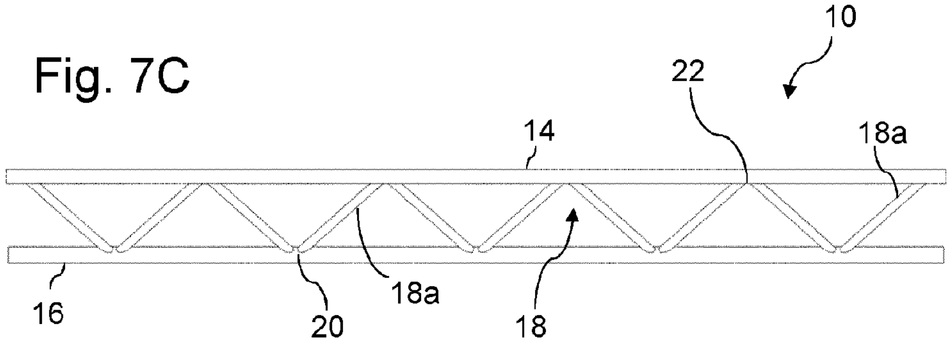

Fig. 8A

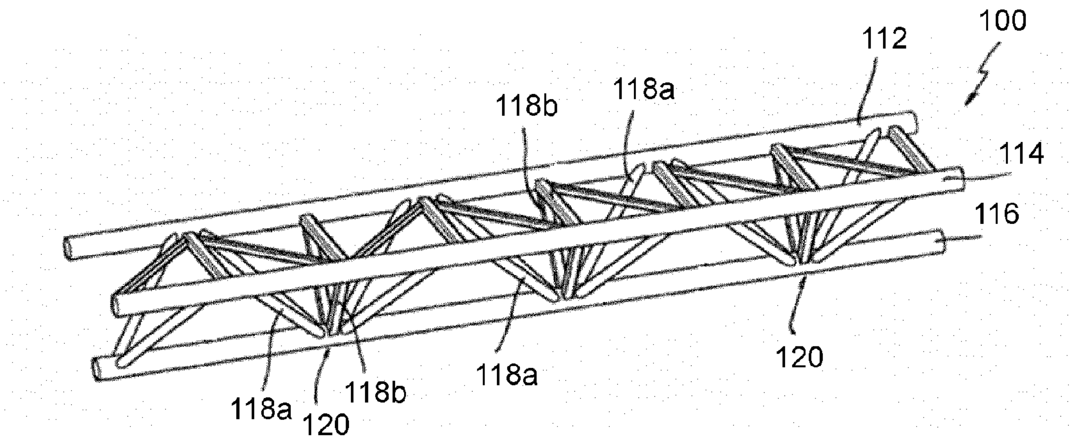

Fig. 8B

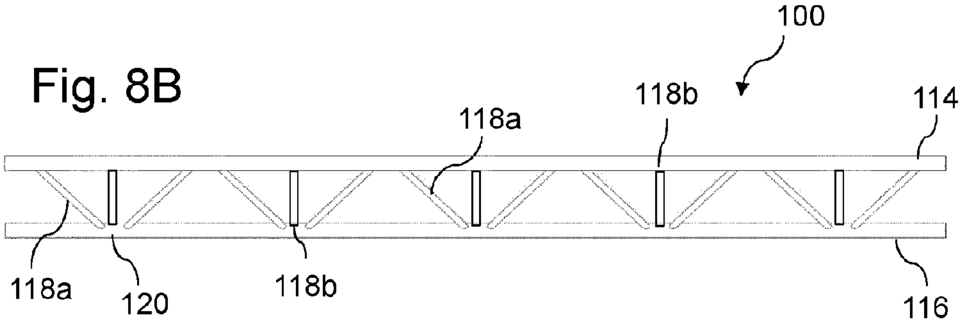

Fig. 9