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(54) **ESCALATOR/MOVING WALKWAY MODULAR TRUSS AND METHOD OF ASSEMBLING AN
ESCALATOR/MOVING WALKWAY MODULAR TRUSS**

(57) Escalator/moving walkway modular truss, each module (1,2,3) comprising opposite sides (4,5) including an steel sheet (7), and a plurality of vertical guide supports (9) placed at the inner surface (8) of the steel sheets, configured for supporting and positioning the guiding system of the escalator/moving walkway.

Additionally, the invention relates to a method of assembling an escalator/moving walkway modular truss, including the cold forming of steel sheets (7), and the cold joining of the soffit plate (6) to the sides (4,5) of each module (1,2,3).

EP 3 109 196 A1

Description

Field of the invention

[0001] The present invention is encompassed within the technical field of escalators and moving walkways, specifically to the truss and structural elements for holding the mechanism of the escalator/moving walkway, and more specifically, to modular structures assembled together to make a whole escalator/moving walkway truss.

[0002] The invention relates, in particular, to an escalator/moving walkway modular truss which is assembled by means of cold joining technology, providing accurate final dimensions, and being able to support and position the whole guiding.

Background of the invention

[0003] Nowadays the escalator and moving walkway truss is intended merely as a structural element with the only aim of holding the mechanisms located inside the escalator or the moving walkway.

[0004] Current escalator and moving walkway modular trusses comprise mainly an upper module, a central module and a lower module, assembled together to form the whole truss. Figure 1 shows an overall view of a current escalator/moving walkway modular truss with those three modules. These modules consist of a plurality of welded steel tubes or hot rolled profiles, which due to bad tolerances and thermal stresses in the manufacturing process made by welding, form a deformed and misaligned truss. These deformations in the welded structure make the following assembly phase of guide supports and guiding system assembly a very time-consuming and expensive process, since due to these deformations and the high number of components, the connection between elements and modules is difficult, and highly qualified operators are required. That is, due to the deformations in the steel during the welding, the final task for each truss assembly is a straightening process of the whole structure in order to maintain the general dimensions into tolerance. This is a very archaic task which depends basically on the expertise of the operators.

[0005] In addition, since the welding process does not ensure accurate truss dimensions, it is not possible to get the same general dimensions in two theoretically identical structures. This means that it is not possible to know exactly the time consumed in assembling each escalator or moving walkway.

[0006] Another problem is that during the welding process a lot of sparks, fumes and noises are generated, creating a bad environment at working place. Also, to take into account, the high energy consumption in the welding process.

[0007] Figures 2a, 2b and 2c show different views of an assembly process of a truss known in the prior art with all the drawbacks thereof. First, welded structures provide dimensions out of tolerance due to poor raw mate-

rials and archaic manufacturing process. Also, the assembly of guide supports for supporting and positioning the guiding system of the escalator/moving walkway takes several hours due to adjustments required. Additionally, the assembly of the guiding system takes another big amount of time due to a high precision required, since ride quality of the escalator/moving walkway highly depends on this guiding system.

[0008] Document EP2117747 discloses a method for clinching thick metal workpieces and the use of a clinching tool. The invention relates to a method for the production of a load-bearing structural steel connection. A clinching connection is formed by a male die and a female die using local deformation, and it connects two metal workpieces. The metal workpieces are placed on top of each other on a processing surface of the female die and aligned. Then the male die is applied and lowered into the two metal workpieces until the clinching connection is formed by plastic deformation. The die is configured in a rotationally symmetrical manner with regard to the rotational axis thereof and has a conically shaped transitional region tapering at an angle in the lowering direction of the die.

[0009] Document WO2011048437 discloses a truss construction for a passenger conveyor. The invention relates to a truss construction for a passenger conveyor comprising at least one self-supporting element. The self-supporting element, which is a roller molded element, extends in a conveying direction of the passenger conveyor and is formed with at least one rail portion for guiding step chain rollers and/or step rollers.

[0010] Document US2009/0050443 discloses a travelator, moving ramp or escalator for transporting passengers, and it comprises a conveyor mounted on a frame that is supported on a fixed structure. The frame comprises a number of mutually identical profiled metallic bodies joined together end to end one after the other and containing coupling, supporting and/or guide elements integrated in the profiled metallic body of solid material.

[0011] Document US2013/0228414 discloses an escalator or a moving walkway which includes a support structure and a soffit plate. A first side edge region of the soffit plate is fixedly connected with the support structure. In addition, the soffit plate is biased between the first side edge region and a second side edge region, which is opposite the first side edge region, by a predetermined biasing force. In order to maintain the bias the second side edge region is fixedly connected with the support structure, wherein through the maintenance of the biasing force a stiffness of the support structure is increased and in operation of the escalator or the moving walkway the output of noise is reduced.

[0012] Document EP2527283 discloses a support, a module to be placed on the support, and a transport system for displacement of people/goods modernized with the module and a modernization method of transport systems for displacement of people/goods. The support has: fixings to fix the support to a bearing structure of the trans-

port system, horizontal tie plates to support and horizontally place the module, lateral tie plates to support and laterally place the module, longitudinal tie plates to support and longitudinally place the module. The module has positioning and verification equipment to place the module maintaining within tolerances the system lines of the transport system. The transport system has: a support and an entrance/exit/central module on an entrance/exit finished floor/in a central section.

[0013] Document US6685002 shows a method of modernizing an escalator using modular components. The mechanical and electrical parts of an existing escalator are removed, leaving only the structural truss framework and cross members as well as external parts, such as external panels, that interface with the building. A single module is placed at the top of the escalator and another module at the bottom. A plurality of incline modules are placed in the central inclined part of the escalator, at each cross member. By utilizing these modules, the assembly of the escalator is simplified. Furthermore, an entirely new escalator system using the latest technology may be installed rather than merely installing new parts in an old system.

[0014] Document US2002/0175039 discloses a support structure for an escalator, which includes a bottom landing, a top landing, and a rise that interconnects the bottom and top landings. An improved truss design comprised of steel modules that are stamped or bent is used to form the rise, the top landing, and the bottom landing. The modules have closed sides, which increases the strength and stiffness of the truss while also providing the enclosure for internal escalator components. The modules are either formed as a single piece or formed from multiple pieces that are welded or fastened together. The modules are then secured to each other to form the rise, the top landing, and the bottom landing.

Description of the invention

[0015] The present invention provides an advantage with respect to the current modular trusses for escalators and moving walkways, providing a modular and accurate truss, which reduces the number of components and saves time in the escalator or moving walkway assembly line.

[0016] This is achieved by means of an escalator/moving walkway modular truss as disclosed in claim 1 of the present application.

[0017] This truss comprises three independent modules which are joined together in a complex structure. These modules are an upper module, a central module, and a lower module.

[0018] Each module comprises a first side, a second side, which is opposite to the first side, and a soffit plate placed between both sides. Each side of the modules has in turn at least a metal sheet, and a plurality of vertical guide supports placed at the inner surface of the metal sheets, configured for supporting and positioning the

guiding system of the escalator/moving walkway. Additionally, the vertical guide supports provide an additional rigidity to the sides of the modules.

[0019] These vertical guide supports may be integral to the metal sheets, and therefore they will be manufactured by press forging, stamping or bending the metal sheets, or on the other hand, the vertical guide supports may be independent from the metal sheets and they will be joined to the metal sheets by cold joining techniques.

[0020] According to particular embodiments of the invention, these metal sheets are steel sheets, and preferably AHSS ("Advanced High Strength Steel") sheets, and they may be laser-cut sheets, folded sheets, stamped sheets or bended sheets.

[0021] Therefore, steel hot rolled profiles or tubes with poor finished and bad dimensional and geometrical tolerances of the prior art are replaced by laser-cut, folded, stamped or bended sheets made of AHSS that provide better mechanical properties than those acquired with the steel used nowadays. In addition, vertical guide supports, manufactured by press forging, stamping or bending the AHSS steel sheet ensure also good tolerances and mechanical properties.

[0022] In order to improve the rigidity and to enhance the structural behaviour of the assembly, the modules of the escalator/moving walkway have a plurality of cross-bars between both sides, each crossbar placed between a pair of opposite vertical guide supports, preferably perpendicularly to both sides.

[0023] In accordance with a particular embodiment of the invention, the upper module and the lower module are joined to the central module by means of at least a joining bended plate made of metal placed at the ends of said upper and lower modules. This joining plate is also used as support for the guides support in the transition areas between upper and central modules, and lower and central modules.

[0024] Another object of the invention is a method of assembling an escalator/moving walkway modular truss as disclosed in claim 10 of the present application.

[0025] The first stage of the method is an assembly of a first side and a second side opposite to the first side, for each one of the three modules of the escalator/moving walkway.

[0026] Then, a soffit plate is placed between both sides of each module, and finally the modules are assembled together.

[0027] According to the object of the present invention, the assembly of each side of the modules includes a cold forming of metal sheets, and a cold joining of the soffit plate to the sides of each module.

[0028] So, in order to avoid thermal loads generated during the process and therefore deformations in the truss, the assembly between different parts is not made by welding, but by cold joining technologies, such for example, clinching, bolting, riveting or even means of hybrid solutions including adhesives.

[0029] With this invention, the truss plays an additional

role, besides of the structural one, and thanks to its good dimensional tolerances it is now able to support and position the whole guiding system of the escalator or the moving walkway.

[0030] Additionally, by using the cold joint technologies, it is possible to get good general dimensions in the trusses, and in addition, sparks, fumes or noises are not generated. Besides, energy consumption is low. Therefore, the assembly method can be considered environmentally friendly.

[0031] In order to improve the rigidity and to enhance the structural behaviour of the assembly, the method includes a cold joining of a plurality of crossbars between both sides of the modules, placing each crossbar between a pair of opposite vertical guide supports, preferably perpendicularly to both sides.

[0032] One of the most critical points in the current escalator and moving walkway trusses is the assembly of upper and lower modules to the central one, due to the high amount of heat generated when welding. These thermal loads results in a deformation between different modules that make impossible achieve the required angle of the escalator or the moving walkway.

[0033] So, in accordance with a particular embodiment of the invention, the assembly of the upper module and the lower module to the central module is made by the cold joining of joining bended plates to the ends of the modules. Preferably the cold joining in this case is clinching. These joining bended plates are conformed specifically according to the escalator requirements.

[0034] Besides, since the connection between upper module and central module is the most demanded zone of the escalator/moving walkway regarding loads, the method object of the present invention reinforce the area and improve the strength in this transition point, due to the substitution of welding by cold joining technologies. Again, since this joint is made by cold joining technologies instead of welding, an important reduction in the energy consumption is also performed.

[0035] According to different particular embodiments of the invention, the cold joining includes a method which may be clinching, bolting, riveting, using adhesives, and any combination of any of them.

[0036] In addition to all of this, one of the main advantages of the present method over the prior art, is to replace an archaic and obsolete manufacturing process depending on high skilled welders, by a fully automatic process. Most of cold joint technologies can be easily automated ensuring a high degree of repetitiveness instead of the current process, in which it is not possible to achieve the same final result in two theoretically identical escalator or moving walkway trusses.

[0037] Additionally, this is an environmental friendly and sustainable manufacturing method, and it allows a reduction in the number of components and in the number of assembly stages that result in a more cost-effective truss for escalators/moving walkways.

Brief description of the drawings

[0038] Next, in order to facilitate the comprehension of the invention, in an illustrative rather than limitative manner an embodiment of the invention with reference to a series of figures shall be made below.

Figure 1 shows an overall and schematic view of an escalator/moving walkway modular truss including an upper module, a central module, and a lower module.

Figures 2a, 2b and 2c show detailed views of an assembly process of a truss known in the prior art. Figure 3 shows a central module for an escalator/moving walkway modular truss according an embodiment of the present invention.

Figure 4 shows a schematic view of the joining of the vertical guides to the metal sheet of the present invention.

Figure 5 shows a central module for an escalator/moving walkway modular truss according a second embodiment of the present invention.

Figure 6 shows an upper module including joining bended plates according an embodiment of the present invention.

Figure 7 shows an upper module including joining bended plates according an alternative embodiment of the present invention.

[0039] These figures refer to the following set of elements:

1. upper module of the escalator/moving walkway
2. central module of the escalator/moving walkway
3. lower module of the escalator/moving walkway
4. first side of the modules
5. second side of the modules
6. soffit plate of the modules
7. metal sheets
8. inner surface of the metal sheets
9. vertical guide supports
10. crossbars of the modules
11. joining bended plates

Detailed description of the invention

[0040] One object of the present invention is an escalator/moving walkway modular truss.

[0041] As shown in the figures, the modular truss has an upper module 1, a central module 2, and a lower module 3.

[0042] As it can be seen in figure 3, each module 1,2,3 has a first side 4 and a second side 5 which is opposite to the first side 4, and a soffit plate 6 placed between both sides 4,5. Additionally, each side 4,5 of the modules 1,2,3 comprises in turn at least a metal sheet 7, and a plurality of vertical guide supports 9 placed at the inner surface 8 of the metal sheets 7, these vertical guide sup-

ports 9 configured for supporting and positioning the guiding system of the escalator or moving walkway.

[0043] According with a particular embodiment of the invention disclosed in figure 3, an output cladding for the escalator/moving walkway would not be necessary due to the configuration and shape of the metal sheets 7.

[0044] According to different embodiments of the invention, each side 4,5 of the modules 1,2,3 may be formed by a single metal sheet 7, or by a plurality of metal sheets 7 joined together by cold joining technologies, forming a longer sheet.

[0045] In accordance to particular embodiments of the invention, the metal sheets 7 are steel sheets, and preferably AHSS ("Advanced High Strength Steel") sheets, and they are selected between folded sheets, stamped sheets and bended sheets.

[0046] According a particular embodiment of the invention, the vertical guide supports 9 are integral to the metal sheets 7. According an alternative embodiment of the invention, the vertical guide supports 9 are independent from the metal sheets 7, i.e., they are originally manufactured separately and independently from the metal sheets 7, and are joined to these sheets 7 by cold joining techniques, as shown in figure 4.

[0047] Each module 1,2,3 has a plurality of crossbars 10 between both sides 4,5, and each crossbar 10 is placed between a pair of opposite vertical guide supports 9, preferably perpendicularly to both sides 4,5. These crossbars 10 improve the rigidity of the assembly, enhancing the structural behaviour of the modular truss.

[0048] According a particular embodiment of the invention, the upper module 1 and the lower module 3 are joined to the central module 2 by means of at least a joining bended plate 11 made of metal, which is placed at the ends of said upper 1 and lower 2 modules. Figure 6 shows an upper module including these joining bended plates 11 according this embodiment.

[0049] According an alternative embodiment of the invention, the truss has a joining bended plate 11 placed at the end of each side 4,5 of the upper module 1 and the lower module 3. These joining bended plates 11 have the same height as the sides 4,5. Figure 7 shows an upper module including these joining bended plates 11 according this alternative embodiment.

[0050] Another object of the present invention is a method of assembling an escalator/moving walkway modular truss formed by an upper module 1, a central module 2, and a lower module 3.

[0051] The method includes an assembly of a first side 4 and a second side 5 opposite to the first side 4 for each module 1,2,3, and attaching a soffit plate 6 between both sides 4,5 of each module 1,2,3. Later, the three modules 1,2,3 are assembled together.

[0052] According the method of the present invention, the assembly of each side 4,5 of the modules includes first a cold forming of metal sheets 7, and then a cold joining of the soffit plate 6 to the sides 4,5 of each module 1,2,3.

[0053] In accordance to different embodiments of the method, the metal sheets 7 may be formed by means of laser-cutting, folding, stamping or bending.

[0054] The method of the present invention includes a cold joining of a plurality of crossbars 10 between both sides 4,5 of the modules 1,2,3. Each crossbar 10 is placed between a pair of opposite vertical guide supports 9, preferably perpendicularly to both sides 4,5 of the modules 1,2,3.

[0055] Different embodiments of the method may include the forming of a single metal sheet 7, or alternatively, the joining of a plurality of metal sheets 7 by means of cold joining technologies forming a longer sheet.

[0056] In accordance to a particular embodiment of the method of the present invention, the assembly of the upper module 1 and the lower module 3 to the central module 2 is made by a cold joining of bended plates 11 to the ends of the modules.

[0057] According to different particular embodiments of the invention, the cold joining of the different elements of the assembly includes a method which may be selected between clinching, bolting, riveting, using adhesives, and a combination of these methods.

[0058] Once the invention has been clearly described, it is hereby noted that the particular embodiments described above can be the subject of detail modifications as long as they do not alter the fundamental principle and the essence of the invention.

Claims

1. Escalator/moving walkway modular truss comprising an upper module (1), a central module (2), and a lower module (3), each module (1,2,3) comprising

- a first side (4) and a second side (5) opposite to the first side (4), and
- a soffit plate (6) placed between both sides (4,5),

said escalator/moving walkway modular truss **characterized in that**

- each side (4,5) of the modules (1,2,3) comprises

- at least a metal sheet (7),
- a plurality of vertical guide supports (9) placed at the inner surface (8) of the metal sheets (7), configured for supporting and positioning the guiding system of the escalator/moving walkway,

- and **in that** each module (1,2,3) comprises a plurality of crossbars (10) between both sides (4,5), each crossbar (10) placed between a pair of opposite vertical guide supports (9).

2. Escalator/moving walkway modular truss, according to claim 1, **characterized in that** the metal sheet (7) is a steel sheet.
3. Escalator/moving walkway modular truss, according to claim 2, **characterized in that** the steel sheet (7) is an AHSS steel sheet. 5
4. Escalator/moving walkway modular truss, according to any of claims 1-3, **characterized in that** each side (4,5) of the modules (1,2,3) comprises a plurality of metal sheets (7) joined together by cold joining technologies. 10
5. Escalator/moving walkway modular truss, according to any of claims 1-4, **characterized in that** the metal sheets (7) are selected between laser-cut sheets, folded sheets, stamped sheets and bended sheets. 15
6. Escalator/moving walkway modular truss, according to any of claims 1-5, **characterized in that** the vertical guide supports (9) are integral to the metal sheets (7). 20
7. Escalator/moving walkway modular truss, according to any of claims 1-5, **characterized in that** the vertical guide supports (9) are independent from the metal sheets (7). 25
8. Escalator/moving walkway modular truss, according to any of claims 1-7, **characterized in that** it comprises at least a joining bended plate (11) made of metal placed at the ends of the upper module (1) and the lower module (3) configured for joining them to the central module (2). 30
9. Escalator/moving walkway modular truss, according to claim 8, **characterized in that** it comprises a joining bended plate (11) placed at the end of each side (4,5) of the upper module (1) and the lower module (3), said joining bended plates (11) having the same height as the metal sheets (7). 40
10. Escalator/moving walkway, **characterized in that** it comprises an escalator/moving walkway modular truss according to any of claims 1-9. 45
11. Method of assembling an escalator/moving walkway modular truss, wherein said escalator/moving walkway comprises an upper module (1), a central module (2), and a lower module (3), the method comprising 50
 - assembling of a first side (4) and a second side (5) opposite to the first side (4) for each module (1,2,3), 55
 - joining a soffit plate (6) between both sides (4,5) of each module (1,2,3),
- and assembling of the modules (1,2,3),
- said method **characterized in that** said assembling of each side (4,5) comprises
 - cold forming of metal sheets (7),
 - cold joining of the soffit plate (6) to the sides (4,5) of each module (1,2,3),
 - placing a plurality of crossbars (10) between both sides (4,5) of the modules and
 - cold joining said crossbars with said sides (4,5).
12. Method of assembling an escalator/moving walkway modular truss, according to claim 11, **characterized in that** said assembling of each side (4,5) comprises cold joining of a plurality of metal sheets (7).
13. Method of assembling an escalator/moving walkway modular truss, according to any of claims 10-12, **characterized in that** said assembling of each side (4,5) comprises cold joining of vertical guide supports (9) to the metal sheets (7).
14. Method of assembling an escalator/moving walkway modular truss, according to any of claims 10-13, **characterized in that** said assembling of the upper module (1) and the lower module (3) with the central module (2) is made by the cold joining of joining bended plates (11) made of metal to the ends of said modules (1,2,3).
15. Method of assembling an escalator/moving walkway modular truss, according to any of claims 10-14, **characterized in that** the cold joining comprises a method selected between clinching, bolting, riveting, using adhesives, and a combination of them.

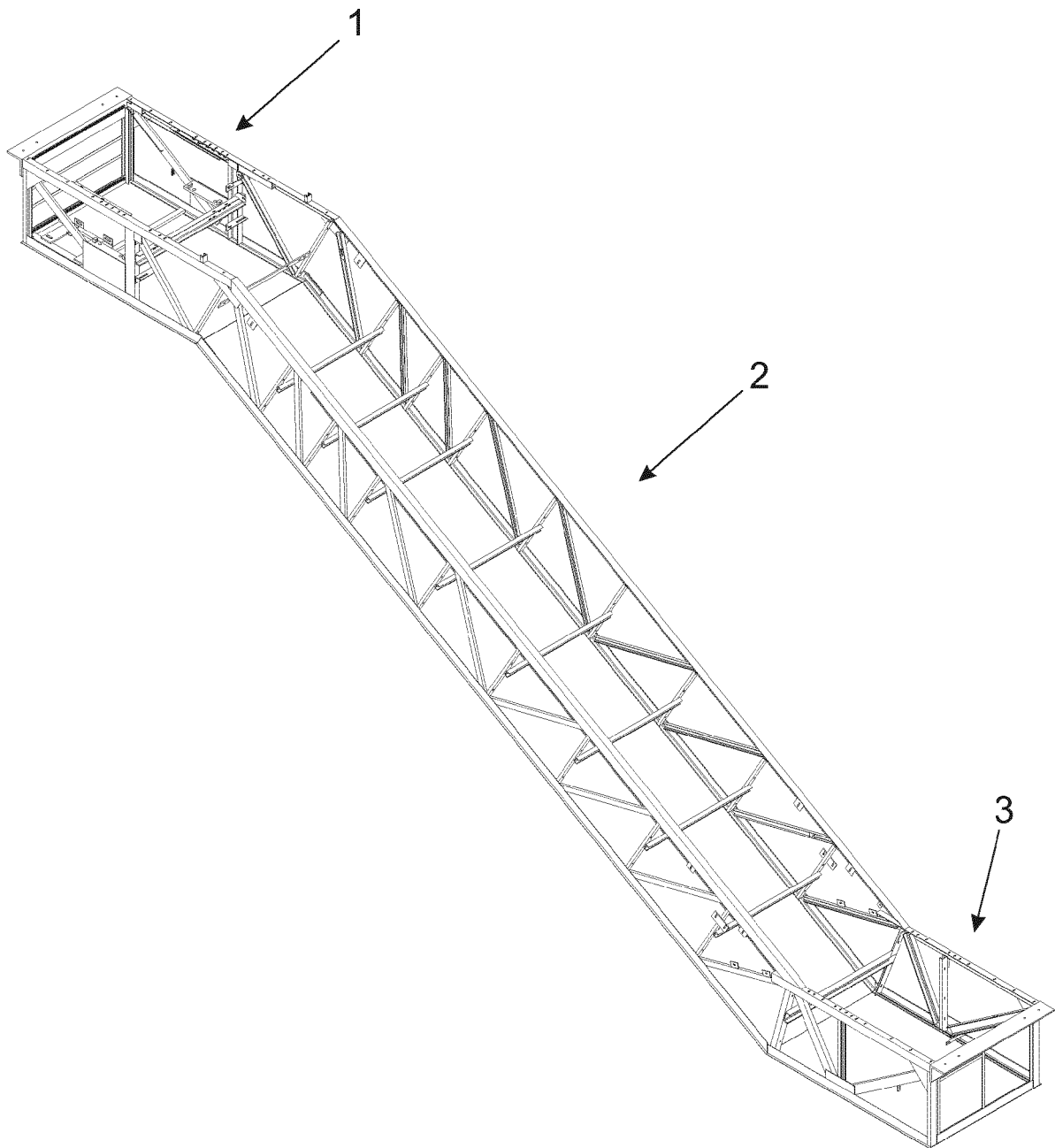


Fig. 1

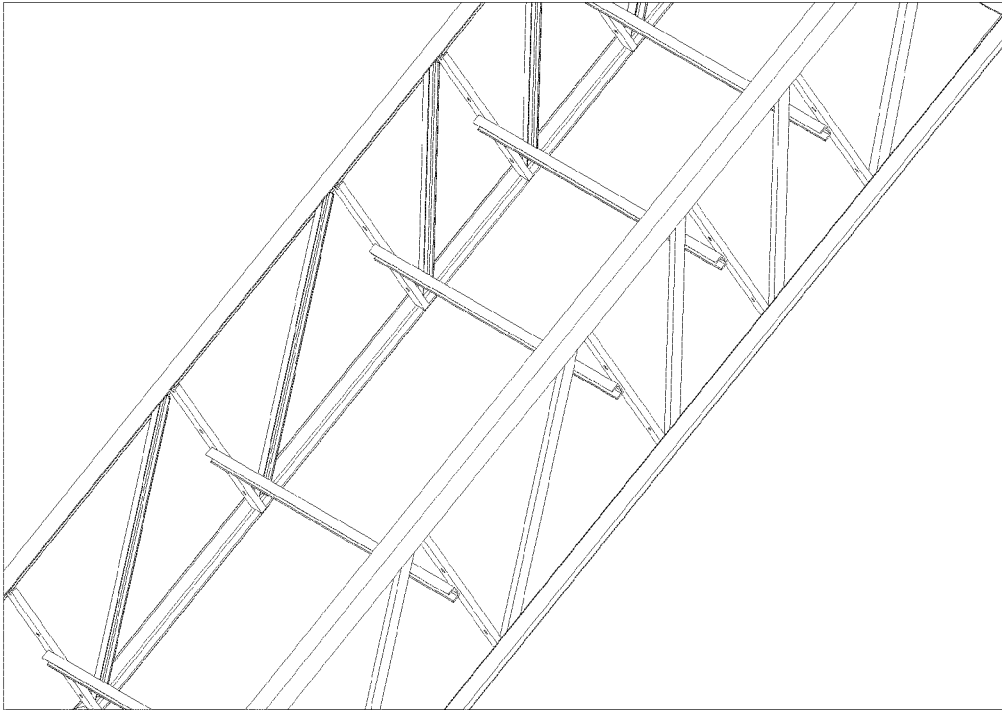


Fig. 2a

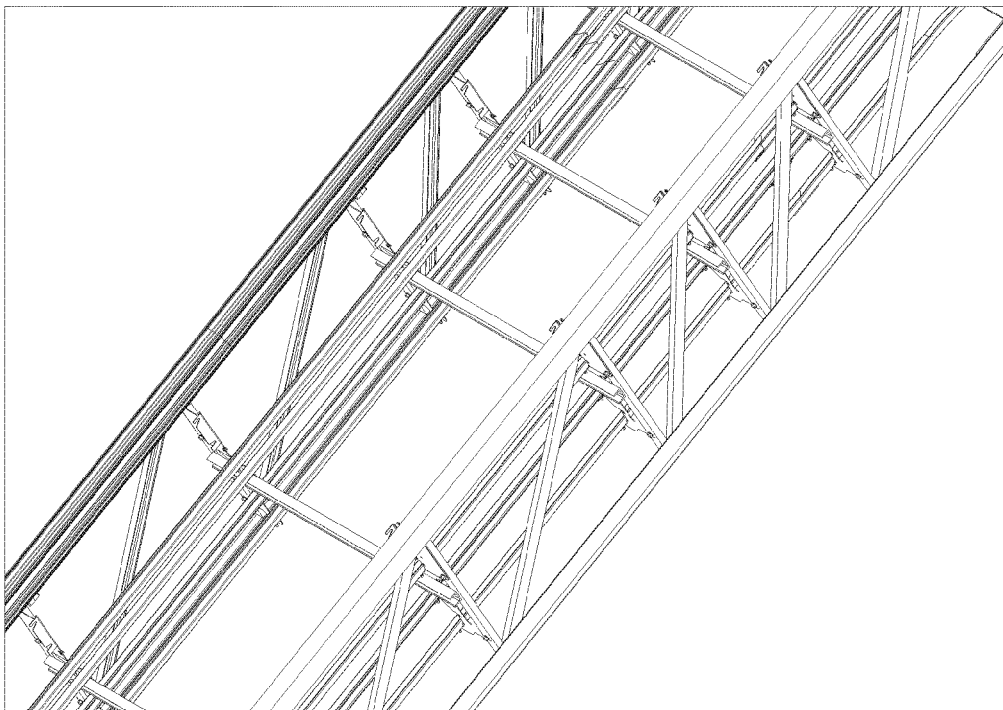


Fig. 2b

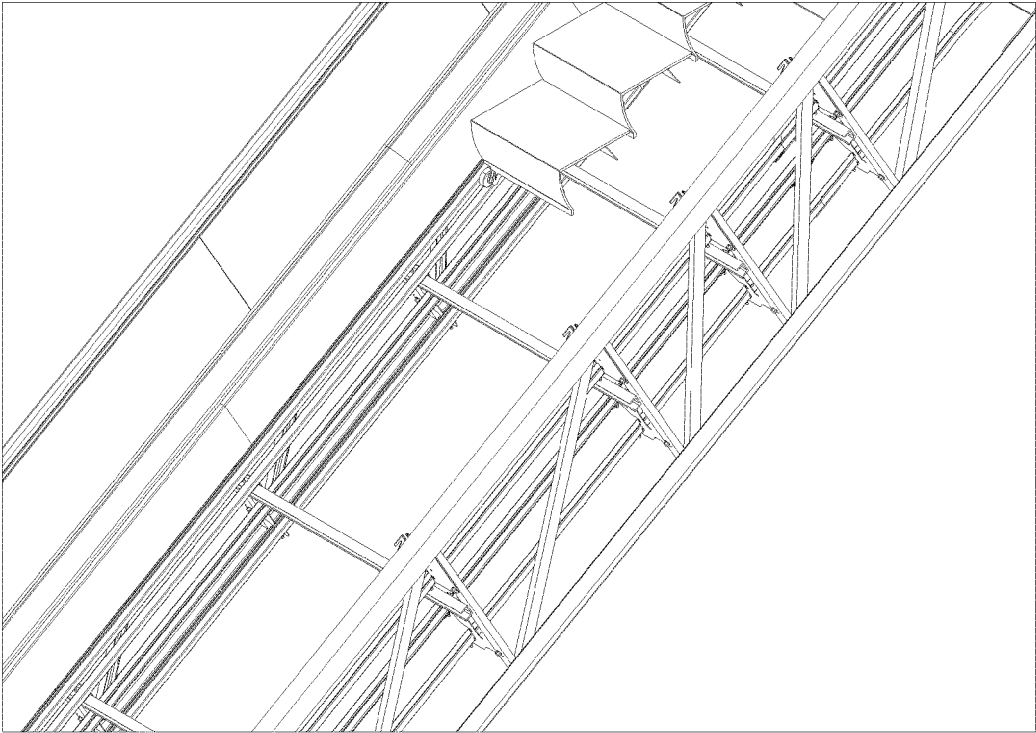


Fig. 2c

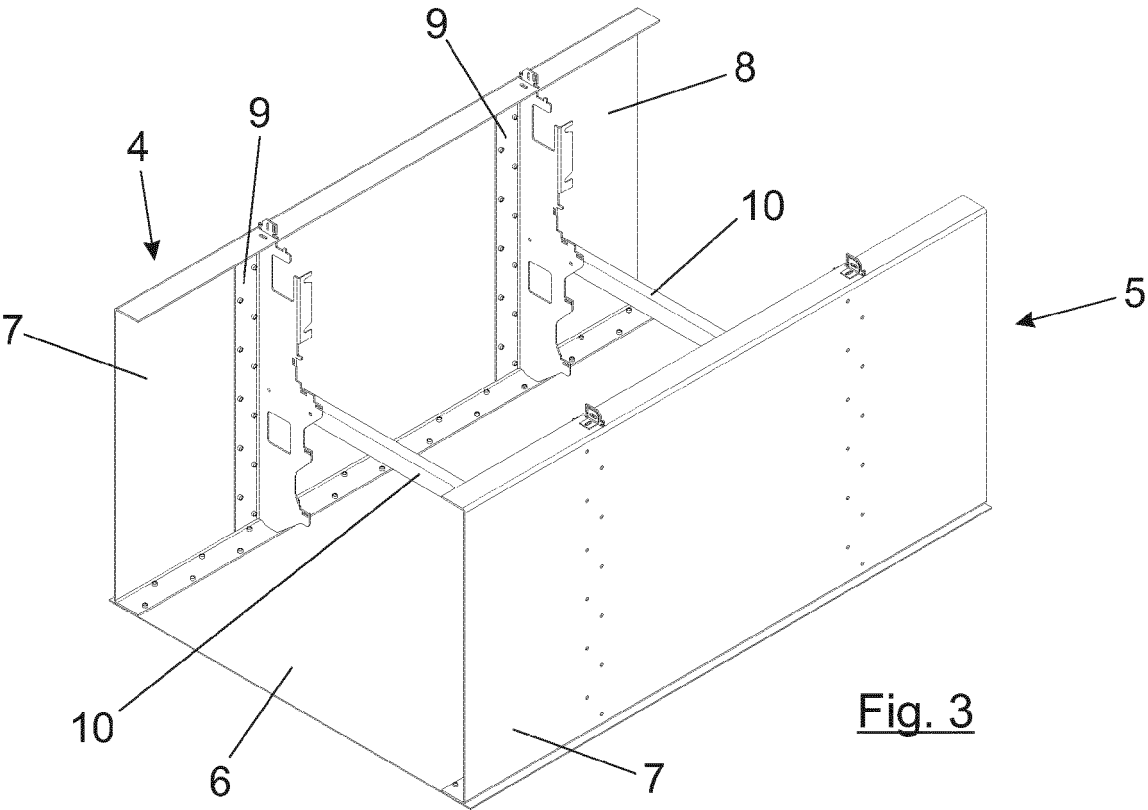


Fig. 3

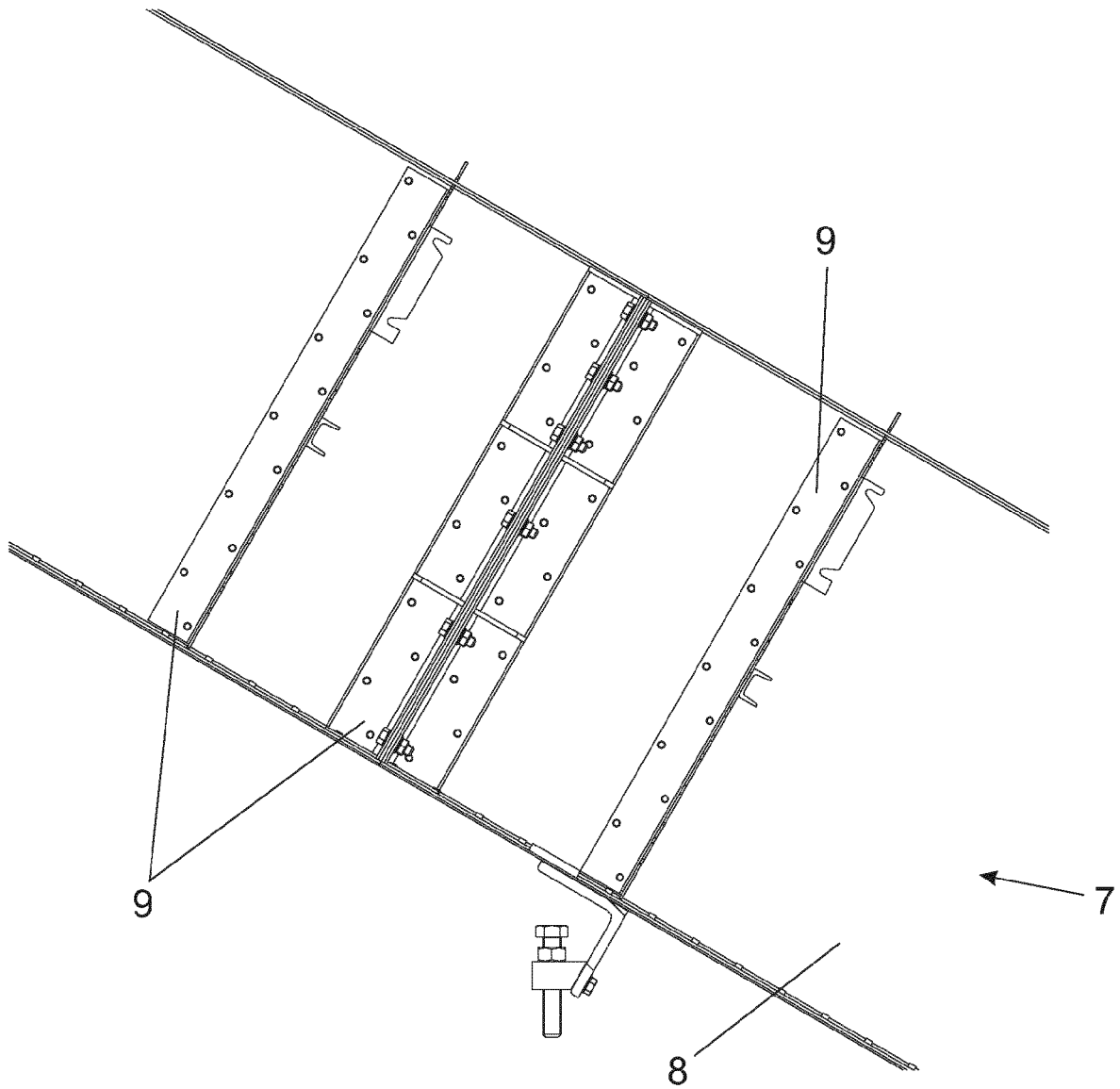


Fig. 4

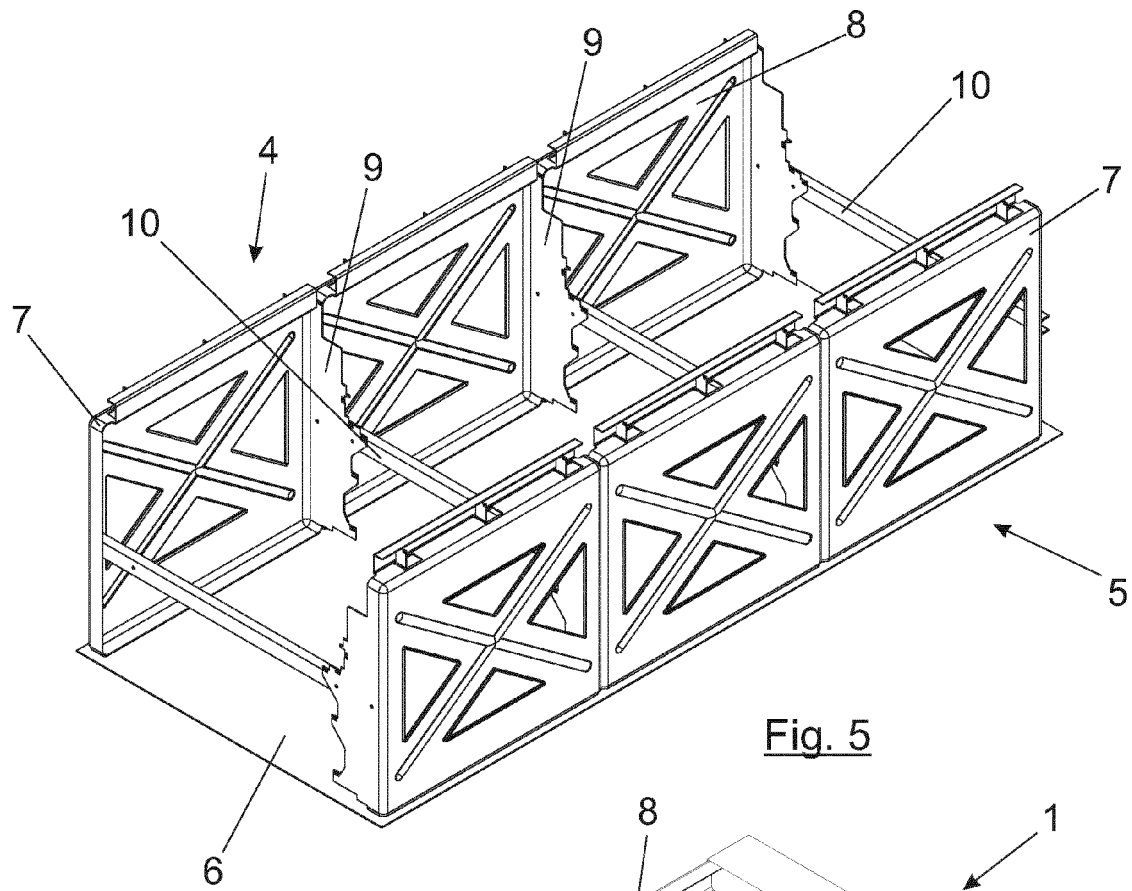


Fig. 5

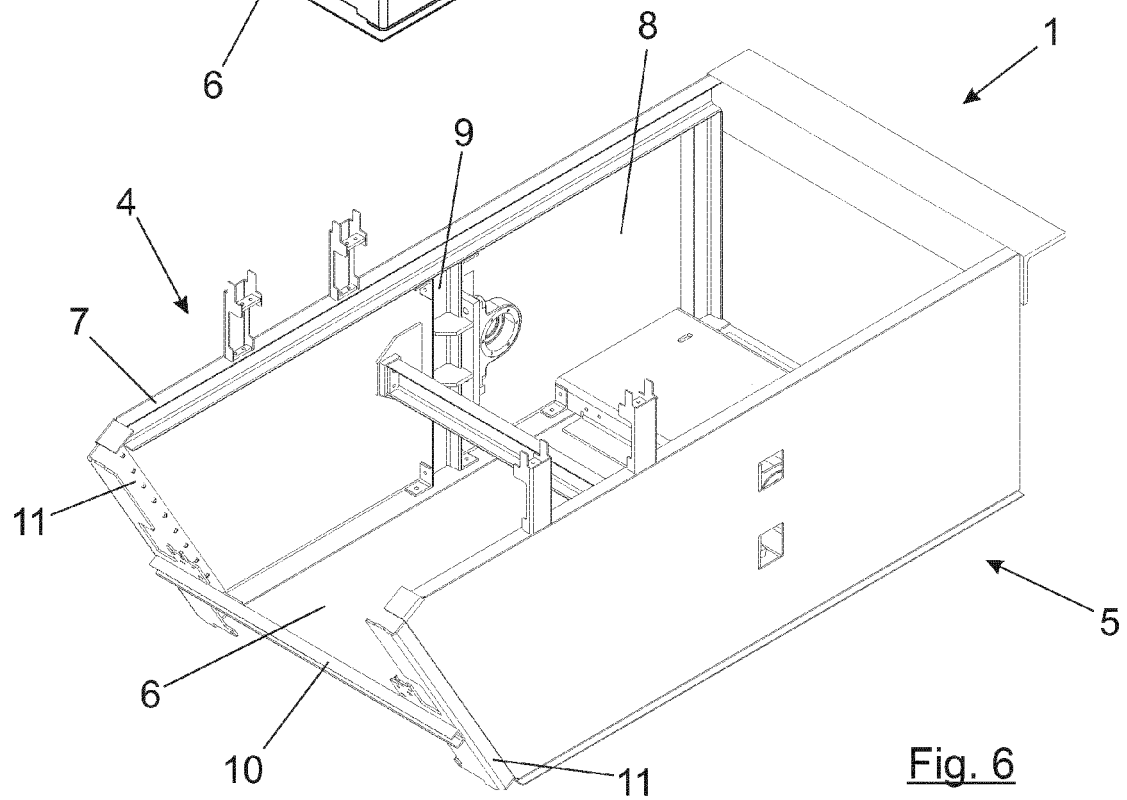


Fig. 6

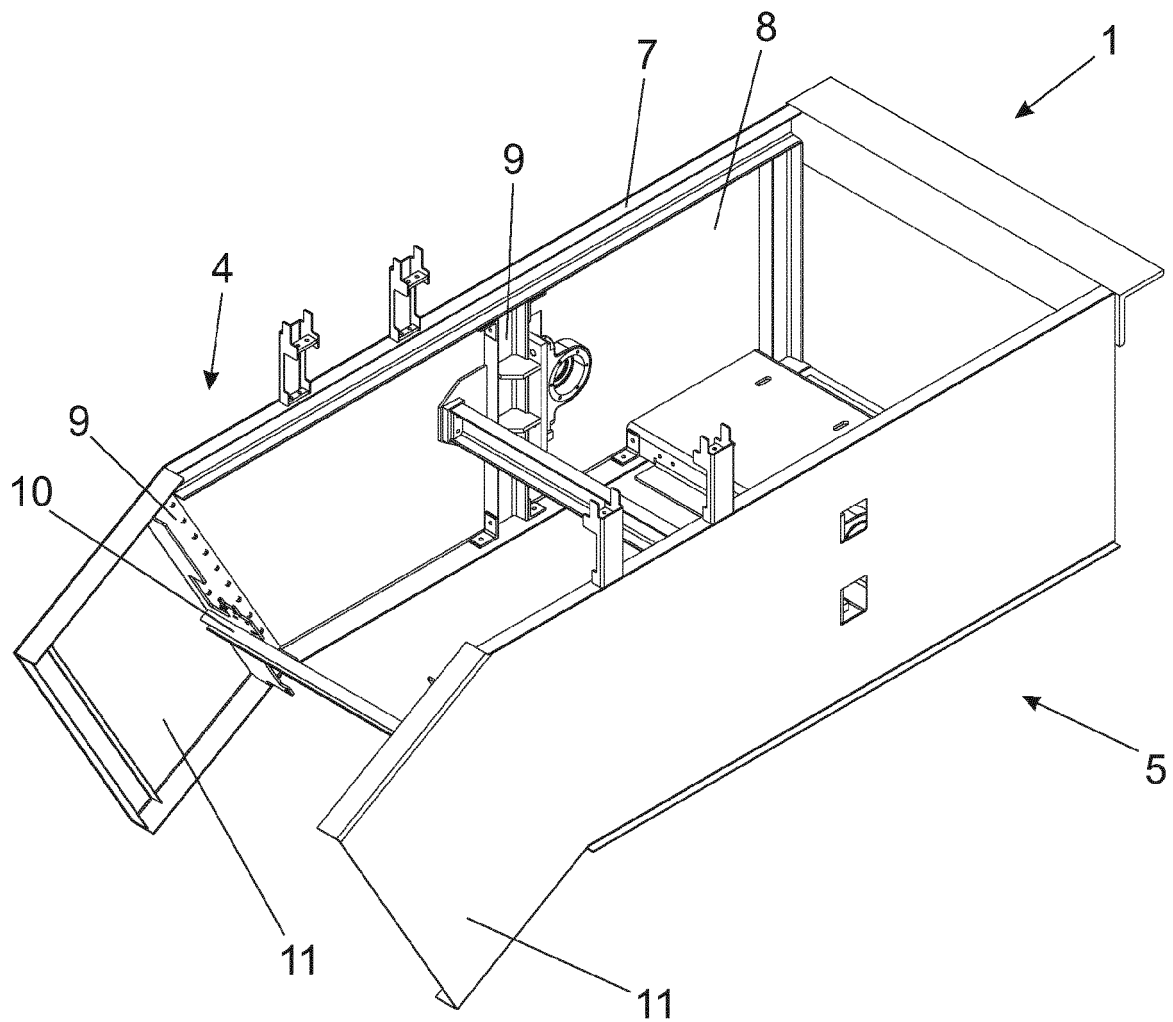


Fig. 7



EUROPEAN SEARCH REPORT

 Application Number
 EP 15 38 2336

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The present search report has been drawn up for all claims			
Place of search The Hague		Date of completion of the search 26 November 2015	Examiner Fiorani, Giuseppe
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document		T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document	

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**ANNEX TO THE EUROPEAN SEARCH REPORT
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