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(71) Applicant: **Ceilix AG**
82049 Pullach i. Isartal (DE)

(72) Inventor: **Siedel, Michael Torsten**
53902 Bad Münstereifel (DE)

(74) Representative: **Jostarndt Patentanwalts-AG**
Metzgerstraße 61
52070 Aachen (DE)

(54) **AUTOMATABLE SYSTEM FOR THE TRANSPORT OF TRANSPORT CABINS; LOGISTICS SYSTEM AND METHOD FOR HANDLING OF A PLURALITY OF CABINS**

(57) The invention relates to an automatable system for a transport of cabins, especially outdoors, characterized in that a guiding arrangement for transporting the transport cabins is arranged, wherein the guiding arrangement comprises:
- at least one structure,
- at least one vehicle, exhibiting a plurality of connection elements configured for guiding the vehicle and configured for coupling the vehicle to the at least one structure by means of de-/coupling kinematics depending on a relative motion of the vehicle with respect to the structure in a second spatial direction, enabling 2D-motion of the vehicles, wherein the at least one vehicle comprises at least one connection element, wherein the connection element is configured to connect to at least one of the transport cabins; and wherein the guiding arrangement is configured for active motion of the vehicle in said first spatial direction and/or said second spatial direction.

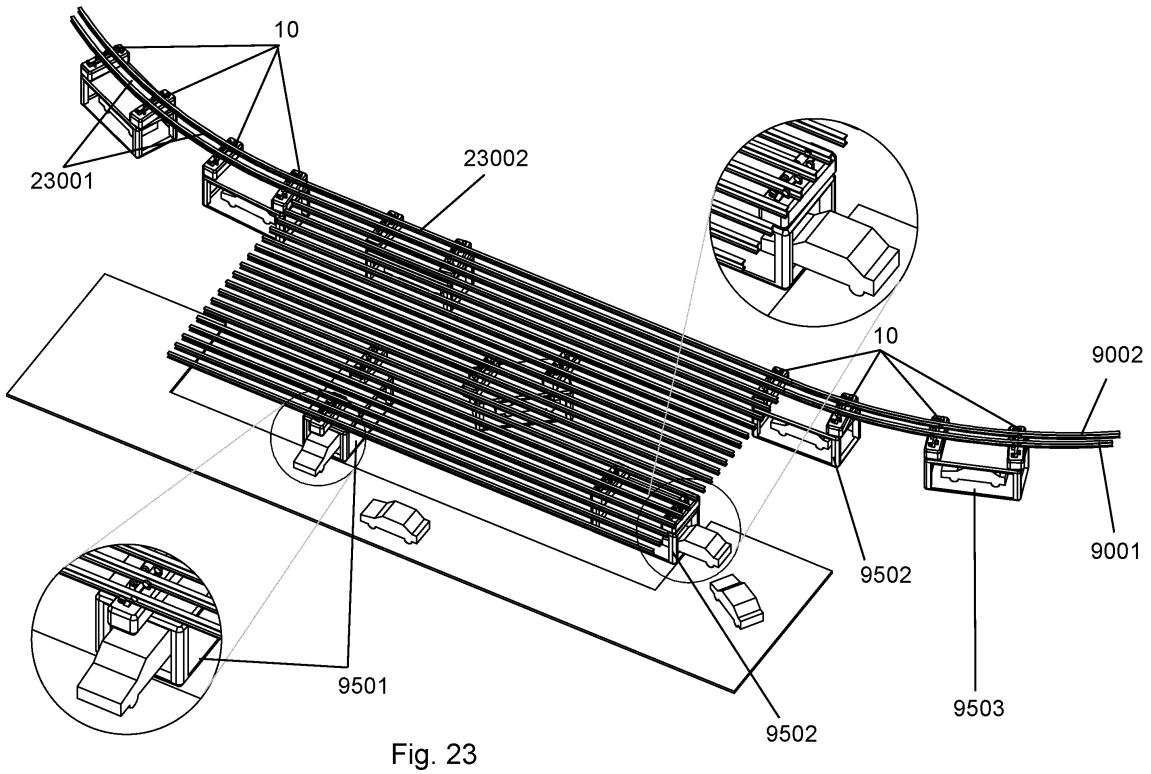


Fig. 23

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Description

[0001] The present invention relates to an overland cabin transport system, method for transporting transport cabins, transport cabin transfer unit and method for transferring transport cabins between the overland transport cabin transport system.

[0002] The present invention relates to guiding arrangements exhibiting at least one crawler type vehicle. Further, the present invention refers to a method of building a guiding structure. In particular, the present invention refers to devices and methods according to features of the enclosed independent and dependent claims.

PRESENTATION OF THE STATE OF THE ART

[0003] The international patent application WO2019099984A1 describes a SYSTEM AND METHOD FOR SWITCHING RAILCARS USING A STATIC RAIL-TRACK CONFIGURATION with an onboard track switching mechanism for a railroad vehicle to switch from one track to another. A switch for enabling a railroad vehicle to switch tracks is disclosed. The system comprises a running track that supports an automotive a switching track comprising a set of static components and a switching mechanism installed- on the automotive, the switching mechanism configured for controlling the movement of one or more switching wheels such that when activated, the switching mechanism is configured to facilitate engagement of the: one or more switching wheels with the switching track for carrying out a track changing operation for the automotive.

[0004] The European patent application EP3705409 A1 describes an androgynous coupling means with great ease of use, high security and high fidelity. Furthermore, this androgynous coupling means may also comprise any efforts or measures for providing androgynous couplings such that the coupling procedure can be carried out with great reliability irrespective of any preload or position tolerance. In particular this androgynous coupling means may be provided in the configuration of a connector and is configured for connecting energy lines or flow lines and/or for connecting information lines or flows and/or for connecting fluid lines or flows like gas flow, especially for thermally and/or electrically connecting these lines or flows.

[0005] The European patent EP3803727B1 describes a method for providing process protocols for a number of physical objects (O) passing through a plurality of production/processing stations (P1... Pn) in a production/-processing line, wherein machine-readable data (D) are assigned to at least one object (O), wherein the data comprise at least one identifier by means of which the relevant object can be uniquely identified, wherein the process protocol is continuously generated by continuous addition.

[0006] The present invention proposes a new type of transport system comprising a new type of vehicle coupled to a structure.

SUMMARY OF THE INVENTION

[0007] The present application is part of an overarching concept whose goal is to perform processing operations of cabins as automated as possible and preferably also autonomously and with the smallest possible ecological footprint.

[0008] In prior art, multiple design philosophies have already been established in context with provision of systems which shall be able to ensure a predefined position or motion also in rough terrain or in context with unpredictable reaction forces or at high inclination or in an overhead arrangement. The present invention focuses on those philosophies departing from the idea that a unit or vehicle or any means of transportation should engage / interact in predefined manner with a predefined structure. Some ideas of provision of reliable contact between the structure and the unit have already been published in context with diagnosis and parameter measurement in nearly inaccessible areas or systems (e.g., duct-work, canal systems), including magnetic adhesion / interference. Nonetheless, there is a need for systems being capable of providing, by interacting with a predefined structure, both a predefined traveling motion and a high accuracy in positioning (positional accuracy) in very reliable manner, preferably irrespective of the kind of underground or wall constitution, wherein the predefined structure should preferably be provided in very flexible and varied manner to many kinds of areas or different kinds of guiding contour / geometry.

[0009] The invention especially proposes an automatable system for the transport of transport cabins, characterized in that a guiding arrangement for transporting the cabins is arranged, wherein the guiding arrangement comprises at least one vehicle and a structure extending in at least two spatial directions, wherein the structure comprises a plurality of profile units extending in a first spatial direction, wherein the structure defines in at least a part of its surface at least one structural regularity in a second spatial direction; and wherein the at least one vehicle comprises a plurality of connection elements configured for guiding the at least one vehicle, wherein the at least one vehicle comprises a connection element, wherein the connection element is configured to connect to at least one cabin; and wherein the guiding arrangement is configured for active motion of the vehicle in said first spatial direction and/or said second spatial direction.

[0010] The transport cabins described in the current application text can be implemented for a transport of persons and/or items. Cabins which can preferably be implemented for the transport of items are described as containers in the current application text. However, in some embodiments the containers can be adapted for the transport of people.

[0011] In the context of the present invention, different

types of containers may be understood as a container, such as a shipping container and an exchangeable container. Preferably it is a robust container designed to endure the rigor of transportation, storage and handling. These containers encompass a wide variety, ranging from durable steel containers commonly employed in intermodal shipping to specialized units tailored for the secure transport of sensitive and high-value cargo, including hazardous materials, electronics, pharmaceuticals, and even temperature-sensitive goods like fresh produce. Such specialized units include refrigerated containers, so-called reefers, tank containers for the transport of liquids, gases and powders.

[0012] While ISO containers follow dimensions and specifications set by the International Organization for Standardization, other types of containers can be handled according to the presented invention too, especially lifted and/or transported, e.g. airfreight-containers or vehicle transport containers might be modified. They can be customized in size and features to accommodate different types and quantities of items to be transported, e.g. goods objects or cars. Car transport containers are specially designed to facilitate the efficient and secure shipping of automobiles, motorcycles, and other cars. Unlike standard ISO containers, which are generalized for various types of cargo, car transport containers are tailored to address the specific needs and challenges associated with transporting cars.

[0013] Car transport containers often feature integrated loading ramps, wheel chocks, and tie-down points to secure cars during transit, minimizing movement and potential damage. The interior is often customized to protect the car's finish, with features like padded walls and floors.

[0014] Car transport containers are especially R-Rack or RORO (Roll On Roll Off) containers. R-Rack is a collapsible and stackable container, whereas RORO refers to ships designed to carry wheeled cargo that are driven on and off the ship on their own wheels or using a platform vehicle.

[0015] To procure the containers, a logistics expert would need to consider the specific requirements of the containers and the items being transported in the containers, including size, weight, and quantity, the containers meet the necessary safety and quality standards.

[0016] Within the realm of international shipping and trade, the term container can be understood as an intermodal freight container. This type of container is purposefully engineered for seamless transition between different modes of transport without the need for unloading and reloading of the container itself. Essentially, intermodal freight containers serve as reusable transport and storage units, facilitating the movement of goods and raw materials between various locations or countries. The present disclosure particularly refers to containers, which (partly) comply with ISO standards and are, therefore, called ISO containers.

[0017] Shipping containers can go through a transportation chain over land and water with or without the transfer of individual units in ports or train stations. These containers have preferably sturdy frame, solid walls, and waterproof doors, allowing them to be stacked in more than five layers and tightly packed in stacks of more than 20 containers side by side. These stacks are usually secured for sea transport using lashings. Shipping containers are commonly configured such that six, often nine or more, fully loaded containers can be stacked on top of each other. For the sea transport, the ship's movements, i.e. the lateral and longitudinal acceleration must be considered. Additional factors such as wind and wave impact must be considered depending on whether the cargo is stored in the hold or on deck of the container ship. Therefore, it is common that the containers on deck are secured with so-called twist locks and lashing rods / tensioners, while in the hold, the containers are typically secured with cell guides. Spacer pieces, the so-called twist stackers, can be used between containers to prevent them from shifting.

[0018] For the dis-/connecting processes these containers are usually equipped with (standardized) corner castings, which enable a connection between containers and hoisting gear via twistlocks. These is a fastener, which is inserted into a corner casting of a container. Then, a part of the twistlock is rotated by 90°, creating a form-fit connection. For example, in the case of an ISO container, each of its eight corners has a corner casting for hoisting, stacking and securing, whereas a vessel of a tank container is arranged in the middle of a steel frame, which itself is equipped with corner castings. Various corner castings arrangements and corner castings shapes for hooks, shackles and other connecting means are possible. Furthermore, alternative container securing mechanisms are possible such as androgynous coupling via actuating a motor and gearing mechanism or connecting via pad eyes or lifting lugs.

[0019] The invention especially proposes an automatable system for the transport of transport cabins, characterized in that a guiding arrangement for transporting the cabins is arranged, wherein the guiding arrangement comprises at least one vehicle and a structure extending in at least two spatial directions, wherein the structure comprises a plurality of profile units extending in a first spatial direction, wherein the structure defines in at least a part of its surface at least one structural regularity in a second spatial direction; and wherein the at least one vehicle comprises a plurality of connection elements configured for guiding the at least one vehicle, wherein the at least one vehicle comprises at least one vehicle, wherein the at least one vehicle comprises a connection element, wherein the connection element is configured to connect to at least one cabin; and wherein the guiding arrangement is configured for active motion of the vehicle in said first spatial direction and/or said second spatial direction.

[0020] A crawler type vehicle can exhibit at least one motor/actuator for actively driving the crawler type vehi-

cle along the structure.

[0021] The crawler type vehicle follows an intended direction resp. an intended path of motion, especially in conjunction with appropriate sensor-actor-arrangements.

[0022] The characteristic, that the guiding arrangement is configured for active motion of the vehicle / the vehicles includes all embodiments wherein the vehicle/s can move on its/their own. According to the present disclosure, "actively moving" designates a motion of the vehicle in relation to the structure actuated preferably by an electric motor of the vehicle connected to a drive unit such that the vehicle can move on its own inside the structure when the motor is activated. The choice of an appropriate motor can be carried out by the person skilled in the art in regard to existing motors and motor arrangements depending on the respective application / task / size of the respective vehicle, e.g., crawler type vehicle.

[0023] Connection elements are implemented to enable coupling the cabin to the vehicle and/or decoupling the cabin from the vehicle. Examples of especially preferred connection elements are the coupling means described in the European patent application EP3705409 A1, especially because of their great ease of use, high security and high fidelity.

[0024] The connection elements may be provided in the configuration of a connector and is configured for connecting energy lines or flow lines and/or for connecting information lines or flows and/or for connecting fluid lines or flows like gas flow, especially for thermally and/or electrically connecting these lines or flows as it is for example described in the European patent application EP3705409 A1.

[0025] When selecting a connection element, it's important to consider factors like the cabin's weight, fragility, shape, and material type. Proper selection and implementation can greatly enhance operational efficiency and safety.

[0026] To optimize the handling of the cabins it is described to analyse as many properties of the cabins as relevant for their handling in the automatable system for the transport of transport cabins and in some implementations also for a handling of the cabins after they are transported. The current application text describes certain options for handling the cabins after their transport with the automatable system for the transport of transport cabins including by at least one logistic process of a further transport system.

[0027] For analyzing and/or identifying the cabins, several detection and identification technologies known from the state oft the art can be utilized, e.g. object identification features as sensors for QR code reading or sensors for RFID tag reading.

[0028] The Automatable system for the transport of transport cabins is designed with regard of the physical properties of the cabins to be transported and adapted to available space.

[0029] The present invention provides for integrating a guiding arrangement exhibiting at least one vehicle and a structure extending in at least two spatial directions, wherein the structure comprises a plurality of profile units (especially rails) extending (preferably continuously, especially without any structural discontinuity) in a first spatial direction, wherein the structure defines at least one structural regularity in a second spatial direction (thereby providing a one-dimensional raster with discrete coupling points distributed in at least one equidistant regularity in said second spatial direction).

[0030] The vehicle is especially a crawler type vehicle that exhibits a plurality of connection elements configured for guiding the vehicle and configured for coupling the crawler type vehicle to the structure by means of de-/coupling kinematics depending on a relative motion of the vehicle with respect to the structure in at least said second spatial direction, wherein the (crawler type) vehicle comprises means for providing for de-/coupling kinematics during a motion of the crawler type vehicle in said second spatial direction, especially with the crawler type vehicle being configured to be moved in said first spatial direction along the profile units irrespective of momentary motion in said second spatial direction.

[0031] All vehicles according to the present description can be designed as any of the crawler type vehicles described in this patent application text.

[0032] According to the present disclosure, when it is referred to "structure", a structure that predominantly extends along a Vertical plane or horizontal plane or even along an inclined plane (or the like) is designated. The present invention is applied for vehicles being arranged at resp. traveling along a structure, and in addition, the present invention also allows for any motion along any structure with alternative orientation and/or arrangement. Thus, referring to a "structure" includes reference to any other "structure" exhibiting the features presently described allowing for coupling with/to the inventive vehicle and corresponding de-/coupling kinematics.

[0033] According to the present disclosure, when it is referred to "profile units" or "profiles" or "T-profiles", the disclosure also generally refers to different kinds of profiles like e.g. I-profiles or L-profiles which may provide for advantageous/favorable arrangements in individual applications.

[0034] The profile units respectively exhibit at least one tread, wherein each connection element exhibits at least one element of motion (for gliding or rolling, especially at least one wheel) arranged and configured for actively moving (especially gliding or rolling) the vehicle in said first spatial direction. Preferably, each connection element exhibits at least two elements of motion, e.g., a main wheel and a side wheel (side friction wheel of a roller coaster) clamping the profile unit from at least two sides.

[0035] According to the present disclosure, when it is referred to "vehicle", the disclosure generally refers to vehicles, capable of moving along the suspension structure. However, vehicles or vehicles connectable to the relative spatial arrangement or traveling motion are pre-

ferred.

[0036] The vehicle exhibits one or more load attachment points configured for connecting to connection element to interact with one or more cabin.

[0037] The vehicle can exhibit at least one motor/actuator for actively driving the vehicle along the structure.

[0038] The vehicle follows an intended direction resp. an intended path of motion, especially in conjunction with appropriate sensor-actor-arrangements.

[0039] The suspension structure can exhibit at least one energy charging point/position/area, wherein the suspension structure is configured for charging/providing the at least one vehicle with energy when being arranged in/at said energy charging point/position/area. For example, the charging area covers at least one charging section or the whole structure.

[0040] By arranging a guiding arrangement that comprises at least one vehicle and a structure extending in at least two spatial directions, wherein the structure comprises a plurality of profile units extending in a first spatial direction, wherein the structure defines in at least a part of its surface at least one structural regularity in a second spatial direction; and wherein the at structure comprises a plurality of connection elements configured for guiding the at least vehicle, wherein the at least one vehicle comprises at least one vehicle, wherein the at least one vehicle comprises a connection element, wherein the connection element is configured to connect to at least one cabin; and wherein the guiding arrangement is configured for active motion of the vehicle in said first spatial direction and/or said second spatial direction for transporting the cabins parallel to at least one transfer area for the cabins in an appropriate distance from the adjacent side of transported cabins the cabins can be flexibly transported and transported.

[0041] It is especially useful to use at least two vehicles which can operate independently, especially move independently.

[0042] Even when two or more vehicles can operate independently implementations are possible and useful in which at least two vehicles, respectively at least two vehicles selected from a plurality of vehicles can be coordinated, especially by coordinating the movements of their connection element units for coordinated lifting and/or moving of a preferably heavier cabin.

[0043] An example of the automatable system for the transport of transport cabins, is described, wherein the at least one vehicle is a crawler type vehicle, wherein the crawler type vehicle comprises means for providing for de-/coupling kinematics during a motion of the crawler type vehicle in said second spatial direction, especially with the crawler type vehicle being configured to be moved in said first spatial direction along the profile units irrespective of momentary motion in said second spatial direction enables independent movements of the vehicles with high acceleration, high speed and high deceleration.

[0044] According to one embodiment of the automatable system for the transport of transport cabins , the vehicle or plurality of vehicles exhibit/s at least two circumferential tracks, wherein the connection elements are attached to the circumferential tracks at predefined longitudinal positions corresponding to the structural regularity, wherein the circumferential tracks respectively define a specific path of circumferential motion of the respective connection elements, thereby providing for de-/coupling kinematics during a motion of the vehicle in said second spatial direction (y).

[0045] According to the present disclosure, when it is referred to "circumferential track", the disclosure also generally refers to closed loop guidings and lines and predefined contours along which the connection elements are guided and/or driven, e.g., chains or any such traction means providing for a closed loop.

[0046] The shape/contour of respective circumferential tracks can be individual, i.e., the skilled person can decide e.g., about a certain degree (radius) of curvature in specific sections of the respective circumferential track. For example, each track exhibits at least three different guide/rail sections, namely: a first (linear) section in which each connection element is engaged with the profile, wherein the connection element performs a linear motion; and at least one second (curved) section in which each connection element performs a de-/coupling motion (wherein each track may exhibit two second sections being arranged oppositely); and a third (linear) section in which the connection elements are returned to couple again with the profile (for continuous, circumferential motion and engagement process). Thereby, first and second tracks may define the trajectory of the respective free ends of the connection elements especially exhibiting at least one element of motion, e.g., a wheel, being attached to the respective connection element by any appropriate means (e.g. by a gliding/rolling contour, a chain drive, a timing belt, or any likewise mechanism or mechanical feature) which is configured for predefining a specific contour and for guiding the free ends resp. the rollers to follow that contour of the tracks.

[0047] The circumferential tracks respectively define a specific path of circumferential motion of the respective connection elements (resp. of coupling means of the connection elements, especially of a free end of the respective connection element). Such configuration not only facilitates implementation in context with complex structures or in context with a plurality of vehicles to be used at the same time, but also considerably increases variability as to positioning. Thereby, the present invention also provides for practical scalability (both with respect to the structure and with respect to the number of vehicles), even in three-dimensional extension, if desired.

[0048] The vehicle can exhibit two or more kinds/types of connection elements, wherein the different types of connection elements are de-/coupled according to individual kinematics (especially in opposite directions/sides at the profile units, especially both in and opposite to the

second spatial direction resp. travel direction of the vehicle), wherein a first subset of the connection elements are attached to a first pair of circumferential tracks (resp. a subset of the first subset, momentary) and at least one further subset of the connection elements are attached to a second pair of circumferential tracks (resp. a subset of the second subset, momentary) respectively at predefined first and second (further) longitudinal positions respectively corresponding to the structural regularity (resp. to the distance of the profile units defined by said structural regularity), wherein the first and second pairs of circumferential tracks provide for individual kinematics for the first and second subsets of connection elements, especially such that the vehicle can be secured with respect to opposite sides/directions (of the second spatial direction) at the structure resp. at the profile units.

[0049] The vehicle can be configured for enabling at least one closed loop trajectory of respective connection elements along corresponding circumferential tracks, especially configured for enabling at least two closed loop trajectories of at least two subsets of respective connection elements.

[0050] The circumferential tracks can be shaped in such a manner that the respective connection elements are de-/coupled from/into the structure when passing a curved section of the tracks.

[0051] For example, a subset of the connection elements can be attached to one of the circumferential tracks (resp. a subset of the first subset, momentary) and at least one further subset of the connection elements are attached to a further one of the circumferential tracks (resp. a subset of the second subset, momentary) respectively at predefined first and second (further) longitudinal positions respectively corresponding to the structural regularity, in particular with each connection element being guided by a pair of circumferential tracks.

[0052] The connection elements can be fixedly attached/coupled by means of a first pulley to/with a/the first circumferential track and are guided within a/the second circumferential track by means of a second pulley respectively, wherein the first and second pulley preferably are arranged at a lever arm of the respective connection element. For example, each connection element can exhibit a first pulley and a second pulley arranged in longitudinal distance with respect to the first pulley at a lever arm of the respective connection element, wherein the connection element is coupled to a/the first and a/the second circumferential tracks via the first and second pulleys. Preferably, each connection element exhibits at least one wheel to roll on a tread of the profile unit a further wheel to roll on a side of the tread of the profile unit to reduce potential slip.

[0053] A respective subset of said connection elements can be connected to each other by means of longitudinal connecting elements, especially by chain elements, thereby forming a closed loop of interrelated connection elements distanced to each other in a/the predefined structural regularity.

[0054] The respective circumferential track e.g., exhibits a chain or is provided/defined by a chain forming a closed loop of interrelated chain elements.

[0055] The vehicle, especially if designed as crawler type vehicle can be configured for lifting a/the respective connection elements out of the structure in an unloaded state, especially such that both de-/coupling kinematics for a subset of momentarily unloaded connection elements and suspension of the vehicle by a subset of momentarily loaded connection elements can be ensured.

[0056] Each connection element can be guided by a pair of circumferential tracks, wherein the vehicle exhibits at least three pairs of circumferential tracks each guiding a subset of the connection elements, wherein said de-/coupling kinematics are predefined by said three pairs of circumferential tracks in such a manner that respective connection elements (resp. a subset of the respective subset, momentary) simultaneously de-/couple both at a first side (resp. first longitudinal position) of a respective profile unit and at a second side (resp. second longitudinal position) of a respective profile unit, especially such that the vehicle is secured with respect to opposite sides/directions (of the second spatial direction) at the structure, especially with all connection elements being guided in same circumferential direction, especially with all circumferential tracks being arranged in parallel to each other.

[0057] The vehicle exhibits at least one drive interacting with (resp. driving) at least one of the circumferential tracks, wherein the suspension system is configured for a predefinable driven motion of the vehicle at least in said second spatial direction (especially back and forth).

[0058] The vehicle can also exhibit an energy storage unit providing energy to a/the at least one drive, preferably all drives, of the vehicle, especially to a/the at least one drive interacting with (resp. driving) at least one of the circumferential tracks.

[0059] According to the present invention, the term "drive unit" especially refers to a unit accommodating kinematics allowing for traveling motion of the vehicle, as described above.

[0060] The shape or dimension of the at least one first drive unit (and also of the circumferential tracks) can be defined individually according to specific applications. E.g., the cross-section geometry of the at least one first drive unit is in the shape of a racecourse (parallel longitudinal sections and opposite semicircle sections). But alternatively, the cross-section geometry can also be circular or elliptical for example.

[0061] According to one embodiment of the Automatable system for the transport of transport cabins, the structure exhibits power rails integrated into the profile units and the vehicle, or the plurality of vehicles exhibits means for electrically connecting to the power rails.

[0062] For example, at least two of the connection elements each comprise at least two electrically connected electrical contacts configured for establishing

an electrical connection between the structure and the vehicle, wherein the first electrical contact of a first connection element for establishing an electrical connection is electrically connected to a first pole/phase of a power bus in the structure when the vehicle is coupled to the structure via the first connection element and the first electrical contact of a second connection element for establishing an electrical connection is electrically connected to a second pole/phase of the power bus in the structure when the vehicle is coupled to the structure via the second connection element, and wherein the second electrical contacts of the connection elements are each connected to a respective pole/phase of an internal bus of the vehicle at least when the vehicle is coupled to the structure via the connection elements for establishing an electrical connection.

[0063] According to the present disclosure, "electrical contact" designates a connection mechanism that enables the flow of electrical current between two or more conductive elements. The primary objective of an electrical contact is to establish a reliable and efficient means of transferring electrical signals or power. The electrical contacts must possess certain key properties, such as high electrical conductivity, mechanical robustness, corrosion resistance, and thermal stability. Examples of suitable materials for electrical contacts may include copper, copper alloys, or noble metals like gold, silver, or platinum, as well as various alloys and composite materials. It is imperative that the connection between the electrical contact and the pole/phase in the structure be established in a reversible manner, allowing for repeated engagement and disengagement without compromising its performance. Examples of reversible electrical contact mechanisms include sliding contacts, where two surfaces slide against each other to establish and break the connection, or roller contacts, where rotating elements facilitate electrical contact.

[0064] The power rails can be integrated into the profiles of the structure, i.e., along the I-, L-, or T-profiles on one edge or side, preferably above the tread surface of the profile.

[0065] The vehicle can e.g., comprise electronics connected to the internal bus for supplying the vehicle with power. These electronics can comprise but are not limited to communication modules for wireless or wired data exchange (vehicle-to-vehicle, vehicle-to-infrastructure, vehicle-to-mobile devices, etc.), a/the central control unit, sensors (proximity sensors, accelerometers, LiDAR, radar, etc.), a power management system (power converters (AC/DC, DC/DC), battery management, voltage regulators, ESD protection), motors, etc. The vehicle can also comprise an energy storage, such as a battery pack and/or super capacitors and/or the vehicle can comprise electrical connection means for connecting to the connection element, wherein the connection element can be supplied with power via the electrical connection means.

[0066] For example, when the vehicle is moving in the second spatial direction, i.e., when connection elements for establishing an electrical connection are coupled into the structure, the second sliders can be connected to the conducting rail such that the first slider has a defined potential before the first sliders are in proximity or connected to the power rail in the structure and when the connection elements are decoupled from the structure, the first sliders are disconnected from the power rail before the second sliders are disconnected from the conducting rail. This measure serves to avoid spark creation, especially in the moment the connection elements are brought into contact with the structure, by pulling the floating potential of the electrical contact to the potential of the power rail before. In an alternative example, when the connection elements are coupled to the structure, the first sliders are connected to the power rail in the structure before the second sliders are in proximity or connected to the conducting rail in the vehicle and when the connection elements are decoupled from the structure, the second sliders are disconnected from the conducting rails before the first sliders are disconnected from the conducting rail. This can reduce wear on the electric rails in the structure and shifts potential wear into the vehicle sliding contacts which are considered to be simpler to retransport by maintenance actions.

[0067] For example, at least two conducting rails are placed in parallel at least to sections of the described circumferential tracks (see above), wherein at least two connection elements for establishing an electrical connection comprise means for dis-/connecting from/to the conducting rails, when the connection elements are de-/coupled from/into the structure. The conducting rails can be integrated into the vehicle particularly easily, when the first drive unit has a race-course shape, wherein the connection elements that are currently coupled into the structure are following a straight or linear section. Arranging two conducting rails in parallel can mean to place them on opposite sides at the same height of the drive unit, on one side at different heights with respect to the plane in which the structure is extending, or on opposite sides at different heights. If only one first drive unit is used, it has proven beneficial to place the conducting rails on opposite sides. However, for scalability and easier integration process of more drive units, it can be beneficial to arrange two conducting rails at different heights on one side, because another drive unit, also exhibiting conducting rails in the same fashion could be integrated into the first drive unit in a mirror-inverted manner.

[0068] The connection elements configured for establishing an electrical connection with the structure can exemplarily be distributed along the at least one first drive unit such that, when the vehicle is moving along the structure, a connection element for the electrical connection of a respective pole/phase is coupled into the structure before an otherwise last/only connection element connected to the respective pole/phase is decoupled from the structure. This helps to ensure an uninterrupted connection with the respective pole/phase while moving the vehicle on the structure. For example, every connec-

tion element is configured for establishing an electrical connection with the structure. This can be beneficial for applications where a particularly high amount of power is to be transferred via the connection elements because the current can be distributed over many connection elements, reducing heat creation and wear of the components. Additionally, with this redundant configuration, a disconnect of single connection elements would not result in a complete disconnection of the full vehicle. It is preferred that the whole structure exhibits poles/phases of the power bus. To ensure that at least two connection elements are connected to at least one respective pole/-phase of the power bus at all times, the vehicle and structure have to be coordinated such that there is always one connection element of a corresponding pole/phase connecting to the bus in the structure by coupling the connection element into the structure before the otherwise last connection element that is currently connected to the same pole/phase in the structure gets disconnected from the bus from a decoupling process of the connection element.

[0069] According to one embodiment of the Automatable system for the transport of transport cabins, the vehicle, or the plurality of vehicles exhibit/s at least two independently controllable motors, wherein at least one motor is configured for driving a motion in the first spatial direction (x) and at least one further motor is configured for driving a motion in the second spatial direction (y).

[0070] Each power unit, drive, motor and/or actuator of the vehicle can be coupled to a control unit of the vehicle.

[0071] The vehicle may exhibit two or three drive units which can be arranged in predefined lateral distance to each other (e.g. defined/connected via cross-beams or the like), and each drive unit may exhibit at least one drive/motor for actively driving the connection elements along the circumferential tracks or the vehicle in the second spatial direction, and these drives/motors can be controlled depending on each other, e.g. via the speed of rotation. Thus, a traveling direction can be controlled in combination with actively driven wheels of the connection elements being driven along the profile rails of the structure. The connection elements can e.g., be connected via a spur gear to a motor. The wheels of the connection elements can also or alternatively exhibit gear grooves to interact with a corresponding contour integrated into a "bottom" side of the profile unit, wherein "bottom" indicates the side of the profile unit facing the vehicle.

[0072] The vehicle can alternatively or in addition exhibit at least one second kind of a drive unit configured for enabling locomotion of the vehicle in the first spatial direction. The first drive units of the vehicle can be scaled up in number, e.g., the vehicle exhibits three first drive units each being based on the same kinematic concept, but at least one of these drive units providing for mirror-inverted type/manner of de-/coupling kinematics. The second kind of drive unit can, e.g., comprise a holonomic wheel, or an elongated gearing wheel, that is able to be moved in the second spatial direction while moving the vehicle in the first spatial direction when driven.

[0073] According to an example at least one holonomic wheel is used. A holonomic wheel is a wheel whose wheel tread consists of rollers whose axes of rotation are at an angle to the axis of rotation of the main wheel. The absolute angle between the axes can for example be any angle between 5 and 90 degrees, especially 45 degrees. This angle has to be regarded when controlling the at least two motors, since the movement of the first drive units and the second drive unit are not independent in the case that the angle of the rollers to the wheel is different than 90 degrees. An angle smaller than 90 degrees can result in advantageous configurations regarding the traction of the holonomic wheel with the profiles of the structure. In case the angle is smaller it is possible to place more rollers with the same diameter around the wheel, which enhances traction transmission and can compensate for gaps in the traction transmission of a single omniwheel. The holonomic wheel can e.g., be disc shaped and comprise a plurality of equally distributed rollers around its circumference, such that it allows for traction control in the first spatial direction and is not affected by a motion in the second spatial direction.

[0074] According to one example of the Automatable system for the transport of transport cabins, the vehicle, or the plurality of vehicles comprise/s a holonomic wheelset exhibiting gear grooves for form fit coupling, especially with a bottom side of the profile units. For this, the bottom side of the profile units needs to exhibit corresponding teeth to form fit with the gear grooves of the holonomic wheelset.

[0075] The gear grooves are distributed equidistantly along the circumference of each holonomic wheel of the wheelset. The holonomic wheel set comprises at least two coaxially arranged holonomic wheels. The coaxially arranged holonomic wheels are e.g., disc shaped and have a thickness that is half the width of the profiles of the structure, such that there is room for at least two holonomic wheels of the holonomic wheelset to interact with one profile (rail) of the structure at all times. Each of the coaxially arranged holonomic wheels can have a predefined offset in the azimuthal direction in respect to their adjacent holonomic wheels. If one holonomic wheel comprises n rollers, that are equally distributed around the circumference of the wheel, each wheel is offset by 180/n degrees with respect to its neighbors. This way, it can be ensured that there is always at least one wheel of the wheelset in contact with the profile of the structure such that slip is prevented.

[0076] According to one example of the Automatable system for the transport of transport cabins, the vehicle or plurality of vehicles exhibit/s a return mechanism. E.g., a holonomic wheelset is connected to a return mechanism that applies a force to the holonomic wheel(s) pressing it/them against the structure. This configuration enhances traction of the holonomic wheel on the profiles (rails) of the structure additionally ensures form fit in the case that the holonomic wheels exhibit gear grooves and

the structure exhibits corresponding teeth. However, it is also possible to connect a return mechanism to parts of the connection elements to also enhance force coupling.

[0077] Alternatively, or in addition, the vehicle or the plurality of vehicles exhibits counter wheels. The counter wheels can also be connected to the return mechanism. For example, the counter wheels are connected to a further first drive unit exhibiting two circumferential tracks (see above), wherein the counter wheels exhibit two pulleys at a lever arm, each of the pulley being connected to an individual track, such that the counter wheels are guided along the circumferential tracks when the vehicle is moving in the second spatial direction. The counter wheels can also exhibit gear grooves to mesh with gear teeth in the structure. The counter wheels press against the profile units from the side of the vehicle, enhancing force fit/form fit coupling.

[0078] According to one example of the Automatable system for the transport of transport cabins the first spatial direction (x) is parallel to the ground. This suspended system is advantageous in terms of coupling security between the vehicle/s and the structure/s. Especially heavy/large bins can be moved with this Automatable system for the transport of transport cabins.

[0079] According to an alternative example of the Automatable system for the transport of transport cabins, the second spatial direction (y) is parallel to the ground. The structure is in this case preferably arranged at a vertical plane. This configuration allows for a particularly high number of transportations between transfer positions, because the first spatial direction (x) pointing upwards, means that the movement speed in first spatial direction is determined by the second kind of drive unit, which can comprise e.g., the described holonomic wheelset and can work in general at higher speeds than the first drive unit.

[0080] In order to achieve the goal of carrying out transport processes of the cabins as automatically as possible and preferably also contactlessly and/or autonomously and with the smallest possible ecological footprint, several measures are proposed in this application, which already contain advantages in their individual application, but whose synergetic interaction is particularly advantageous.

[0081] The control component is in particular a central component of one of the transport systems presented in this application. Preferably, the control component is designed in such a way that it controls as many or even all of the processing steps of the cabins as possible. However, it is also possible that the control component only controls individual process steps as described in this application.

[0082] The control component of the transport system can be designed in such a way that the control component can carry out individual or several or even all of the procedures presented in this application.

[0083] The invention can also be described by the following characteristics. The characteristics presented below can be combined with each other as well as with the following presentation of preferred embodiments based on the figures, whereby particularly preferred combinations of characteristics are highlighted by reference to previously presented combinations of characteristics.

[0084] AA. Automatable system for the transport of transport cabins for, with a guiding arrangement for transporting the cabins, wherein the guiding arrangement comprises independently movable vehicles.

[0085] AB. Automatable system for the transport of transport cabins, with a guiding arrangement for transporting the cabins, wherein the guiding arrangement comprises independently movable vehicles.

[0086] AC. Automatable system for the transport of transport cabins, with a guiding arrangement for transporting the cabins, wherein the guiding arrangement comprises independently movable vehicles and wherein the area, wherein the vehicles can move along the guiding structure.

[0087] BA. Method of using an automatable system for the transport of transport cabins with vehicles, each configured for moving along the guiding arrangement wherein the guiding arrangement is configured for active motion of the vehicle in said first spatial direction and/or said second spatial direction so that the vehicles can move individually.

[0088] BB. Method of using an Automatable system for the transport of transport cabins, with a guiding arrangement for transporting a cabin with a vehicle, each vehicle configured for moving along the guiding arrangement wherein the guiding arrangement is configured for active motion of the vehicle in said first spatial direction and/or said second spatial direction so that the vehicles can move individually, wherein the vehicle moves omnidirectionally along the at least one structure especially allowing for (fast) passing maneuvers thus increasing the number of transportations.

[0089] BC. Method of using an automatable system for the transport of transport, with a guiding arrangement for transporting the cabin with at least one vehicle, configured for moving along the guiding arrangement wherein the guiding arrangement is configured for active motion of the vehicle in said first spatial direction and/or said second spatial direction so that the vehicle can move individually, storing arrangement wherein the vehicle moves omnidirectionally along the at least one structure, especially allowing for (fast) passing maneuvers thus increasing the number of transportations.

[0090] BD. Method of using an automatable system for the transport of transport cabins with vehicles, each configured for moving along the guiding arrangement wherein the guiding arrangement is configured for active motion of the vehicle in said first spatial direction and/or said second spatial direction so that the vehicles can move individually, wherein the vehicle moves omnidirectionally along the at least one structure, especially allowing for (fast) passing maneuvers thus increasing

the number of transportations.

[0091] BE. Method of using an automatable system for the transport of transport cabins especially with a combination of previously presented characteristics, respectively combinations of characteristics BA to BD, wherein a route-planning tool plans a path for at least one vehicle connected to at least one connection element along at least one guiding arrangement from one transfer position to another, especially taking into account at least momentary positions and paths of at least one other vehicle also coupled to the at least one suspension structure.

[0092] BF. Method of using an automatable system for the transport of transport cabins for the especially with a combination of previously presented characteristics, respectively combinations of characteristics BA to BE, with a guiding arrangement for transporting the cabins, wherein a route-planning tool plans a path for at least one vehicle connected to at least one connection element along at least one structure from one transfer position to another, especially taking into account at least momentary positions and paths of at least one other vehicle also coupled to the at least one structure, wherein the vehicle moves omnidirectionally along the at least one structure, especially allowing for (fast) passing maneuvers thus increasing the number of transportations.

[0093] CA Ceiling suspension arrangement for lifting, transferring and lowering containers comprising at least one crawler type ceiling unit and a ceiling structure extending in at least two spatial directions wherein the ceiling structure comprises a plurality of profile units extending in a first spatial direction, wherein the ceiling structure defines in at least an area at least one structural regularity in a second spatial direction; and wherein the at least one crawler type ceiling unit comprises a plurality of suspension elements configured for suspending the at least one crawler type ceiling unit and configured for coupling the at least one crawler type ceiling unit to the ceiling structure by means of de-/coupling kinematics during a motion of the at least one crawler type ceiling unit in said second spatial direction, particularly depending on a relative motion of the at least one crawler type ceiling unit with respect to the ceiling structure in at least said second spatial direction, especially with the crawler type ceiling unit being configured to be moved in said first spatial direction along the profile units irrespective of momentary motion in said second spatial direction y; and wherein the at least one ceiling unit comprises at least one hoist unit 50, wherein the at least one hoist unit comprises a gripping unit 53, wherein the gripping unit 53 is configured to connect and/or to be connected to at least one container 60.

[0094] CB Ceiling suspension arrangement 100 especially with a combination of previously presented characteristics, respectively combinations of characteristics BA to BE and/or CA, wherein the crawler type ceiling unit comprises at least two circumferential tracks 12, 12a, 12b, wherein the suspension elements are attached to the circumferential tracks at predefined longitudinal positions corresponding to the structural regularity, wherein the circumferential tracks respectively define a specific path of circumferential motion of the respective suspension elements, thereby providing de-/coupling kinematics during a motion of the crawler type ceiling unit in said second spatial direction y.

[0095] CC Ceiling suspension arrangement especially with a combination of previously presented characteristics, respectively combinations of characteristics CA and/or CB, wherein the at least one crawler type ceiling unit comprises:

- at least one first drive unit configured for circumferential motion and accommodating the at least two circumferential tracks, wherein the at least two circumferential tracks comprise at least a first circumferential track and a second circumferential track having a different circumferential shape/contour than the first circumferential track, wherein the at least one crawler type ceiling unit is configured for moving in said second spatial direction by decoupling a subset of the plurality of suspension elements from resp. coupling them into the ceiling structure when the suspension elements are guided along the two circumferential tracks by the circumferential motion,
- at least one second drive unit configured for enabling locomotion of the crawler type ceiling unit in at least said first spatial direction x and said second spatial direction, wherein the at least one second drive unit is configured for locomotion of the crawler type ceiling unit in said first spatial direction providing for at least two-dimensional locomotion capability of the crawler type ceiling unit, wherein the respective suspension element exhibits at least one wheel, which is arranged and configured for being guided along the ceiling structure, especially on a wheel tread of a respective/corresponding profile unit of the ceiling structure,
- at least two individually controllable motors, wherein the at least one first drive unit and the at least one second drive unit is connected to at least one motor, and wherein the motors for the first drive unit(s) and the second drive unit(s) are different, providing for active two-dimensional traveling capability of the crawler type ceiling unit.

[0096] CD. Ceiling suspension arrangement especially with a combination of previously presented characteristics, respectively combinations of characteristics CA to CC, wherein the at least one crawler type ceiling unit comprises at least one (further) drive unit, wherein the at least one further drive unit is configured for at least one of the following functions:

- lifting, holding and/or lowering at least one container with the at least one hoist unit during a stop and/or movement of the at least one crawler type ceiling unit

in at least said first spatial direction x and/or said second spatial direction y,
- connecting the at least one gripping unit of the at least one ceiling unit to the at least one container.

[0097] CE. Ceiling suspension arrangement especially with a combination of previously presented characteristics, respectively combinations of characteristics CA to CD, wherein the ceiling suspension arrangement comprises at least one sensing device comprising at least one sensor, wherein the at least one sensing device is configured to provide sensor data related to at least one of the following:

- motion of the at least one crawler type ceiling unit in said first spatial direction (x) and/or second spatial direction (y),
- hoisting operation of the at least one hoist unit,
- gripping operation of the at least one gripping unit.

[0098] CF. Ceiling suspension arrangement especially with a combination of previously presented characteristics, respectively combinations of characteristics CA to CE comprising a tracking system, wherein the at least one crawler type ceiling unit and/or the ceiling structure comprises a tracking unit; and/or wherein the at least one crawler type ceiling unit comprises at least one sensor from the following group: speed sensor, distance sensor, position measuring sensor, force sensor, acceleration sensor.

[0099] CG. Ceiling suspension arrangement especially with a combination of previously presented characteristics, respectively combinations of characteristics CA to CF, wherein the system comprises at least one control unit, wherein the at least one control unit is characterized in at least one of the following, particularly based on corresponding sensor data:

- providing for trajectory planning and/or collision avoidance,
- computing actuator signals for the ceiling units , particularly to follow a predefined trajectory, and/or to execute driven/driving motion according to a collision avoidance strategy,
- computing actuator signals for the gripping and hoisting motion of the at least one crawler type ceiling unit,
- comprising a wireless communication module to provide actuator signals to at least one crawler type ceiling unit.

[0100] CH. Ceiling suspension arrangement especially with a combination of previously presented characteristics, respectively combinations of characteristics CA to CG, wherein the ceiling suspension arrangement comprises a supporting structure for the ceiling structure.

[0101] CI. Ceiling suspension arrangement especially with a combination of previously presented characteristics, respectively combinations of characteristics CA to CH, wherein the at least one hoist unit of the at least one crawler type ceiling unit is configured to lift, transfer and lower a container arrangement of at least two containers 60, wherein the at least two containers are arranged in a side-by-side and/or superimposed manner.

[0102] CJ. Ceiling suspension arrangement especially with a combination of previously presented characteristics, respectively combinations of characteristics CA to CI, wherein the ceiling suspension arrangement comprises at least two crawler type ceiling units , wherein at least two of the at least two crawler type ceiling units are configured to lift, transfer and lower a container or an arrangement of at least two containers, wherein the at least two containers are arranged in a side-by-side and/or superimposed manner, wherein the gripping units of the at least two crawler type ceiling units connect to the container or the arrangement of the at least two containers 60 at least at two different gripping points.

[0103] CK. Ceiling suspension arrangement especially with a combination of previously presented characteristics, respectively combinations of characteristics CA to CJ, wherein at least a part of the ceiling structure is arranged at a height, which is above the height of a container transport ceiling unit and/or container stack and/or freight-carrying ceiling unit.

[0104] CL. Ceiling suspension arrangement especially with a combination of previously presented characteristics, respectively combinations of characteristics CA to CK, wherein the at least one gripping unit comprises a mechanism for connecting at least semi-autonomous to at least one container; and/or wherein the at least one hoist unit comprises a connector unit for connecting the at least one gripping unit with the at least one container in an at least semi-autonomous manner.

[0105] CM. Container port comprising at least one ceiling suspension arrangement especially with a combination of previously presented characteristics, respectively combinations of characteristics CA to CL, wherein the at least one ceiling suspension arrangement is configured to load and/or unload at least one container transport ceiling unit and/or transfer containers to freight-carrying ceiling units and/or uninterruptedly transfer containers to a storage yard and/or uninterruptedly transfer at least one container from at least a first container transport ceiling unit to at least a second container transport ceiling unit.

[0106] DA. Method of container loading and unloading with a ceiling suspension arrangement 100 especially with a combination of previously presented characteristics, respectively combinations of characteristics CA to CM, particularly in a container port, comprising at least one, particularly all, of the following steps:

- positioning of at least one crawler type ceiling unit at a predefined position,
- lowering at least one gripping unit of at least one hoist unit of at least one crawler type ceiling unit,

- connecting at least one gripping unit of at least one hoist unit of at least one crawler type ceiling unit to at least one container,
- lifting at least one container via at least one hoist unit of at least one crawler type ceiling unit,
- transferring at least one container via a motion of at least one crawler type ceiling unit in at least one spatial direction,
- lowering at least one container via at least one hoist unit of at least one crawler type ceiling unit.

[0107] EA. Method of operating a ceiling suspension arrangement especially with a combination of previously presented characteristics, respectively combinations of characteristics CA to CD, particularly in a container port especially with the characteristics of CM, comprising at least one of the following:

- monitoring a position and/or trajectory of at least one crawler type ceiling unit,
- trajectory planning, particularly with a collision avoidance strategy,
- computing actuator signals for at least one crawler type ceiling unit to follow a predefined trajectory and/or to execute driven/driving motion according to a collision avoidance strategy,
- computing actuator signals for a gripping of at least one gripping unit and/or hoisting operation of at least one hoist unit of at least one crawler type ceiling unit, particularly with an overload protection mechanism,
- coordinating a motion of at least two crawler type ceiling units in at least one spatial direction, particularly via corresponding trajectory planning and/or collision avoidance strategy.

[0108] It is useful to integrate and adapt known software concepts for the operation of a transport system. However, it is especially recommendable to implement a learning system, and/or a method of providing process protocols for a number of physical objects (O), which pass through several production/processing stations (P 1 ... Pn) in a production/processing line, wherein machine-readable data (D) are assigned to at least one object (O), wherein the data comprise at least one identification, by means of which the respective object can be uniquely identified,

at least one reading means (R) is arranged at at least one production/processing station (P 1 ... Pn), which is adapted to read out the machine-readable data (D) assigned to the objects (O),

the respective reading means (R) arranged at a production/processing station (P 1 ... Pn) reads out the machine-readable data (D) assigned to the object (O) as soon as the object reaches and/or leaves the production/processing station (P 1 ... Pn),

the machine-readable data (D) that have been read out are assigned to the respective production/processing station (P 1 ... Pn) and/or the respective reading means (R),

at least one time stamp is assigned to the machine-readable data (D) read out by the respective reading means (R),

the process protocol is generated from the machine-readable data (D) read out by the at least one reading means (R), the assignment of the machine-readable data (D) that have been read out to the production/-processing station (P 1 ... Pn) and/or to the reading means (R), and the time stamp assigned to the machine-readable data (D) that have been read out, wherein the process protocol comprises a number of data sets, wherein each data set describes a process step of a process, and wherein each data set of the process protocol comprises at least:

a first attribute, in which a unique identification of a process is transported and by means of which the process step is assigned to the process;

a second attribute, in which an identification of the process step is transported; and

a third attribute, in which a sequence of the process steps within a process is transported; and

the process protocol that has been generated is transported in a storage means (DB).

[0109] An adaptable example of such a method is it is for example described in the European patent EP3803727B1 which proposes a method for providing process protocols and the adaptation and utilization of these process protocols.

[0110] According to one example, the Automatable system for the transport of transport cabins further comprises - at least one route planning tool for route planning along the at least one structure.

[0111] Exemplarily, the at least one vehicle can exhibit a sensing device exhibiting at least one sensor from the following group: speed sensor, distance sensor, height and position measuring sensor, force sensor, acceleration sensor resp. gyroscope.

[0112] The automatable system for the transport of transport cabins, especially the route planning tool, is configured for transmitting commands to a communication unit of the at least one vehicle, especially to the communication units of all vehicles individually, such that control units of the vehicles control their respective vehicle based on received commands as well as based on momentary measuring data of at least sensor.

[0113] The communication unit can be configured for

wireless communication at least within the automatable system for the transport of transport cabins, wherein the (respective) vehicle or the suspension structure provides energy to the communication unit, especially such that the communication unit of the vehicle is energetically self-sustaining (autarkic) for at least a period of several days or weeks or month.

[0114] The automatable system for the transport of transport cabins can be configured for localizing individual vehicles based on at least one locating signal transmitted by individual vehicles (passively or actively, e.g., passively based on at least one individual transmitter, especially based on individual identification features). Additionally, the vehicles transmit sensor data and information about destination transfer positions to the at least one route planning tool when a request to do so is received in the communication unit of the vehicle.

[0115] According to an aspect of the invention, a method of using an automatable system for the transport of transport cabins, is provided, wherein a route-planning tool plans a path for at least one vehicle connected to at least one connection element along at least one structure from one transfer position to another, especially taking into account at least momentary positions and paths of at least one other vehicle, especially all vehicles also coupled to the at least one structure, wherein the vehicle moves omnidirectionally along the at least one structure, especially allowing for (fast) passing maneuvers. This increases the number of transportations between transfer positions.

[0116] According to a further aspect of the invention, a computer implemented method for route-planning for an automatable system for the transport of transport cabins, , is provided, the method comprising the following steps:

- receiving in a route-planning tool a request to plan a path from a starting transfer position to a destination transfer position from a vehicle or a group of synchronized vehicles,
- obtaining and verifying position information of at least one other vehicle by sending a request to the at least one other vehicle, receiving a current position, and comparing the current position with the predicted positions of the vehicles, wherein the prediction takes into account momentary positions and/or measured data of the vehicles, and a planned route for the vehicles,
- planning the path for the vehicle or the group of synchronized vehicles from the starting transfer position to the destination transfer position by solving an optimization problem, minimizing the traveling time taking into account path length, potential wait time of each path, and predicted positions of other vehicles to avoid collisions.

[0117] Further advantages, features, and advantageous refinements of the invention are derived from the dependent claims and the following description of preferred embodiments with reference to the figures.

[0118] Of the figures show

Fig. 1a, 1b exemplary suspension elements for de-/coupling crawler type vehicles with to/from structure;
Fig. 1c, 1d exemplary counter wheels for enhancing grip between crawler type vehicles and a structure;
Fig. 2a-2n kinematic aspects and details of a crawler type according to an embodiment of the invention suspended on a structure;
Fig. 3a, 3b a drive unit (of the first kind) of a crawler type vehicle according to one embodiment of the invention;
Fig. 3c, 3d an exemplary counter wheel unit;
Fig. 3e, 3f a first arrangement of drive units (of the first kind) and a counter wheel unit;
Fig. 3g, 3h a second arrangement of drive units (of the first kind) and a counter wheel unit;
Fig. 3i a side view of a drive unit (of the first kind) and a counter wheel unit coupled into a structure;
Fig. 4a, 4b an arrangement of drive units (of the first kind) with counter wheel units with a motor (and a housing);
Fig. 4c a crawler type vehicle according to a first embodiment;
Fig. 4d a crawler type vehicle according to a second embodiment;
Fig. 4e, 4f the crawler type vehicle according to the second embodiment in side-views;
Fig. 5a-5b a suspension arrangement according to embodiments of the invention with conveyor/connector rails;
Fig. 6 a suspension arrangement according to one embodiment with a conveyor/connector rail;
Fig. 7 a suspension arrangement according to one embodiment with two structures and a conveyor/-connector rail;
Fig. 8 details of a crawler type vehicle driving along a conveyor/connector rail;
Fig. 9 a suspension arrangement according to one embodiment with a conveyor/connector rail;
Fig. 10 a suspension arrangement according to one embodiment with two structures connected via a conveyor/connector rail;
Fig. 11 a detail of a crawler type vehicle driving along a conveyor/connector rail.
Figures 12a, 12b, 13a, 13b, 14a, 14b, 15a,15b, 16, 17, 18, 19, 20, 21a, 21b, 21c, 22a, 22b, 22c, 23, 24, 25, 25, 26, 27 a part of an automatable system for the transport of transport cabins
Fig. 28 a ceiling suspension arrangement and a container port equipped with this ceiling suspension arrangement.

DETAILED DESCRIPTION OF THE DRAWINGS

[0119] The invention will now be described first in

general for the inventive concept with reference to all drawings before the drawings are described in detail.

[0120] The crawler type vehicles can exhibit at least one first drive unit 11 which may provide for accommodation of a crawling or driving mechanism 11.1 with motor(s), which allows for circumferential motion of suspension elements 13 along circumferential tracks 12, namely simultaneously along a first and a second circumferential track 12a, 12b, which tracks exhibit individual shapes/-contours XZa, XZb. Preferably, the tracks only extend two-dimensionally (2D), i.e., in a plane, and the shape is different at least in curved sections 12r of the tracks. Each track 12a, 12b exhibits a parallel/linear section 12p (resp. two parallel sections) and at least one redirection/curved section 12r (resp. two curved sections). A lateral area resp. surface shell of the at one chassis or housing is preferably flat, plane, even, respectively on each lateral side. Such a configuration is favorable in view of interconnection of several housings 17 (side by side).

[0121] The crawler type vehicle 10 exhibits at least one further housing 17 (preferably in the same drive unit 11) exhibiting first and second circumferential tracks 12a, 12b and accommodating a plurality of further suspension elements 13b which are arranged mirror-inverted, with respect to the suspension elements 13 of the first housing 17. Both types of suspension elements 13, 13b can be arranged within the same drive unit 11, and optionally, both types of suspension elements 13, 13b can be guided by the same pair of circumferential tracks 12a, 12b. The drive unit 11 may actively provide for a traveling motion (e.g., by a synchronous guiding/driving motion of/to the suspension elements 13, 13b). Several first drive units 11a, 11b, 11c can be interconnected, e.g., via cross-beams or the like. The desired/required traveling motion can be controlled via a control unit which can be coupled to at least one motor 11.5. A drive section may also comprise at least one gear unit 18 configured for interacting with the track(s) and at least one energy storage unit. A sensor arrangement exhibiting at least one sensing device, e.g., comprising position sensors and velocity sensors and/or weight sensors and/or gyroscopes, may provide sensor data to the control unit.

[0122] Preferably, each suspension element 13, 13a, 13b exhibits a first pulley 13.1 and a second pulley 13.2, and optionally, at least one wheel 13.3 is provided at the free end of the suspension element 13 (bearing point/-coupling point P13). The first and second pulleys are arranged on a lever arm 13.5 in distance from/to each other (y-offset, longitudinal extension y13 of lever arm); the bearing point P13 resp. the wheel 13.3 is arranged at a protruding section resp. suspension arm 13.6 (z-offset). At the free end of the suspension arm, optionally, a current collector resp. power-slider 13.4 (conductive slider for energy transfer) is provided in an arrangement geometrically corresponding to a/the power rail 1.3 of the respective profile unit 1.1. The plurality of suspension elements 13 of a/the respective first drive unit 11 can be interconnected via longitudinal connecting elements 15 which can ensure a closed loop 15a of interrelated suspension elements. The suspension elements 13 are coupled to the respective circumferential tracks.

[0123] In other words: The suspension elements preferably exhibit at least one wheel 13.3 performing a rolling motion on the profile units 1.1, preferably on the wheel tread 1.2 and preferably additionally on the side of the profile units, of the structure 1, allowing for a motion which is orthogonal to the motion predefined and evoked by the tracks 12, wherein the wheel 13.3 is positioned and aligned orthogonally with respect to the first and second pulleys 13.1, 13.2. Optionally, the wheel can be motorized e.g., by means of further actuators or motors. The first pulley 13.1 is engaged with the first or second circumferential track, thereby following the contour defined by said track; also, the second pulley 13.2 is engaged with the first or second circumferential track, thereby following said track (which is different from the track engaged by the first pulley, i.e., vice versa). The lever arm 13.5 is preferably L-shaped, especially provided as integral element in one piece (massive, solid).

[0124] The structure 1 and its raster 1a is defined by profile units 1.1 being arranged in parallel and with similar distance (pitch) to adjacent profile units. Each profile unit is preferably configured to support geometries/surface(s) which are adequate for interaction with the wheel(s) of the suspension elements (e.g. T-profile, C-profile, L-profile, I-profile), and a series of such profile units preferably provides for a planar surface or for a tubular surface at least in sections.

[0125] By means of the circumferential tracks 12a, 12b and the suspension elements 13, the (respective) first drive units 11, and the kinematics defined by the shape of the tracks provide for de-/coupling kinematics 20 which ensure both horizontal/vertical motion kinematics and non-circular pivot motion kinematics. Thereby, de-/coupling of each suspension element can be affected via circumferential motion along the tracks without the need of any axial telescopic motion within each suspension element, i.e., the respective suspension element can be designed as purely mechanic unit.

[0126] In the following, the kinematics provided by the guiding/driving motion along circumferential tracks is described in general, first:

The first pulley 13.1 of each suspension element 13 rotates about a first pulley axis and defines a first guiding point G13.1 (coupling the first track and the respective suspension element), and vice versa, the corresponding point of the corresponding circumferential track defines that first guiding point G13.1 for each suspension element. Likewise, the second pulley 13.2 of each suspension element 13 rotates about a second pulley axis (which is preferably aligned in parallel) and defines a second guiding point G13.2 (coupling the second track and the respective suspension element). When referring to the kinematics of each suspension element, an instantaneous centre of rotation of each suspension element is defined by the axis of the first pulley 13.1 being coupled to

the first track 12a, wherein coupling/attachment/fixation can be ensured e.g. at the axial section between a/the suspension arm 13.6 and the first pulley 13.1. The two tracks 12a, 12b are arranged with respect to another in such a manner that the contacting/bearing point/area P13 (coupling point) of the respective suspension element 13 can be hooked or hitched in the structure. The wheel 13.3 of each suspension element rotates about a wheel axis which is preferably aligned orthogonally to the first and second pulley axis. Since each suspension element 13 is coupled to the tracks 12a, 12b in predefined positions, namely in a predefined first longitudinal position y12a via the first pulley 13.1 and in a predefined second longitudinal position y12b via the second pulley 13.2, when driving the tracks resp. when guiding the suspension elements along the tracks, the bearing point P13 at the free end of the suspension element 13 is guided according to the relative position/contour and distance of the corresponding tracks (of a pair of tracks guiding the respective suspension element).

[0127] The crawler type vehicle 10 may exhibit a control unit which can be a decentral (individual) control unit. Further, a respective crawler type vehicle 10 may exhibit a communicating unit (e.g., near field, mobile network, LAN, LP-WAN, SigFox, NBIoT) and/or a transmitter (active or passive), especially for transmitting locating signals. These components are configured to interact in/with a positioning system or route-planning tool.

[0128] The crawler type vehicle 10 can be configured to carry a load, which can be attached to the crawler type vehicle 10 at a connecting point. The load may comprise an identification feature, especially a code (e.g., including a number). Likewise, each crawler type vehicle 10 may comprise an identification feature, especially a code (e.g., including a number).

[0129] A digital twin referring to a respective crawler type vehicle 10 and/or a digital twin referring to a respective load can be stored in a database of a route-planning tool. The database is configured for storing and accessing the at least one digital twin at least comprising information of momentary status, wherein the suspension arrangement is configured to define at least one control parameter for individual crawler type vehicles based on information of the at least one digital twin.

[0130] In the figures, x designates a/the first spatial direction (especially cross direction, especially direction of longitudinal extension of profile units), and y designates a/the second spatial direction (especially longitudinal direction or momentary driving direction of the crawler type vehicle), and z designates a/the third spatial direction.

[0131] In Fig. 1a and 1b, a suspension element 13 is shown in an isolated view from a "front" and "back" side. A first pulley 13.1 intended to be pulled along a circumferential track 12, 12b is shown. The suspension element 13 exhibits two elements of motion 13.3, a first wheel to roll on a wheel tread 1.2 of a profile unit 1.1, and a second wheel to roll on a side of the wheel tread 1.2. Additionally, the suspension element 13 exhibits a first electrical contact ("current collector") 13.4 to connect to a power line 1.3 integrated into the structure 1 and a second electrical contact 13.7 electrically connected to the first electrical contact 13.4 via a wire 13.8 to provide power to an internal bus of a crawler type vehicle 10.

[0132] Fig. 1c and 1d show wheels 16.1 of a counter mechanism 16, wherein the wheels 16.1 push on a "bottom" side of a profile unit 1.1 further enhancing force fit coupling between the crawler type vehicle 10 and the structure 1. Similar to the suspension elements 13, the counter wheels 16.1 exhibit pulleys 16.2 intended to be pulled via a chain/belt 16a and guided along a circumferential track to follow a predefined path of motion. Preferably, a crawler type vehicle 10 exhibits at least one first set of suspension elements 13 with a first orientation, at least one second set of suspension elements of suspension elements 13b facing in opposite direction (mirror-inverted) and at least one set of counter wheels 16, such that a "T"-shaped profile unit can be clamped between the wheels from all (six) sides, i.e., both sides (top and bottom) of the wheel tread as well as a side of the wheel tread. "Top" and "bottom" in this case are the sides facing away from the crawler type vehicle and towards the vehicle respectively and do not limit the crawler to be used in a ceiling arrangement. The clamping of the profile unit (preferably from all sides) allows vehicles to switch between structures exhibiting different orientations (e.g., being arranged at a wall, a ceiling, the floor).

[0133] In conjunction with appropriate sensor-actor-arrangements, not shown here, the crawler type vehicle 10 can follow an intended direction resp. an intended path of motion in the structure shown in Fig. 2. Fig. 2a shows a cross-section of an energy charging area P10. The profile units 1.1 respectively exhibit treads 1.2, wherein suspension elements 13 exhibit at least one wheel 13.3 for gliding or rolling, arranged and configured for moving the crawler type vehicle 10 in the first spatial direction (x). The crawler type vehicle 10 enables two closed loop trajectories of at least two subsets of respective suspension elements, as can be seen in Fig. 2d-j. The circumferential tracks 12, 12a, 12b are shaped in such a manner that the respective suspension elements 13 are de-/coupled from/into the structure 1 when passing a curved section 12r of the tracks 12a, 12b. One subset of the suspension elements 13 is attached to one of the circumferential tracks (resp. a subset of the first subset, momentary) and one further subset of the suspension elements 13 are attached to a further one of the circumferential tracks (resp. a subset of the second subset, momentary) respectively at predefined first and second (further) longitudinal positions respectively corresponding to the structural regularity 1a, with each suspension element being guided by a pair of circumferential tracks. The suspension elements 13 are fixedly attached/-coupled by means of a first pulley 13.1 to/with a/the first circumferential track 12a and are guided within a/the second circumferential track 12b by means of a second

pulley 13.2 respectively, wherein the first pulley 13.1 and the second pulley 13.2 are arranged at a lever arm 13.5 of the respective suspension element 13. A respective subset of said suspension elements 13 is connected to each other by means of longitudinal connecting elements 15 (chain elements) forming a closed loop of interrelated suspension elements 15a distanced to each other in the predefined structural regularity 1a, as can be seen in Fig. 2k m. The crawler type vehicle 10 in Fig. 2b exhibits two kinds/types of suspension elements 13a, 13b, wherein the different types of suspension elements 13 are de-/coupled according to individual kinematics (here, in opposite directions/sides at the profile units 1.1, both in and opposite to the second spatial direction (y) resp. travel direction of the crawler type vehicle 10), wherein a first subset of the suspension elements 13a are attached to a first pair of circumferential tracks 12a, 12b (resp. a subset of the first subset, momentary) and at least one further subset of the suspension elements 13b are attached to a second pair of circumferential tracks 12a, 12b (resp. a subset of the second subset, momentary) respectively at predefined first and second (further) longitudinal positions y12a, y12b respectively corresponding to the structural regularity 1a (resp. to the distance of the profile units defined by said structural regularity), wherein the first and second pairs of circumferential tracks 12a, 12b provide for individual kinematics for the first and second subsets of suspension elements 13a, 13b, especially such that the crawler type vehicle 10 can be secured with respect to opposite sides/directions (of the second spatial direction) at the structure 1 resp. at the profile units 1.1.

[0134] In Fig. 2n, each suspension element 13, 13b is guided by a pair of circumferential tracks 12a, 12b, wherein the crawler type vehicle 10 exhibits at least three pairs of circumferential tracks 12a, 12b, each guiding a subset of the suspension elements 13, 13b, wherein said de-/coupling kinematics are predefined by said three pairs of circumferential tracks 12a, 12b in such a manner that respective suspension elements 13a, 13b (resp. a subset of the respective subset, momentary) simultaneously de-/couple both at a first side (resp. first longitudinal position) of a respective profile unit 1.1 and at a second side (resp. second longitudinal position) of a respective profile unit 1.1, especially such that the crawler type vehicle 10 is secured with respect to opposite sides/directions (of the second spatial direction) at the structure 1 with all suspension elements 13a, 13b being guided in same circumferential direction with all circumferential tracks 12 being arranged in parallel to each other. The vehicle exhibits three (first) drive units 11a, 11b, 11c, wherein two of the drive units 11, 11c comprise suspension elements 13 with a first orientation, and the drive unit 11b in the middle exhibits suspension elements with mirror-inverted orientation. The crawler type vehicle 10 exhibits at least one motor 11.5 (not shown here) interacting with at least one of the circumferential tracks 12. The crawler type vehicle 10 also exhibits an energy storage unit (also not depicted) providing energy to a/the at least one motor of the crawler type vehicle 10. As can be seen in Fig. 2b, the exemplary crawler type vehicle 10 also exhibits electrical contacts 13.4 to connect to a power line 1.3 in the structure 1. The power line can be AC or DC, and additionally provide for a communication bus, i.e., powerline communication. To improve safety and electromagnetic shielding of the crawler type vehicle 10, the crawler type vehicle 10 in Fig. 2c exhibits a protective casing 14.

[0135] The (first) drive unit 11 shown in Fig. 3a exhibits suspension elements 13, 13b of the kind described in Fig. 1a, 1b but without the electrical contacts. The electrical contacts being hidden in the remaining figures is for easier interpretation and clarity only. A first set of suspension elements 13 is facing in a first direction, while a second set of suspension elements 13b is facing in a second direction, opposite to the first direction. The (first) drive unit 11 comprises two circumferential tracks 12a, 12b for each set of suspension elements 13, 13b (i.e., in total four circumferential tracks), as described with respect to Fig. 2d-2m. The second housing 17 exhibiting the two circumferential tracks 12a, 12b for the second set of suspension elements 13b is hidden in Fig. 3b to show how the suspension elements 13, 13b can be connected to a common chain 15a (e.g., via pulleys 13.1 of both sets of suspension elements 13, 13b) which can be driven by a gear unit 18 connected to a motor 11.5. Fig. 3c and Fig. 3d show a further unit 16 (counter unit) guiding counter wheels 16.1 for also contacting profile units 1.1 from a "bottom" side with the same shape as the first drive unit 11. The counter wheels 16.1 alone cannot suspend/fix the crawler type vehicle 10. The counter wheels 16.1 only serve as a counter mechanism to push against the structure 1 to increase the force coupling between the suspension elements 13 and the structure 1. The counter wheels 16.1 also exhibit pulleys 16.2 via which they are pulled along two circumferential tracks to follow a predefined motion. Two (first) drive units 11 exhibiting two sets of suspension elements 13a, 13b respectively being arranged mirror-inverted to grasp a profile unit 1.1 from two sides, as well as two sets of counter wheels 16.1, are shown in Fig. 3e and Fig. 3f. The drive units from Fig. 3e and 3f are shown from a diagonally above perspective in Fig. 3g and Fig. 3h. The drive units 11 are connected to form a (first) drive arrangement 11.2 comprising two (first) drive units 11 and a counter unit 16. The drive arrangement 11.2 can be driven via a common shaft connected to the gear units 18 of the drive units 11 and counter unit 16 as shown in Fig. 3b and Fig. 3d. The mirror-inverted set of suspension element 13b is hidden behind the profile unit 1.1 in Fig. 3g and 3h. It is preferred to always have at least one set of mirror-inverted suspension elements 13b in order to enhance coupling security with the structure 1.

[0136] In addition to the two elements of motion 13.3 at the free ends of the suspension elements 13, 13b which couple the crawler type vehicle 10 to the structure 1 from the "top" side of the wheel tread of the profile units 1.1 as

well as from the side of the wheel tread 1.2, which is not necessarily as thin as shown in the figures, but can also be wider in order to build the elements of motion 13.3 connecting to the side of the wheel tread bigger to allow for heavier loads to be lifted by a crawler type vehicle 10, especially in structures 1 being arranged at a wall. In Fig. 3i, a side view of a (first) drive unit 11 of a crawler type vehicle 10 coupled via a subset of suspension elements 13, 13b to the structure 1 is shown. In total, six wheels 13.3, 16.1 clamp the "T"-shaped profile unit 1.1 such that slip is minimized.

[0137] The (first) drive units 11 from Fig. 3e and Fig. 3f form a first drive arrangement with a common motor 11.5 in Fig. 4a. To enhance protection (for and from the surroundings) an additional casing 14 is shown in Fig. 4b. The casing 14 exhibits a ball 14.2 of a ball joint 14.1 in the center of the drive arrangement (both in first x and second y direction). The (first) drive units 11a, 11b of the first drive arrangement 11.2 may need some flexibility even though they are very close together in order to follow curved profile units 1.1. A short splined shaft with a universal joint (not shown) can exemplarily be used to account for the small changes in angle between the (first) drive units 11 (of one first drive arrangement) when the vehicle 10 is following curved profile units 1.1 (in first spatial direction x).

[0138] Fig. 4c shows a crawler type vehicle 10 according to one embodiment. The crawler type vehicle 10 exhibits two arrangements 11.2 of the type shown in Fig. 4b. It is however also possible to only use one (first) drive unit 11 for each of the arrangements 11.2. The two casings 14 of the arrangements 11.2 are coupled via a ball joint 14.1. The ball joint 14.1 preferably connects to a framework 14.3 of the vehicle 10 as shown in Fig. 4d. The (first) drive units 11 of the two drive arrangements 11.2 are connected via a drive mechanism 11.1 comprising a splined shaft 11.3 with universal joints 11.4, a close-up view of which can be found in Fig. 4c. Additionally, two holonomic wheelsets 90 are shown in Fig. 4d. A motor 91 engages in a differential 91.1 connected to the holonomic wheelsets 90. The motor 91 and the holonomic wheels 90 are connected to the vehicle framework 14.3 in the middle between the two drive arrangements 11.2. Fig. 4e shows the crawler type vehicle 10 from a side-view perspective (from the second spatial direction). Fig. 4f shows the suspension elements 13, 13b of the crawler type vehicle 10 clamping the profile unit 1.1. The holonomic wheelsets 90 can be pressed against the profile units 1.1 from the bottom side (side facing the vehicle) with an additional return mechanism 90.1 not shown here.

[0139] Fig. 5a shows a first suspension arrangement 100 according to an embodiment. The suspension arrangement 100 comprises a structure 1 with a crawler type vehicle 10 suspended in the structure 1. A first conveyor/connector rail 1.5 leads out of the structure 1 e.g., to a further structure 1'. The first conveyor/connector rail 1.5 comprises two directly adjacent profile units 1.1. However, as shown in Fig. 5b, a second conveyor/connector rail 1.5 comprises two profile units 1.1 further spaced apart. As long as the vehicle is wide enough to be coupled into both of the at least two profile units of the conveyor/connector rail 1.5 when driving along the conveyor/connector rail 1.5, the profile unit can be spaced apart any integer multiple of the pitch of the structural regularity 1a. Using profile units 1.1 further spaced apart for the conveyor/connector rail 1.5 can increase the stability of the crawler type vehicle 10 when driving along the conveyor/connector rail 1.5, especially in curved sections.

[0140] Fig. 6 shows a further suspension arrangement 100 comprising a structure 1 and a crawler type vehicle 10 of the kind described in Fig. 4d to Fig. 4f. A conveyor/-connector rail 1.5 describing a curve 1.5r leads out of the structure 1. A crawler type vehicle 10 driving along the curve 1.5r is also shown in a close-up view. The crawler type vehicle 10 is able to follow the curved conveyor/-connector rail 1.5 due to the (first) drive units 11 (resp. the drive arrangements 11.2) being able to deviate from their original parallel orientation because of the ball joint 14.1 connecting the at least two (first) drive units (here connecting the casings 14 of the drive arrangements 11.2 comprising multiple drive units 11a, 11b and possibly also a counter unit 16).

[0141] In Fig. 7, a suspension arrangement 100 according to a further embodiment is shown. The suspension arrangement 100 comprises two structures 1, 1', wherein one of the structures 1' comprises curved profile units 1.1, a conveyor/connector rail 1.5 and two crawler type vehicles 10. The profile units 1.1 must follow a continuous curve, essentially without kinks. As indicated by the close-up view of a cross-section of the structure 1 exhibiting curved profile units 1.1, the profile units always have to exhibit the structural regularity 1a in second spatial direction y (depending on orientation of the first spatial direction x, essentially always orthogonal to the first spatial direction x) such that a coupling as shown in Fig. 3i is always ensured. Thus, the crawler type vehicle 10 is able to move (or to be moved) in the first spatial direction x (right or left along the curved profile units) irrespective of momentary motion in second spatial direction y. The orientation between the at least two drive units 11 (of the first kind) changes depending on the position of the vehicle in the structure 1' exhibiting curved profile units 1.1, i.e., the farther out (with respect to the radius of the curve) the vehicle 10 is in the structure 1, the smaller is the angle between the orientations of the drive units (of the first kind). The details of a crawler type vehicle 10 following a curved conveyor/connector rail 1.5r is shown in Fig. 8 from a perspective view from diagonally above. The suspension elements 13 engage in the same manner with the profile units 1.1 as in Fig. 7 in the structure exhibiting the curved profile units 1.1. The suspension elements 13 of the (first) drive units 11 couple to the profile units 1.1 via the elements of motion 13.3 (preferably first wheel and side wheel (see Fig. 3i), preferably from both sides of the profile unit 1.1 via mirror-

inverted suspension elements 13 not shown here).

[0142] In Fig. 9, a further suspension arrangement 100 is shown, wherein the suspension arrangement 100 comprises a structure 1, two crawler type vehicles 10 and a conveyor/connector rail 1.5 leading out of the structure 1. The conveyor/connector rail 1.5 (from the perspective of the x, y-plane described by the structure 1) leads upwards on a curve 1.5r out of the plane defined by the structure 1. In this configuration, it is important to ensure good (force fit) coupling between the crawler type vehicles 10 and the structure 1 or conveyor/connector rails 1.5. As indicated in the close-up view, the crawler type vehicle 10 exhibits a return mechanism 90.1 connected to the vehicle framework 14.3 and the holonomic wheelsets 90. In Fig. 11, the crawler type vehicle going upwards on the conveyor/connector rail 1.5 is shown in a perspective view from diagonally above. A close-up view further shows the return mechanism 90.1 applying a force onto the two holonomic wheelsets 90. The ball joints 14.1 of the crawler type vehicle 10 allow for the (first) drive units 11 to be tilted with respect to each other in any direction, i.e., not only left-right, but also up-down thus allowing the crawler type vehicle 10 to follow parallel profile units 1.1 going upwards/downwards, left/right as well as any combination thereof.

[0143] Fig. 10 shows a further suspension arrangement 100 according to an embodiment. The suspension arrangement 100 exhibits two structures 1, 1' connected via a conveyor/connector rail 1.5 and two crawler type vehicles 10. One of the structures 1' exhibits curved profile units 1.1 describing a segment of a tube-like shape. As indicated in the cross-section here, the profile units 1.1 define the same structural regularity 1a in the second spatial direction y as before (see Fig. 3i). Thus, the crawler type vehicle 10 is able to move (or to be moved) in the first spatial direction x (upwards or downwards the curved profile units) irrespective of momentary motion in second spatial direction y.

[0144] Figures 12a, 12b, 13a, 13b, 14a, 14b, 15a,15b, 16, 17, 18, 19, 20, 21a, 21b, 21c, 22a, 22b, 22c, 23, 24, 25, 25, 26, 27 show a part of an automatable system for the transport of transport cabins, especially outdoors, wherein a guiding arrangement for guiding arrangement for transporting a cabin with a vehicle, especially a crawler type vehicle 10, wherein the vehicle 10 can move along a track, preferably at least two tracks 9001, 9002 which are a part of the guiding arrangement g

[0145] In the embodiments according to figures 12a, 13a, 13b, 14a, 15a, 17, 18, 21a, 21b, 24, 25, 25, 26, 27 the tracks 9001, 9002 are straight tracks.

[0146] In the embodiments according to figures 12b, 14b, 15b, the tracks 9001, 9002 are curved tracks.

[0147] In the embodiments according to figures 16, 19, 20, 23 and 28 at least a part of the tracks 9001, 9002 are in at least one track segment straight and in at least another track segment curved.

[0148] In the embodiments according to figures 12a, 12b, 13a, 15a,15b, 18, 20 and 28 the vehicles 10 move below the tracks 9001, 9002.

[0149] In the embodiments according to figures 13b, 14a, 14b, 16, 17, 19, 21a, 21b, 21c the vehicles move above the tracks 9001, 9002.

[0150] In the embodiments according to figures 14a, 14b, 15a,15b, 16, 17, 18, 19, 20, 21a, 22a, 22b, 22c, 23, 24, 25, 25, 26, 27 the transport cabins 9700, 9701, 9703 are equipped as transport cabins for transporting people.

[0151] In the embodiments according to figures 21b, 21c, 22b, 22c, 23, 24, 25, 25, 26, 27 and 28 the transport cabins are equipped as containers for the transport of all transportable items, ranging from goods objects to cars.

[0152] Figure 16 shows an embodiment of a track changing arrangement 9600 in which a transport cabin 9700 can change from a first position 9701 on tracks 9001 to 9002 during its movement to another position 9703 on tracks 9011, 9012 by moving in relative motion of the vehicle 10 with respect to the structure 1, 1' in at least a second spatial direction y, while being capable of maintaining its movement in a first spatial direction x.

[0153] The track changing arrangement 9600 can operate without a switch.

[0154] Figure 1, 18 show embodiments of an automatable system for a transport of cabins according to the invention with a plurality of tracks.

[0155] Figs. 19 and 20 show a passenger station 2000 at which cabins 19001, 19002, 19003, 19004, 19005, 19006 and 19007, respectively 20001, 20002, 20002, 20003, 20004, 20005, 20006, 20007 can move independently from each other. While some cabins, e.g. cabins 20003, 19005 move uninterrupted along the tracks 9001, 9002 at least one other cabin 19003, 19004, 20004, 20005 moves in -y-direction towards/from a platform 9900.

[0156] At the platform 9900 passengers 2001 can enter/leave the cabin 19004, 20004.

[0157] The containers 21000, 22000, 23001, 23002, 9501, 9500, 95001, 9502 and 9503 are designed for accommodating passengers in the cars during the transport of the cars in the specially equipped containers 21000, 22000, 23001, 23002, 9501, 9500, 95001, 9502 and 9503.

[0158] In a preferred embodiment electric cars can be charged during their transport in the containers 21000, 22000, 23001, 23002, 9501, 9500, 95001, 9502 and 9503.

[0159] In some embodiments, e.g. depicted in Figs. 18 and 23 the cabin is connected to at least two transport vehicles 10, 10'. By movement of one vehicle 10 in -y-direction and of the other vehicle 10 in y-direction the orientation of the transport cabin can change from a first orientation 9801 via an intermediary orientation 9802 to another orientation 9803 perpendicular to the first orientation 9801.

[0160] The automatable system for the transport of transport cabins, especially outdoors, described according to the figures can be combined with a ceiling suspension arrangement 100 for lifting, transferring and lowering

containers 60 comprising at least one crawler type ceiling unit 10 and a ceiling structure 1 extending in at least two spatial directions x, y, wherein the ceiling structure 1 comprises a plurality of profile units 1.1 extending in a first spatial direction x, wherein the ceiling structure 1 defines in at least an area at least one structural regularity 1a in a second spatial direction y; and wherein the at least one crawler type ceiling unit 10 comprises a plurality of suspension elements 13, 13a, 13b configured for suspending the at least one crawler type ceiling unit 10 and configured for coupling the at least one crawler type ceiling unit 10 to the ceiling structure 1 by means of de-/coupling kinematics during a motion of the at least one crawler type ceiling unit 10 in said second spatial direction y, particularly depending on a relative motion of the at least one crawler type ceiling unit 10 with respect to the ceiling structure 1 in at least said second spatial direction y, especially with the crawler type ceiling unit 10 being configured to be moved in said first spatial direction x along the profile units 1.1 irrespective of momentary motion in said second spatial direction y; and wherein the at least one ceiling unit 10 comprises at least one hoist unit 50, wherein the at least one hoist unit 50 comprises a gripping unit 53, wherein the gripping unit 53 is configured to connect and/or to be connected to at least one container 60.

[0161] If the guiding arrangement for transporting the transport cabins, wherein the guiding arrangement comprises

- at least one structure 1, 1' extending in at least two spatial directions x, y, wherein the structure 1, 1' comprises a plurality of profile units 1.1 extending in a first spatial direction x, wherein the structure 1, 1' defines at least one structural regularity 1a in a second spatial direction y,
- at least one vehicle 10, exhibiting a plurality of connection elements 13, 13a, 13b configured for guiding the vehicle 10 and configured for coupling the vehicle 10 to the at least one structure 1, 1' by means of de-/coupling kinematics depending on a relative motion of the vehicle 10 with respect to the structure 1, 1' in at least said second spatial direction y, wherein the connection elements 13, 13a, 13b exhibit at least one element of motion configured for rolling on the profile units 1.1 irrespective of momentary motion in said second spatial direction, enabling 2D-motion of the vehicles 10, wherein the at least one vehicle comprises at least one connection element, wherein the connection element is configured to connect to at least one of the transport cabins; and wherein the guiding arrangement is configured for active motion of the vehicle in said first spatial direction and/or said second spatial direction.

is designed as ceiling suspension arrangement 100 for lifting, transferring and lowering containers, especially as described in Fig. 1 to 13a, 15a, 15b 18, 20, 22a, 22b, 22c, 23, 24, 25, 26, 27, 28 characteristics and advantages of the suspended transport can be added to the guiding arrangement.

[0162] This is advantageously achieved if one or more of the following characteristics of a ceiling suspension arrangement 100 for lifting, transferring and lowering containers 60 comprising at least one crawler type ceiling unit 10 and a ceiling structure 1 extending in at least two spatial directions x, y, wherein the ceiling structure 1 comprises a plurality of profile units 1.1 extending in a first spatial direction x, wherein the ceiling structure 1 defines in at least an area at least one structural regularity 1a in a second spatial direction y; and wherein the at least one crawler type ceiling unit 10 comprises a plurality of suspension elements 13, 13a, 13b configured for suspending the at least one crawler type ceiling unit 10 and configured for coupling the at least one crawler type ceiling unit 10 to the ceiling structure 1 by means of de-/coupling kinematics during a motion of the at least one crawler type ceiling unit 10 in said second spatial direction y, particularly depending on a relative motion of the at least one crawler type ceiling unit 10 with respect to the ceiling structure 1 in at least said second spatial direction y, especially with the crawler type ceiling unit 10 being configured to be moved in said first spatial direction x along the profile units 1.1 irrespective of momentary motion in said second spatial direction y; and wherein the at least one ceiling unit 10 comprises at least one hoist unit 50, wherein the at least one hoist unit 50 comprises a gripping unit 53, wherein the gripping unit 53 is configured to connect and/or to be connected to at least one container 60 are implemented, especially at least one of the following implementations:.

- implementing the guiding arrangement as ceiling suspension arrangement;
- implementing the vehicle as crawler type ceiling unit;
- implementing the connection elements as suspension elements.
- at least one structure 1, 1' extending in at least two spatial directions x, y, wherein the structure 1, 1' comprises a plurality of profile units 1.1 extending in a first spatial direction x, wherein the structure 1, 1' defines at least one structural regularity 1a in a second spatial direction y,

    - at least one vehicle 10, exhibiting a plurality of connection elements 13, 13a, 13b configured for guiding the vehicle 10 and configured for coupling the vehicle 10 to the at least one structure 1, 1' by means of de-/coupling kinematics depending on a relative motion of the vehicle 10 with respect to the structure 1, 1' in at least said second spatial direction y, wherein the connection elements 13, 13a, 13b exhibit at least one element of motion configured for rolling on the profile units 1.1 irrespective of momentary motion in said second spatial direction, enabling

2D-motion of the vehicles 10, wherein the at least one vehicle comprises at least one connection element, wherein the connection element is configured to connect to at least one of the transport cabins; and wherein the guiding arrangement is configured for active motion of the vehicle in said first spatial direction and/or said second spatial direction.

[0163] Figures 24, 25, 25, 26, 27 show a part of a ceiling suspension arrangement 100 for lifting, transferring and lowering containers 60, 60a, 60b, 60d, comprising at least one crawler type ceiling unit 10 especially designed as previously described in Figs. 13a and 13b in detail and a ceiling structure 1 extending in at least two spatial directions x, y, wherein the ceiling structure 1 comprises a plurality of profile units 1.1 extending in a first spatial direction x, wherein the ceiling structure 1 defines in at least an area at least one structural regularity 1a in a second spatial direction y; and wherein the at least one crawler type ceiling unit 10 comprises a plurality of suspension elements 13, 13a, 13b configured for suspending the at least one crawler type ceiling unit 10 and configured for coupling the at least one crawler type ceiling unit 10 to the ceiling structure 1 by means of de-/coupling kinematics during a motion of the at least one crawler type ceiling unit 10 in said second spatial direction y, particularly depending on a relative motion of the at least one crawler type ceiling unit 10 with respect to the ceiling structure 1 in at least said second spatial direction y, especially with the crawler type ceiling unit 10 being configured to be moved in said first spatial direction x along the profile units 1.1 irrespective of momentary motion in said second spatial direction y; and wherein the at least one ceiling unit 10 comprises at least one hoist unit 50, wherein the at least one hoist unit 50 comprises a gripping unit 53, wherein the gripping unit 53 is configured to connect and/or to be connected to at least one container 60.

[0164] The container transported and/or lifted which is shown in Fig. 24 is an air-freight container 60a. This container is lifted transported and/or lifted by a ceiling unit 10 as the ceiling unit 10 is capable of transporting and/or lifting containers of different sizes and with different requirements.

[0165] The container transported and/or lifted which is shown in Fig. 25 is a car-transport container 60b capable of transporting multiple cars 300. This container is lifted transported and/or lifted by a ceiling unit 10 as the ceiling unit 10 is capable of transporting and/or lifting containers of different sizes and with different requirements.

[0166] The container transported and/or lifted which is shown in Fig. 26 is a car-transport container 60c capable of transporting a car 310. This container is lifted transported and/or lifted by a ceiling unit 10 as the ceiling unit 10 is capable of transporting and/or lifting containers of different sizes and with different requirements.

[0167] The container transported and/or lifted which is shown in Fig. 27 is a standard ISO container 60d capable of transporting a variety of items according to the requirements for handling these items, e.g., cooling. This container is lifted transported and/or lifted by a ceiling unit 10 as the ceiling unit 10 is capable of transporting and/or lifting containers of different sizes and with different requirements.

[0168] Figure 28 shows a ceiling suspension arrangement with a ceiling structure 1 extending in at least two spatial directions x, y, wherein the ceiling structure 1 comprises a plurality of profile units extending in a first spatial direction x, wherein the ceiling structure 1 defines in at least an area at least one structural regularity in a second spatial direction y as depicted before.

[0169] The at least one crawler type ceiling unit 1010, 1020, 1030, 3010, 3110, 3111, 3112, 3201, 3202, 4010, 4011 comprises a plurality of suspension elements, especially as described before, configured for suspending the at least one crawler type ceiling unit 1010, 1020, 1030, 3010, 3110, 3111, 3112, 3201, 3202, 4010, 4011, and configured for coupling the at least one crawler type ceiling unit 1010, 1020, 1030, 3010, 3110, 3111, 3112, 3201, 3202, 4010, 4011 to the ceiling structure 1 by means of de-/coupling kinematics during a motion of the at least one crawler type ceiling unit 1010, 1020, 1030, 3010, 3110, 3111, 3112, 32010, 3202, 4010, 4011 in said second spatial direction y, particularly depending on a relative motion of the at least one crawler type ceiling unit 1010, 1020, 1030, 3010, 3110, 3111, 3112, 3201, 3202, 4010, 4011 with respect to the ceiling structure 1 in at least said second spatial direction y, especially with the crawler type ceiling unit 1010, 1020, 1030, 3010, 3110, 3111, 3112, 32010, 3202, 4010, 4011 being configured to be moved in said first spatial direction x along the profile units irrespective of momentary motion in said second spatial direction y; and wherein the at least one ceiling unit 1010, 1020, 1030, 3010, 3110, 3111, 3112, 3201, 3202, 4010, 4011 comprises at least one hoist unit, wherein the at least one hoist unit comprises a gripping unit, wherein the gripping unit is configured to connect and/or to be connected to at least one container.

[0170] As described beforehand, the at least one crawler type ceiling unit 1010, 1020, 1030, 3010, 3110, 3111, 3112, 3201, 3202, 4010, 4011 each can handle, especially lift and transport different containers. The ceiling units 1010, 1020, 1030, 3010, 3110, 3111, 3112, 3201, 3202, 4010, 4011 can be identical or may be designed different with regard to the containers to be handled.

[0171] The gripping unit is configured to connect and/or to be connected to at least one container. To handle different types of containers, different gripping units can be implemented. It is especially useful to connect the ceiling unit to the gripping unit by a connecting means that, comprises a coupling section for easy coupling and decoupling, especially for changing / removing the gripping unit.

[0172] The ceiling suspension arrangement comprises a tracking system, wherein the at least one crawler type

ceiling unit 1010, 1020, 1030, 3010, 3110, 3111, 3112, 3201, 3202, 4010, 4011 and/or the ceiling structure 1 comprises a tracking unit; and/or wherein the at least one crawler type ceiling unit 1010, 1020, 1030, 3010, 3110, 3111, 3112, 3201, 3202, 4010, 4011 comprises at least one sensor from the following group: speed sensor, distance sensor, position measuring sensor, force sensor, acceleration sensor.

[0173] The ceiling suspension arrangement described in Fig. 28 comprises at least one control unit, wherein the at least one control unit is characterized in at least one of the following, particularly based on corresponding sensor data:

- providing for trajectory planning and/or collision avoidance,
- computing actuator signals for the ceiling units 10, particularly to follow a predefined trajectory, and/or to execute driven/driving motion according to a collision avoidance strategy,
- computing actuator signals for the gripping and hoisting motion of the at least one crawler type ceiling unit 10,
- comprising a wireless communication module to provide actuator signals to at least one crawler type ceiling unit 10.

[0174] It is especially useful if the ceiling suspension arrangement comprises a supporting structure for the ceiling structure 1.

[0175] Preferably, the at least one hoist unit of the at least one crawler type ceiling unit 1010, 1020, 1030, 3010, 3110, 3111, 3112, 3201, 3202, 4010, 4011 is configured to lift, transfer and lower a container arrangement of at least two containers, wherein the at least two containers are arranged in a side-by-side and/or superimposed manner.

[0176] In another preferred mode, the ceiling suspension arrangement comprises at least two crawler type ceiling units 1010, 1020, 1030, 3010, 3110, 3111, 3112, 3201, 3202, 4010, 4011, wherein at least two of the at least two crawler type ceiling units 1010, 1020, 1030, 3010, 3110, 3111, 3112, 3201, 3202, 4010, 4011are configured to lift, transfer and lower a container or an arrangement of at least two containers, wherein the at least two containers are arranged in a side-by-side and/or superimposed manner, wherein the gripping units of the at least two crawler type ceiling units 1010, 1020, 1030, 3010, 3110, 3111, 3112, 3201, 3202, 4010, 4011 connect to the container or the arrangement of the at least two containers at least at two different gripping points.

[0177] The ceiling suspension arrangement shown in Figure 18 can be installed according to requirements of a logistics system. It can be arranged above ships 2010, 2020, 2030, 2040 on a seaside 1802, above logistics entities on a landside 1801, e.g. constituting a transfer area 3000 of an overland transport system, above a container storage area 4000 or above a truck/train loading area 5000.

[0178] To allow for enhanced flexibility it is preferred, that at least a part of the ceiling structure 1 is arranged at a height, which is above the height of a container transport ceiling unit and/or container stack and/or freight-carrying ceiling unit.

[0179] It is especially preferred to modify or create a container port comprising at least one ceiling suspension arrangement according to any preceding claim, wherein the at least one ceiling suspension arrangement is configured to load and/or unload at least one container transport ceiling unit and/or transfer containers to freight-carrying ceiling units and/or uninterruptedly transfer containers to a storage yard and/or uninterruptedly transfer at least one container from at least a first container transport ceiling unit to at least a second container transport ceiling unit.

[0180] In an advanced embodiment the ceiling suspension arrangement is enabled for a flexible transport of ceiling units 1010, 1020, 1030, 3010, 3110, 3111, 3112, 3201, 3202, 4010, 4011 to/from and between the ships, 2010, 2020, 2030, 2040, the transfer area 3000, the container storage area 4000 or above the truck/train loading area 5000 especially along transport paths.

[0181] In particular, Figure 28 shows a snapshot of a process for operating the container port. This snapshot shows ceiling units 1010, 1020, 1030, which move items to/from ships ceiling units 3010 which move containers to from and within the transfer area 3000 of the overland transport system, ceiling units 3010, 3110, 3111, 3112, 3113 3201, 3202, currently moving along the overland transport system, wherein the ceiling units 3010, 3110, 3111, 3112, 3113 are arranged as a train 3100 with virtual drawbars.

[0182] The ceiling units 4010, 4011 store containers to the container storage area 4000 and/or retrieve containers from the container storage area 4000.

[0183] The described embodiments of the invention can be adapted to cabins to be transported with predefined upper and/or lower boundaries for their weight and/or size as well to handle transported cabins that can have different sizes, shapes and weights. The size and configuration of the ceiling arrangement and its components for transporting the cabins is partly predefined, especially by the dimension and strengths of profiles implemented in the structure. Other parts of the ceiling arrangement can be modified more easily, for example by providing vehicles with connection elements which are adapted to the cabins to be transported to the structure. Furthermore, the number of vehicles connected to the suspension structure can be modified.

[0184] It is appropriate to add protocol functionality to the control components.

[0185] The embodiments shown here are only examples of the present invention and must therefore not be understood as limiting. Alternative embodiments contemplated by the skilled person are equally encompassed by the scope of protection of the present inven-

tion.

List of reference signs:

[0186]

1 ceiling structure
1a structural regularity or raster defined by the ceiling structure
1.1 profile unit, especially T-profile resp. T-rail
1.2 wheel tread
1.3 power rail
10 crawler type vehicle
10' crawler type vehicle
11 drive unit (motor, actuator), especially chain drive
11.1 drive mechanism
11a first drive
11b further (second) drive
11c further (third) drive
12 circumferential track
12a first circumferential track, especially comprising a chain
12b second circumferential track
12p parallel section / linear section of the track
12r redirection section / curved section of the track
13 connection element resp. chain element
13a first connection element resp. chain element (first type)
13b further connection element (second type, especially mirror-inverted)
13.1, 13.2 first pulley, second pulley
13.3 wheel
13.4 current collector resp. power-slider (conductive slider for energy transfer)
13.5 lever arm
13.6 protruding section / suspension arm
13.7 protruding axial section (guiding bolt or shaft)
14 casing15 longitudinal connecting element, especially chain element
15a closed loop of interrelated connection elements, especially chain
16 counter bearing
16.1 wheel, pulley
17 housing or chassis
18 gear unit
18a further gear unit
19 energy storage unit
20 de-/coupling kinematics
30 central control unit
31 decentral (individual) control unit
35 communicating unit (e.g. near filed, mobile network, LAN, LP-WAN, SigFox, NBIoT)
36 transmitter (active or passive), especially for transmitting locating signals
40 sensor arrangement
41 sensing device
43 sensor
45 positioning system, e.g. based on near filed, mobile network, LAN, LP-WAN, SigFox, NBIoT
50 hoist unit
51 traction mechanism, especially rope winch
53 transmission means, especially rope
60 external load, especially object or individual
61 package, e.g. including consumables, food, postal items
70 identification feature referring to vehicle, especially code (e.g. including a number)
71 identification feature referring to package, especially code (e.g. including a number)
80 digital twin referring to a respective vehicle
81 digital twin referring to a respective package
82 database
90 accommodating cavity
100 suspension arrangement
300 cars
310 car
1801 landside
1802 seaside
2001 passengers
3100 train
4000 storage area
5000 loading area
1010, 1020, 1030, 3010,, 3110, 3111, 3112, 3201, 3202, 4010, 4011 crawler type ceiling units
2010, 2020, 2030, 2040 ships
3010, 3110, 3111, 3112, 3113 ceiling units
4010, 4011 ceiling units
9001, 9002 tracks
9700, 9701, 9703 transport cabins
9600 track changing arrangement
9703 another position
9801 first orientation
9802 intermediary orientation
9803 another orientation
9900 platform
19001, 19002, 19003, 19004, 19005, 19006, 19007 cabins
20001,20002,20002,20003,20004,20005,20006,20007 cabins
21000, 22000, 23001, 23002, 9501, 9500, 95001, 9502, 9503 containersG13.1 first guiding point or axis (coupling the first track and the connection element)
G13.2 second guiding point or axis (coupling the second track and the connection element)
P10 energy charging point/position
P13 contacting/bearing point/area of the connection element with the ceiling structure
P60 attachment point
XZa shape/contour of the first circumferential track
XZb shape/contour of the second circumferential track
y12a predefined first longitudinal positions
y12b predefined second longitudinal positions
y13 longitudinal extension of lever arm
x first spatial direction: direction of longitudinal ex-

tension of profile units
y second spatial direction: longitudinal direction resp. alignment of the circumferential tracks
z third spatial direction, especially vertical direction

Claims

1. Automatable system for a transport of cabins, especially outdoors, **characterized in that** a guiding arrangement for transporting the transport cabins is arranged, wherein the guiding arrangement comprises

   - at least one structure 1, 1' extending in at least two spatial directions x, y, wherein the structure 1, 1' comprises a plurality of profile units 1.1 extending in a first spatial direction x, wherein the structure 1, 1' defines at least one structural regularity 1a in a second spatial direction y,
   - at least one vehicle 10, exhibiting a plurality of connection elements 13, 13a, 13b configured for guiding the vehicle 10 and configured for coupling the vehicle 10 to the at least one structure 1, 1' by means of de-/coupling kinematics depending on a relative motion of the vehicle 10 with respect to the structure 1, 1' in at least said second spatial direction y, wherein the connection elements 13, 13a, 13b exhibit at least one element of motion configured for rolling on the profile units 1.1 irrespective of momentary motion in said second spatial direction, enabling 2D-motion of the vehicles 10, wherein the at least one vehicle comprises at least one connection element, wherein the connection element is configured to connect to at least one of the transport cabins; and wherein the guiding arrangement is configured for active motion of the vehicle in said first spatial direction and/or said second spatial direction.

2. Automatable system for the transport of transport cabins according to claim 1, wherein the at least one vehicle is a vehicle which comprises means for providing for decoupling kinematics during a motion of the vehicle in said second spatial direction, especially with the vehicle being configured to be moved in said first spatial direction along the profile units irrespective of momentary motion in said second spatial direction.

3. Automatable system for the transport of transport cabins according to claim 1 or 2, wherein the vehicle/s 10 exhibit/s at least two circumferential tracks 12, 12a, 12b, wherein the connection elements 13, 13a, 13b are attached to the circumferential tracks 12, 12a, 12b at predefined longitudinal positions corresponding to the structural regularity 1a, wherein the circumferential tracks 12, 12a, 12b respectively define a specific path of circumferential motion of the respective connection elements 13, 13a, 13b, thereby providing for de-/coupling kinematics during a motion of the vehicle 10 in said second spatial direction y

4. Automatable system for the transport of transport cabins according to any of the preceding claims, wherein the connection elements 13, 13a, 13b are connected via a spur gear to a drive unit, and/or wherein the wheels of the connection elements 13, 13a, 13b exhibit gear grooves .

5. Automatable system for the transport of transport cabins 100 according to any of the preceding claims, wherein the structure 1, 1' exhibits power rails integrated into the profile units 1.1 and the vehicle/s 10 exhibit/s means for electrically connecting to the power rails

6. Automatable system for the transport of transport cabins 100 according to any of the preceding claims, wherein the vehicle/s 10 exhibit/s at least two independently controllable motors , wherein a first motor is configured for driving a motion in the first spatial direction x and a second motor is configured for driving a motion in the second spatial direction y.

7. Automatable system for the transport of transport cabins according any of the preceding claims, wherein the guiding arrangement is located above at least a part of the storing arrangement, wherein the crawler type vehicle can move above the at least one part of the storing arrangement and wherein the vehicle is equipped with at least one connection element for lifting cabins from the storing arrangement to a position located above the storing arrangement.

8. Automatable system for the transport of transport cabins according to claim 7, wherein the storing arrangement is at least partly grid structured.

9. Automatable system for the transport of transport cabins according to any of the claims 7 or 8, wherein the cabins are arranged in stacks.

10. Automatable system for the transport of transport cabins according to claim 9, wherein the cabins are arranged in stacks and at least some stacks contains identical goods objects.

11. Automatable system for the transport of transport cabins according to any of the claims 9 or 10, wherein at least a part of the stacks are separated from other stacks by at least one separation element..

12. Automatable system for the transport of transport cabins according to any of the preceding claims, wherein the storing arrangement contains a plurality of storage positions accessible from at least one lateral side of the storing arrangement, wherein in each of the storage positions at least one cabin can be transported and wherein the guiding arrangement is located at least at a lateral part of the storing arrangement, wherein the vehicle can move parallel to the at least one part of the storing arrangement and wherein the vehicle is equipped with at least one connection element for lifting cabins from the storing arrangement to a position located on the side of the storing arrangement.

13. Method of using an Automatable system for the transport of transport cabins , according to any of the preceding claims, wherein a route-planning tool plans a path for at least one vehicle connected to at least one connection element and moves along at least one suspension structure between transfer positions and storage positions, especially taking into account at least momentary positions and paths of at least one other vehicle also coupled to the at least one structure wherein the vehicle moves omnidirectionally along the at least one suspension structure 1, 1', especially allowing for (fast) passing maneuvers thus increasing the number of transportations.

14. Computer implemented method for route-planning for an Automatable system for the transport of transport cabins, especially for an Automatable system for the transport of transport cabins 100 according to any of the claims 1 to 9, the method comprising the following steps:

- receiving a route-planning tool request to plan a path from a starting transfer position to a destination transfer position from a vehicle 10 or a group of synchronized vehicles 10,
- obtaining and verifying position information of at least one other vehicle 10 by sending a request to the at least one other vehicle 10, receiving a current position, and comparing the current position with the predicted positions of the vehicles 10, wherein the prediction takes into account momentary positions and/or measured data of the vehicles 10, and a planned route for the vehicles 10,
- planning the path for the vehicle 10 or the group of synchronized vehicles 10 from the starting transfer position to the destination transfer position by solving an optimization problem, minimizing the traveling time taking into account path length, potential wait time of each path, and predicted positions of other vehicles 10 to avoid collisions and/or increase the number of transportations between transfer positions.

15. Logistics system, wherein the logistics systems contains at least one automatable system for the transport of transport cabins for the storing of cabins in a storing arrangement according to any of the claims 1 to 11.

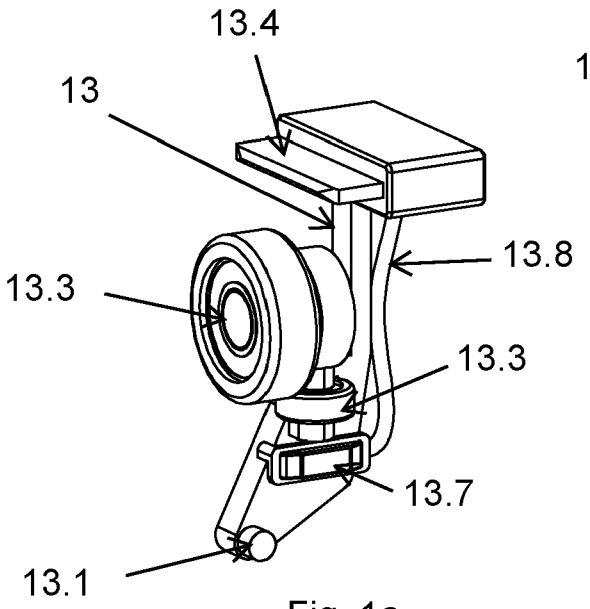


Fig. 1a

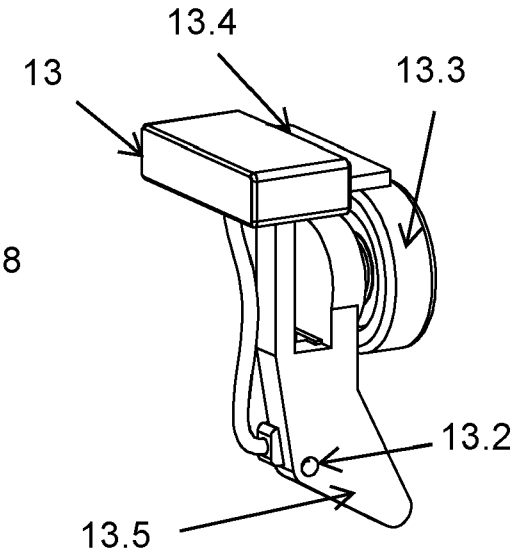


Fig. 1b

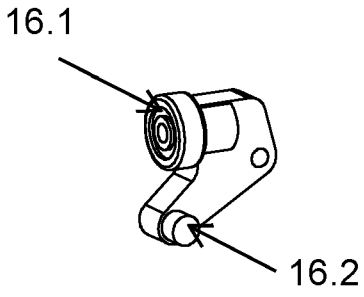


Fig. 1c

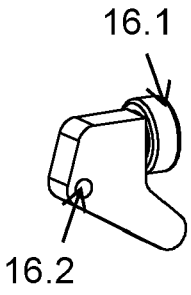


Fig. 1d

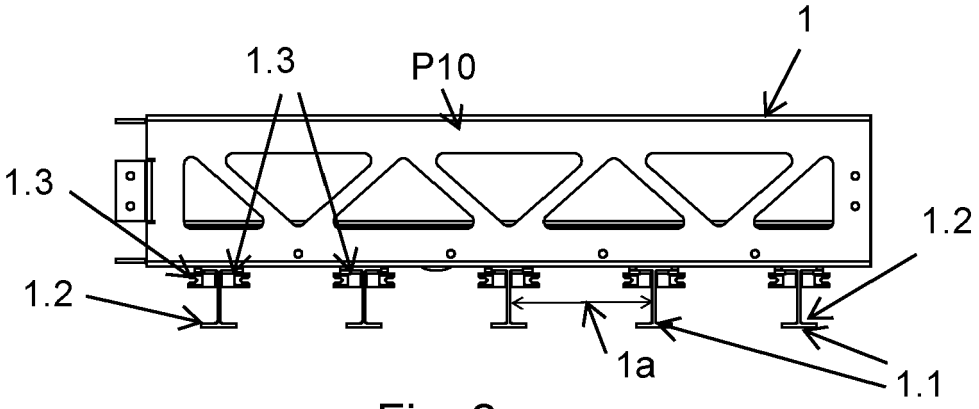


Fig. 2a

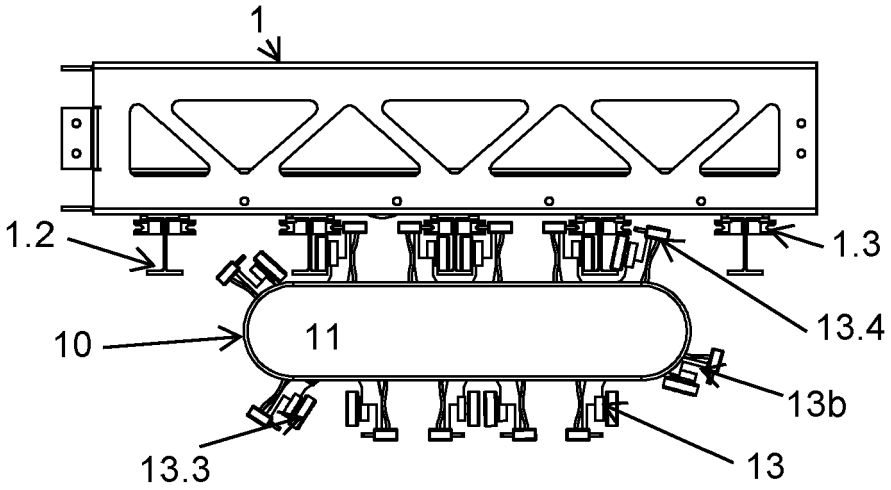


Fig. 2b

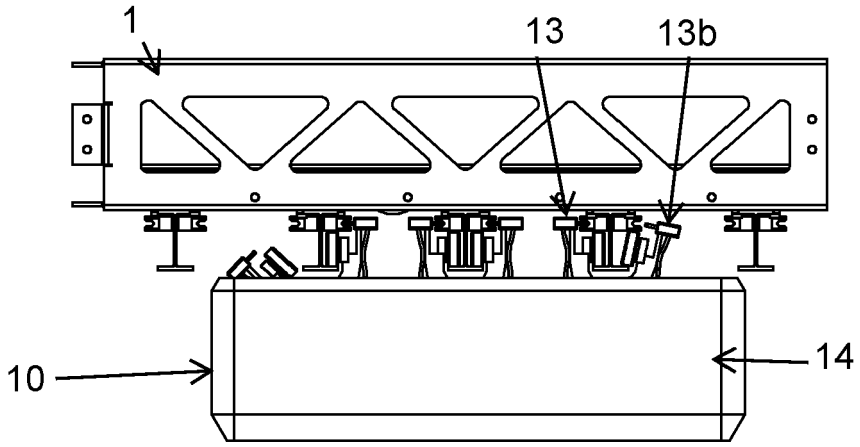


Fig. 2c

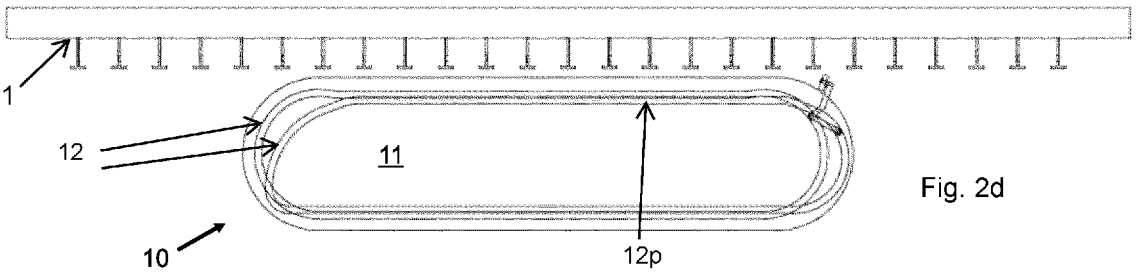


Fig. 2d

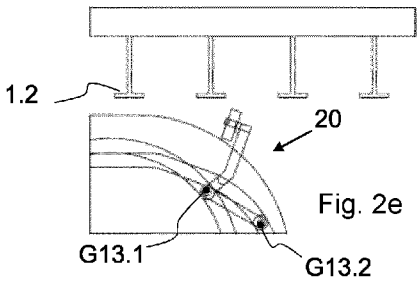


Fig. 2e

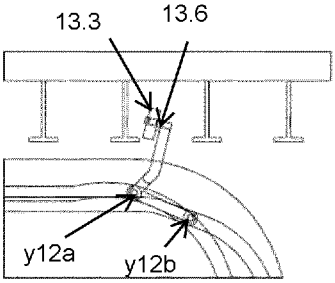


Fig. 2f

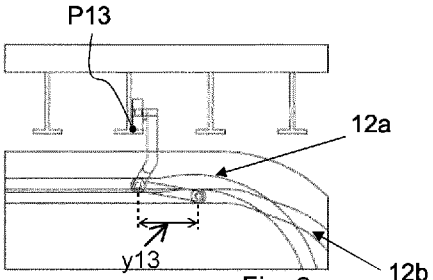


Fig. 2g

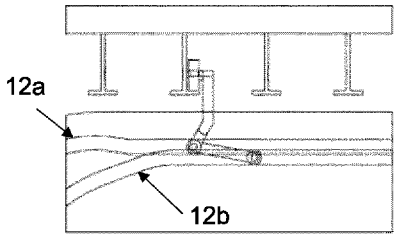


Fig. 2h

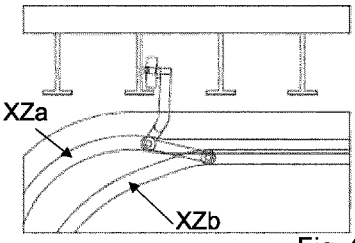


Fig. 2i

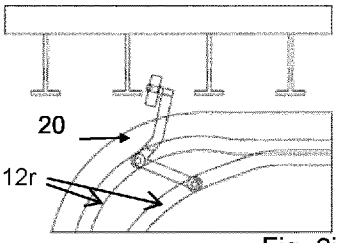


Fig. 2j

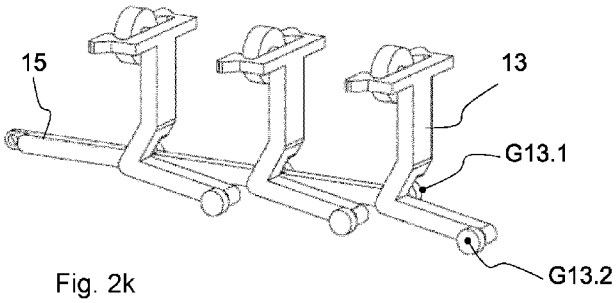


Fig. 2k

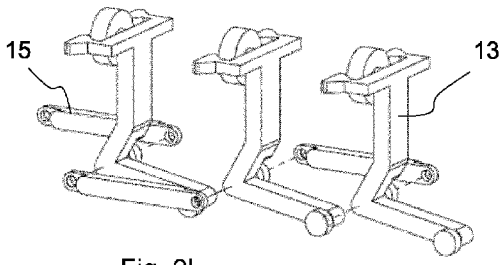


Fig. 2l

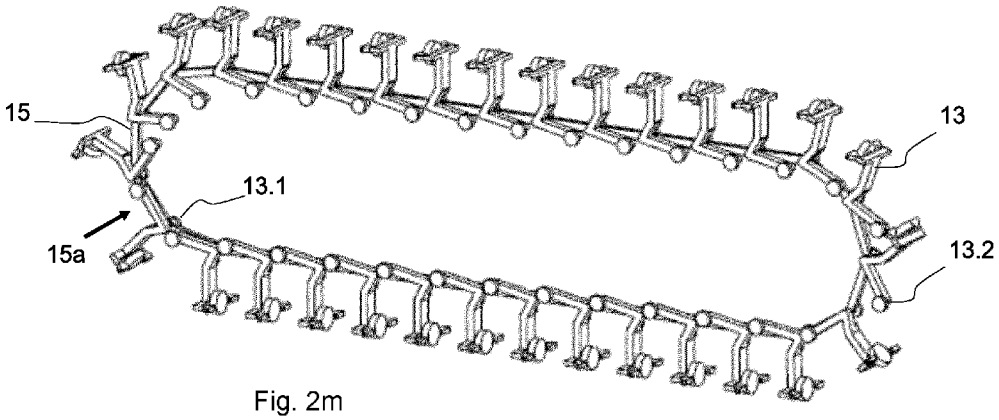


Fig. 2m

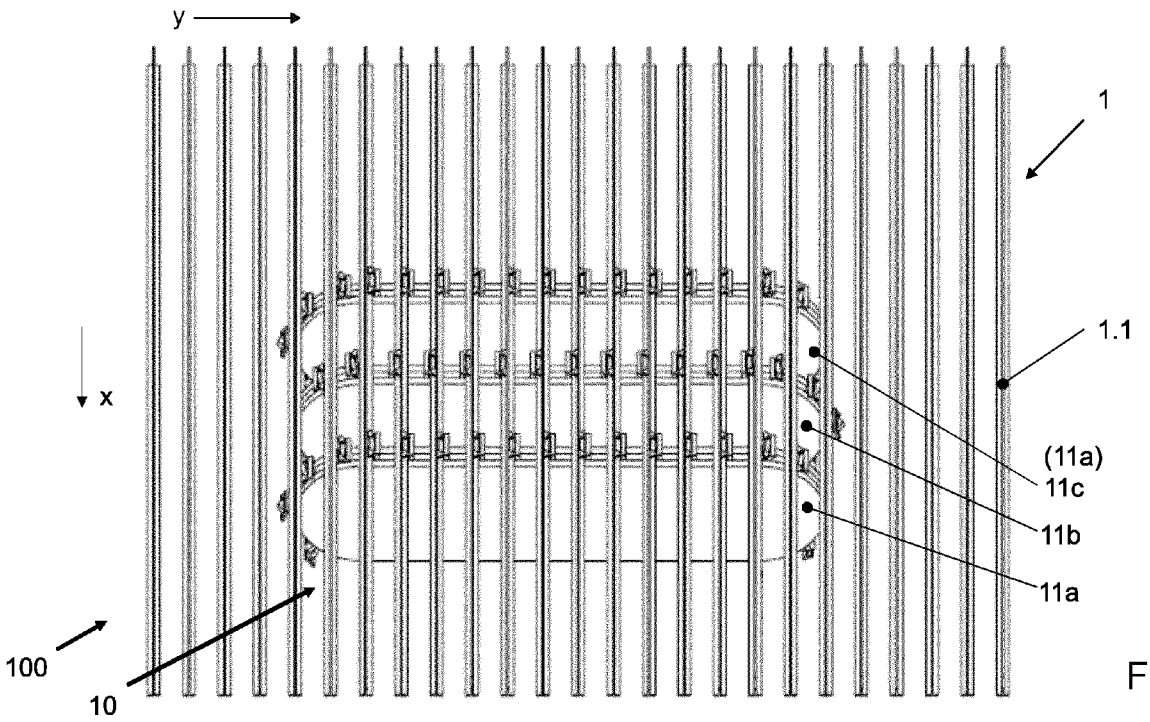


Fig. 2n

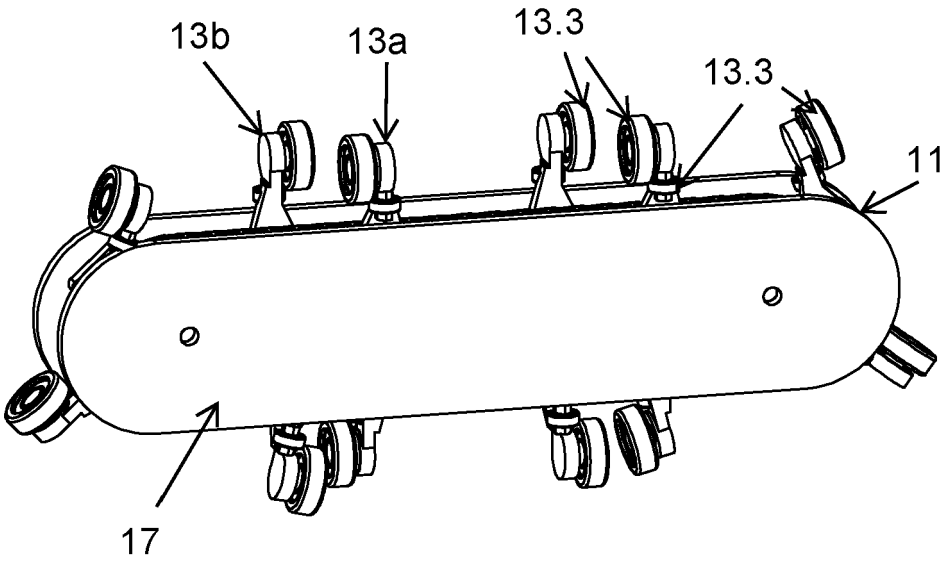


Fig. 3a

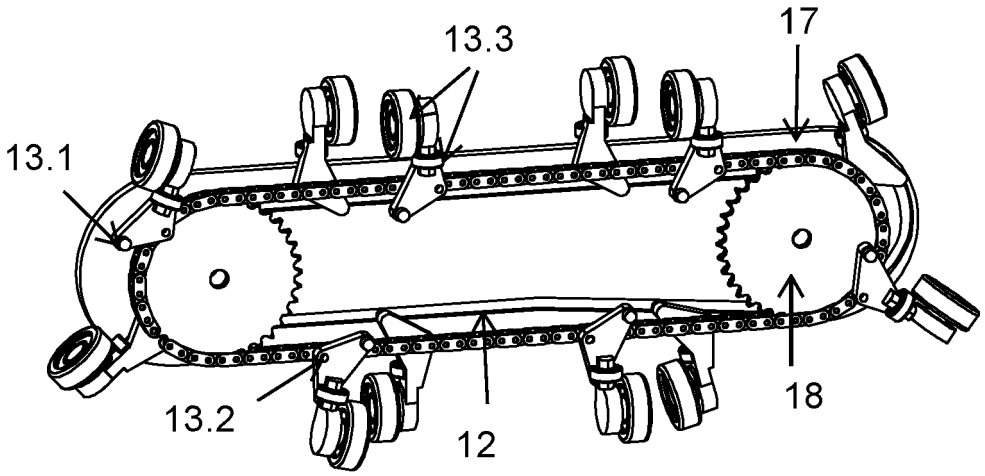


Fig. 3b

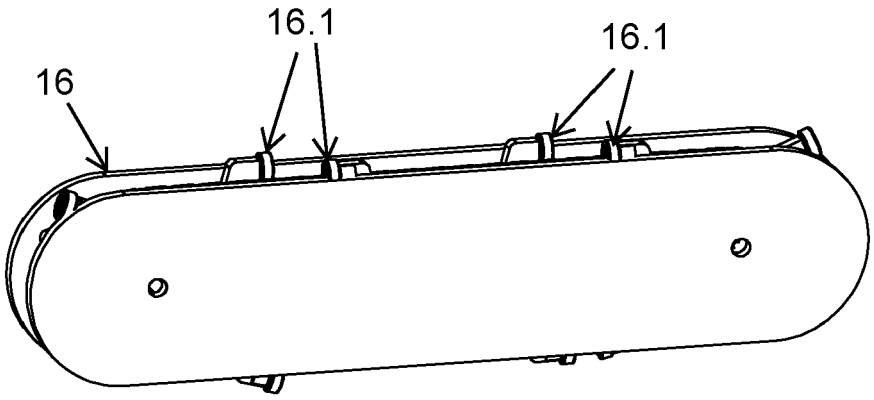


Fig. 3c

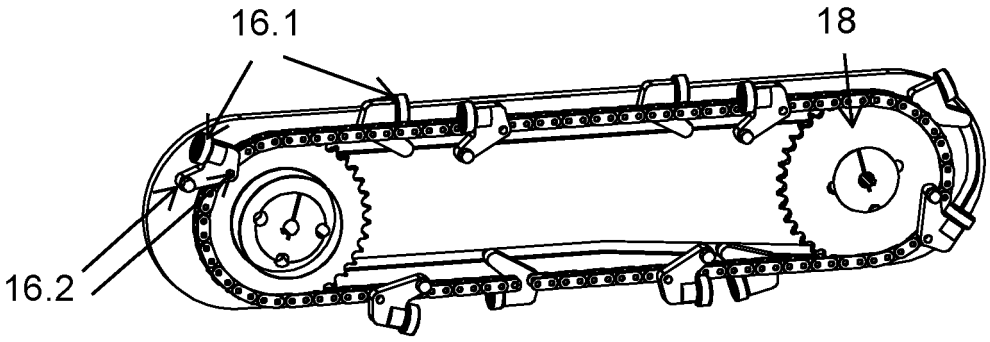


Fig. 3d

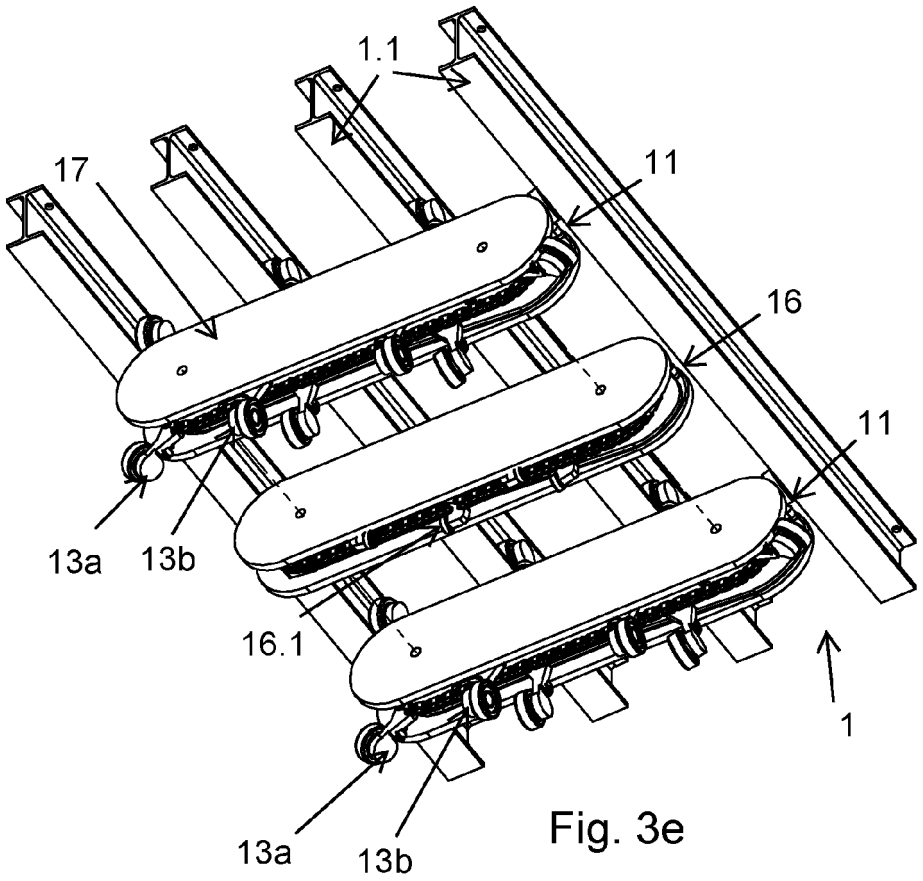


Fig. 3e

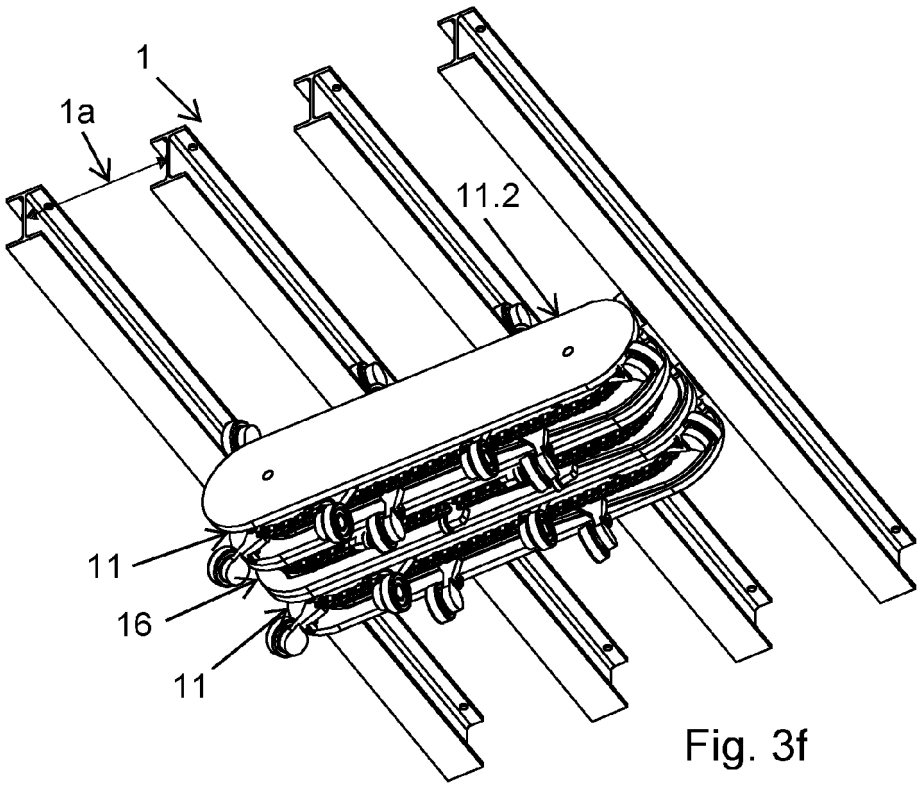


Fig. 3f

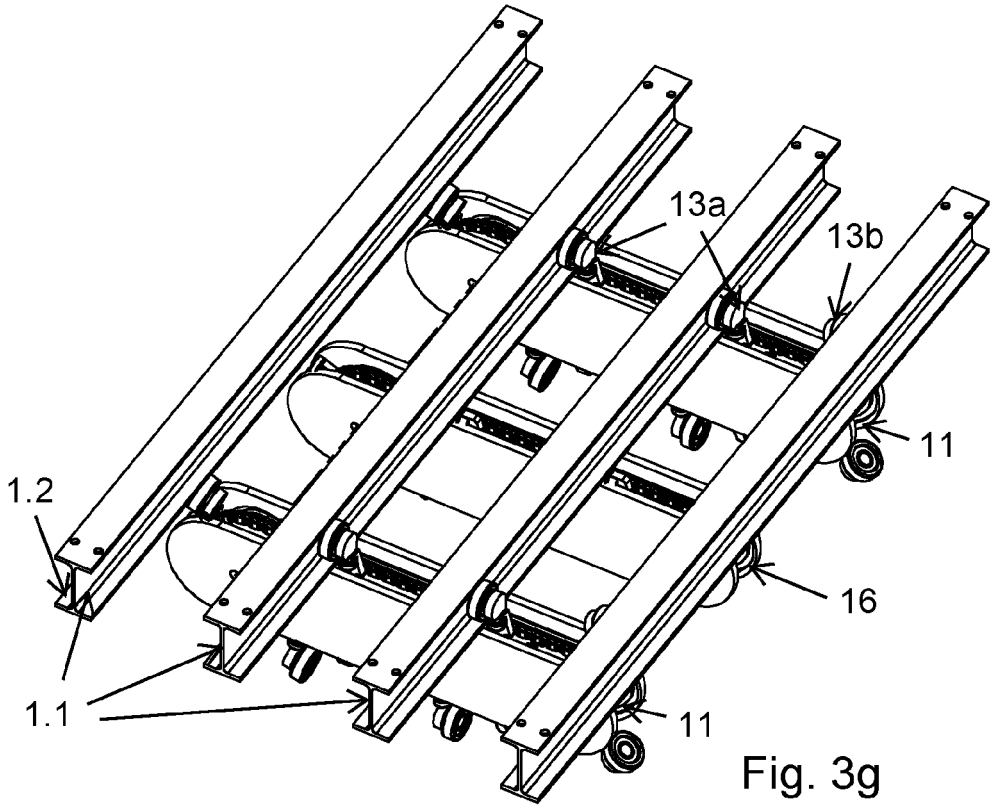


Fig. 3g

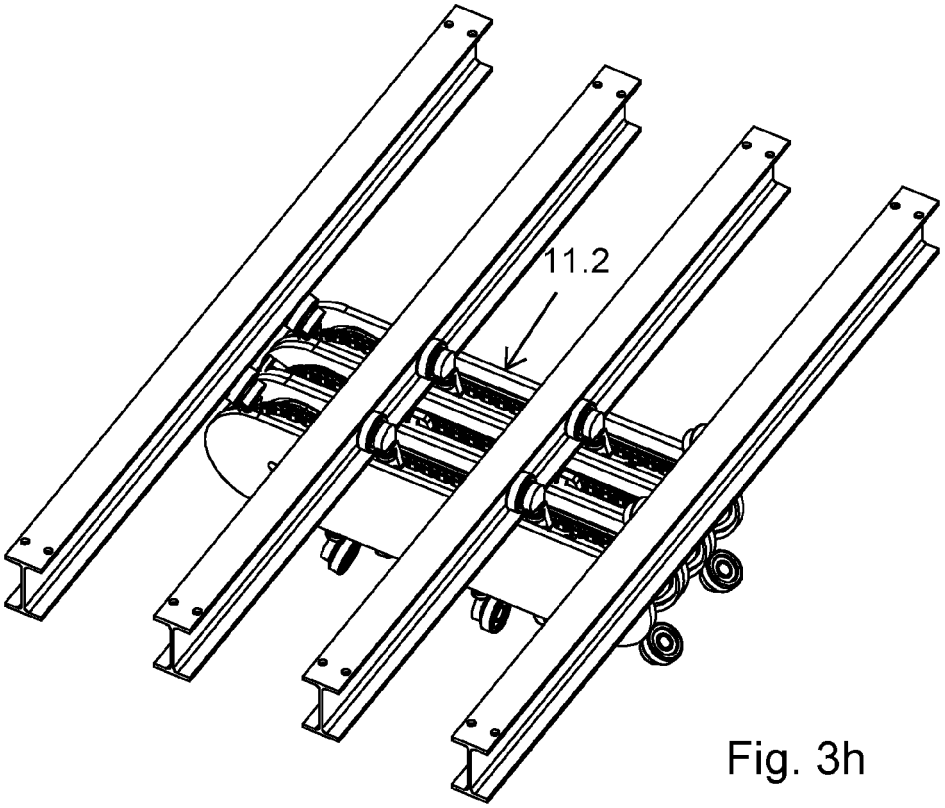


Fig. 3h

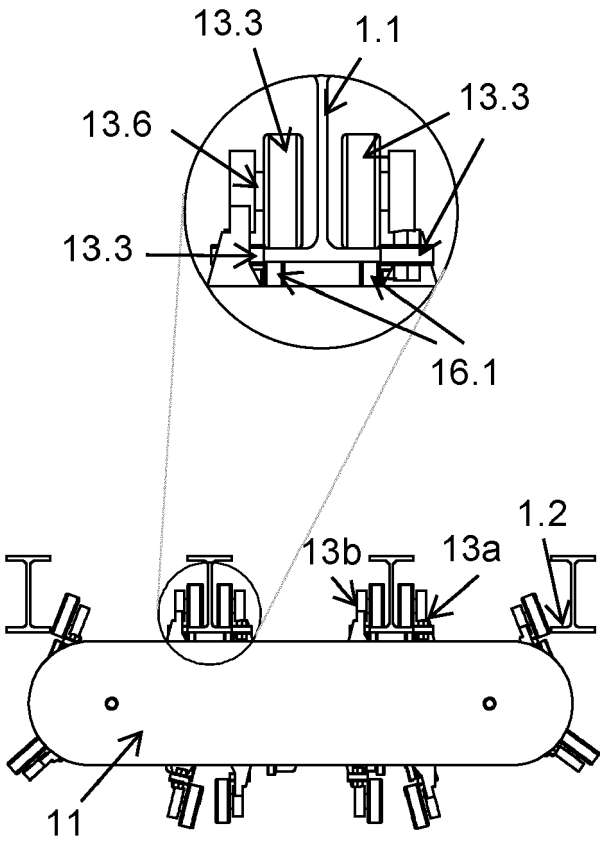


Fig. 3i

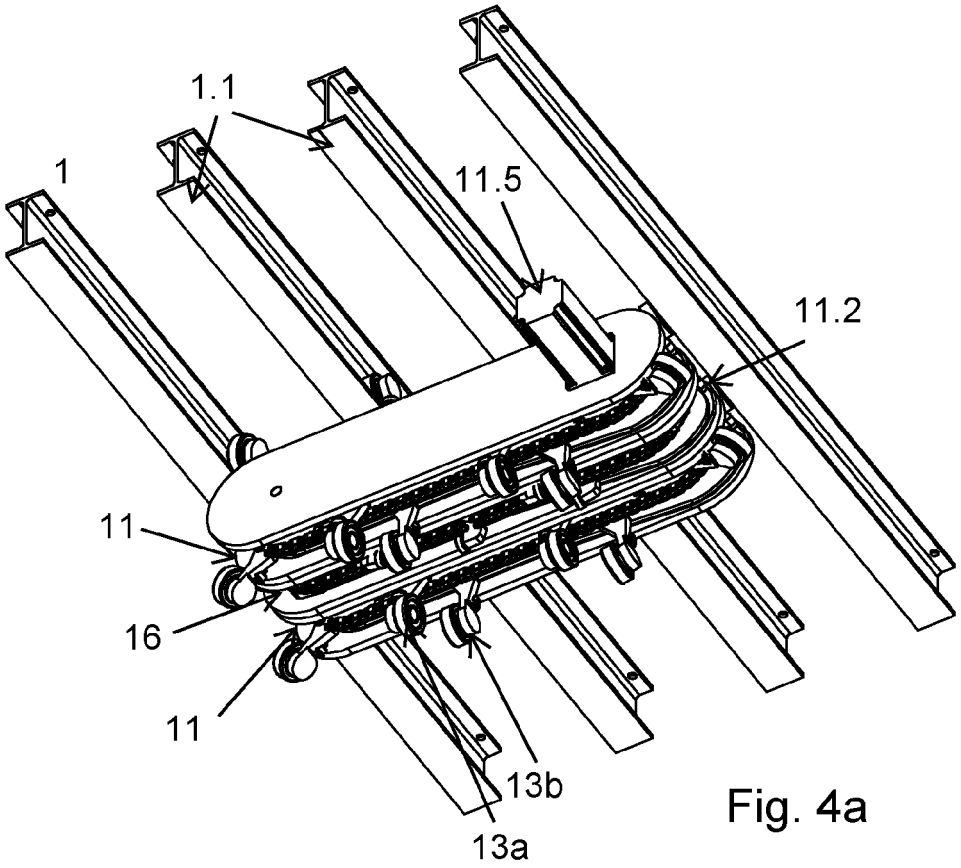


Fig. 4a

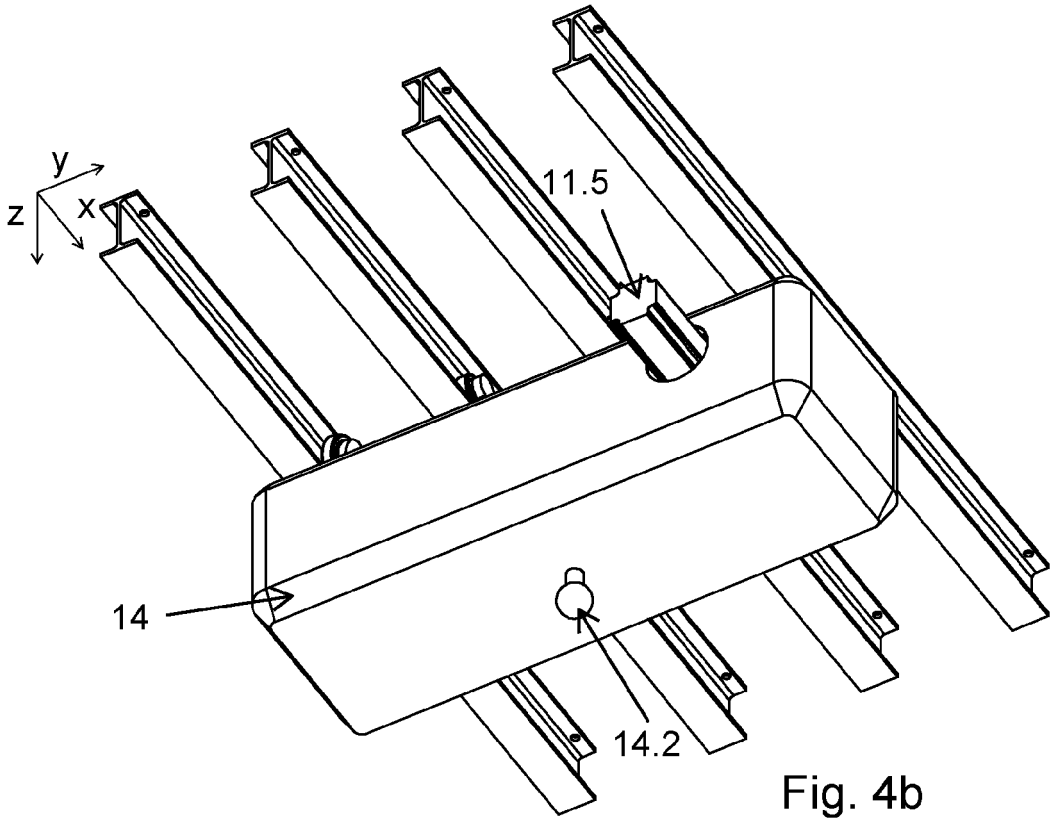


Fig. 4b

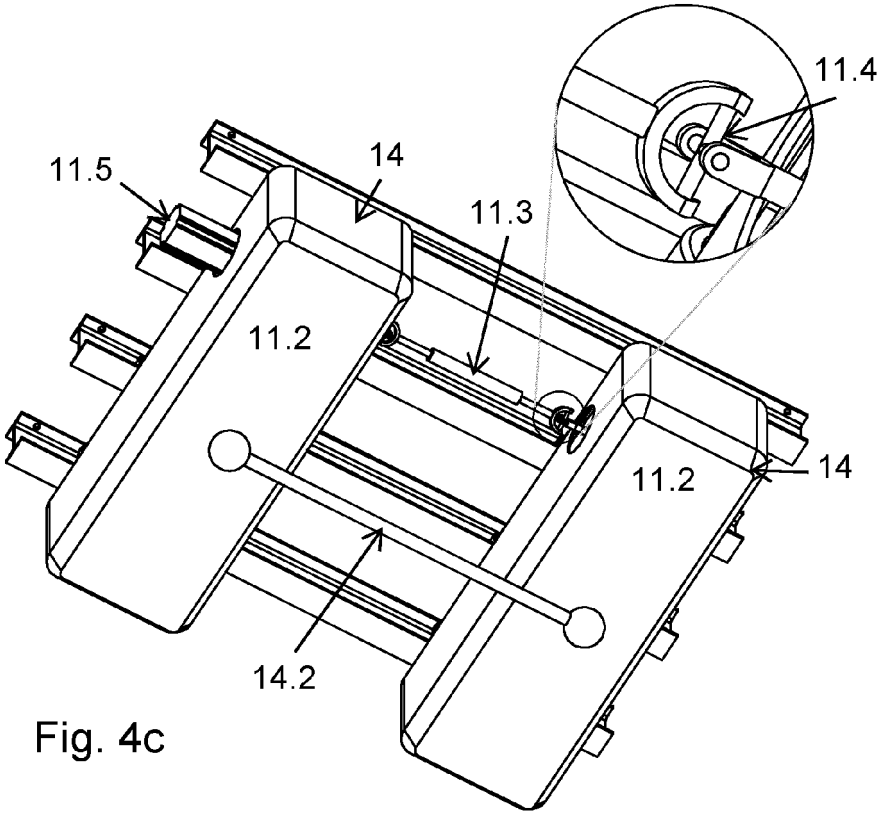

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Fig. 4c

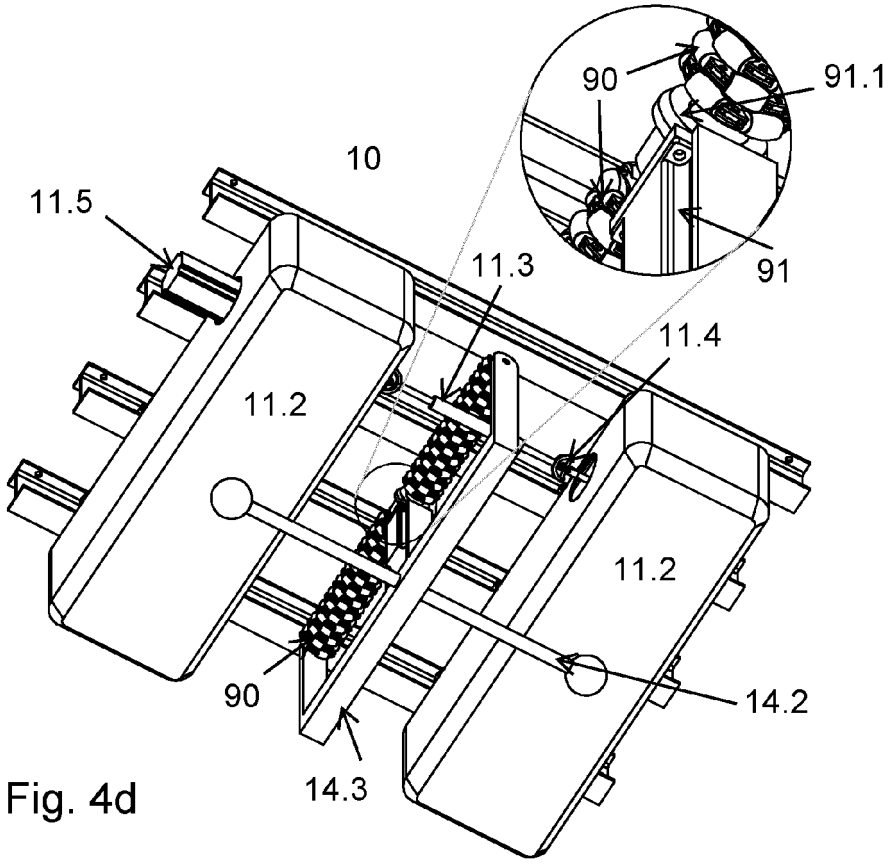

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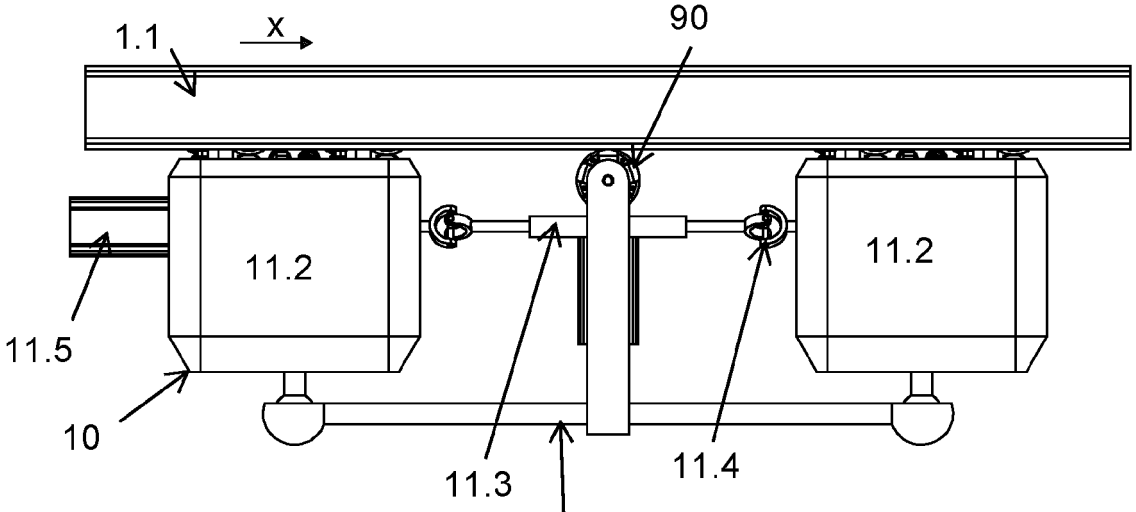

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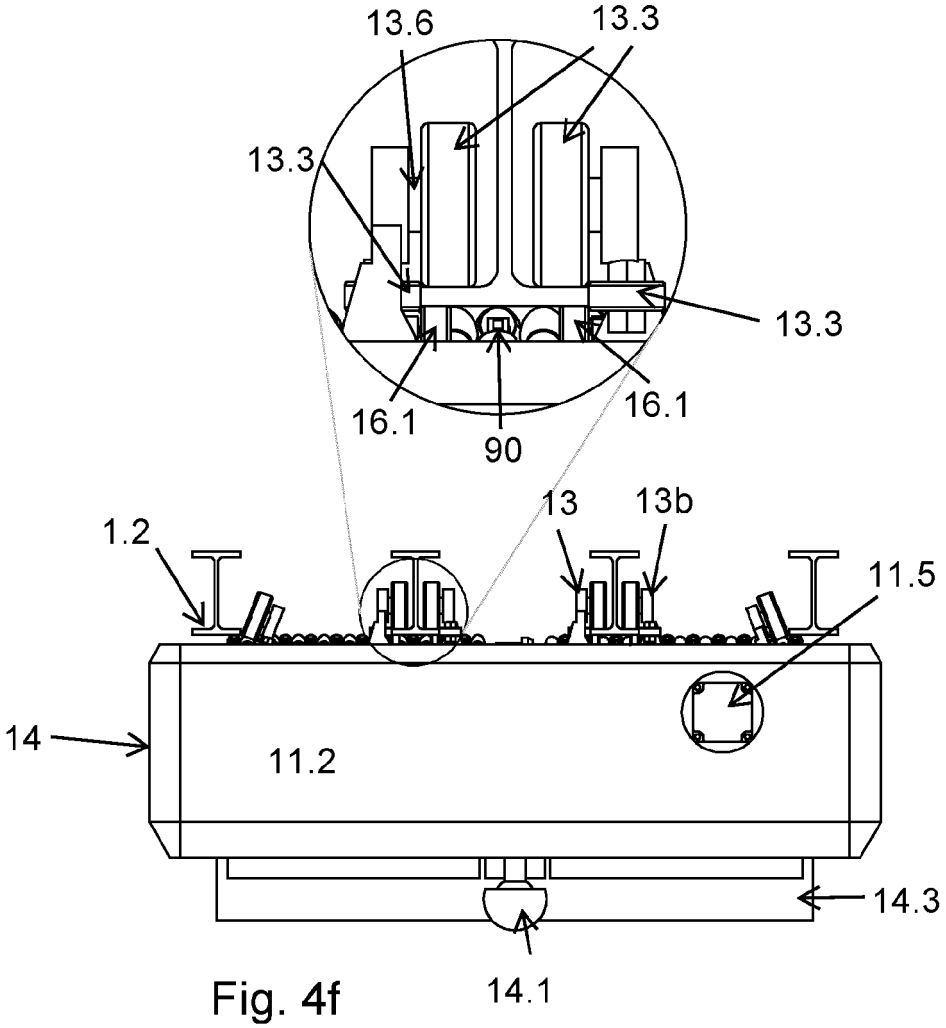

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14.3
14.1

Fig. 4f

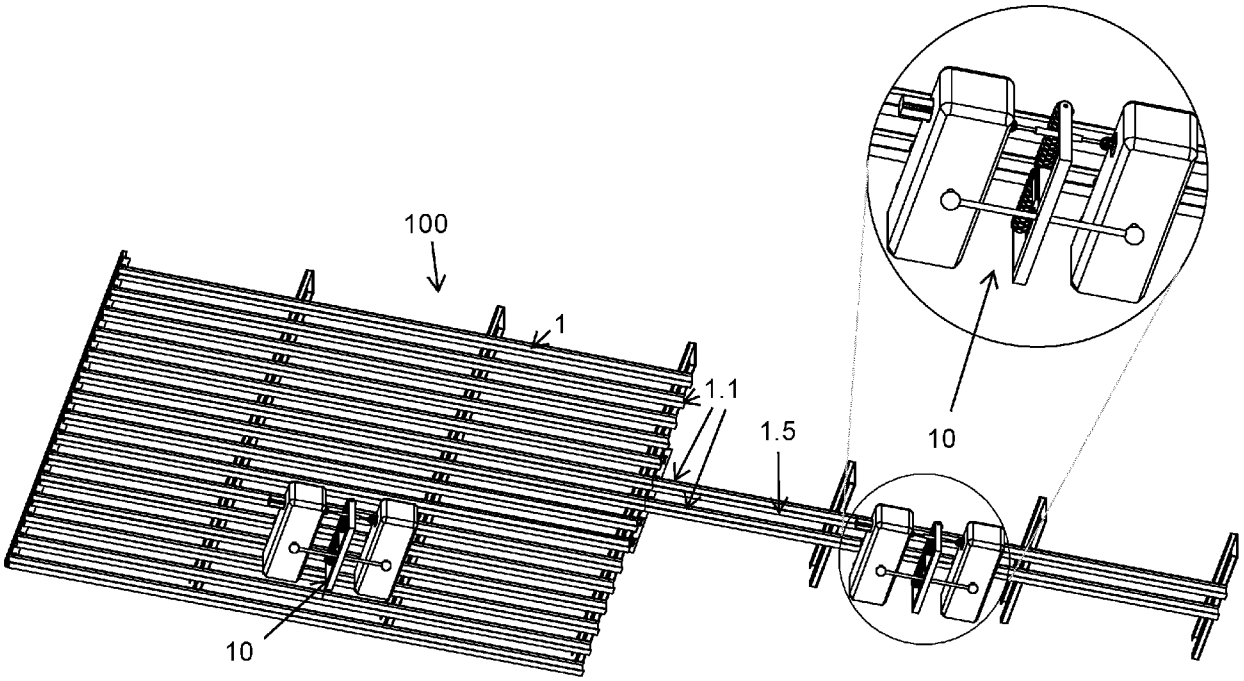


Fig. 5a

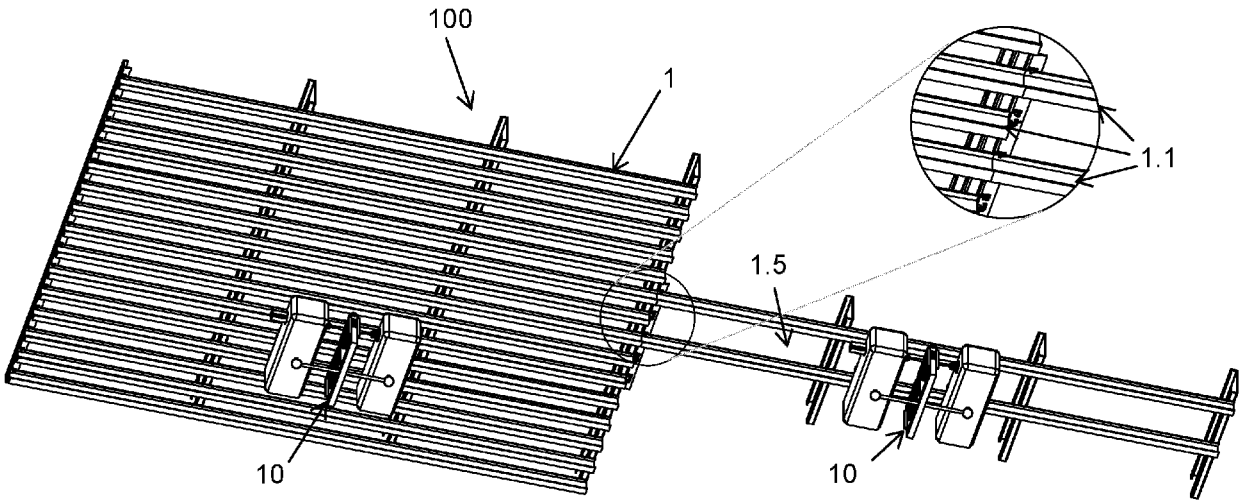


Fig. 5b

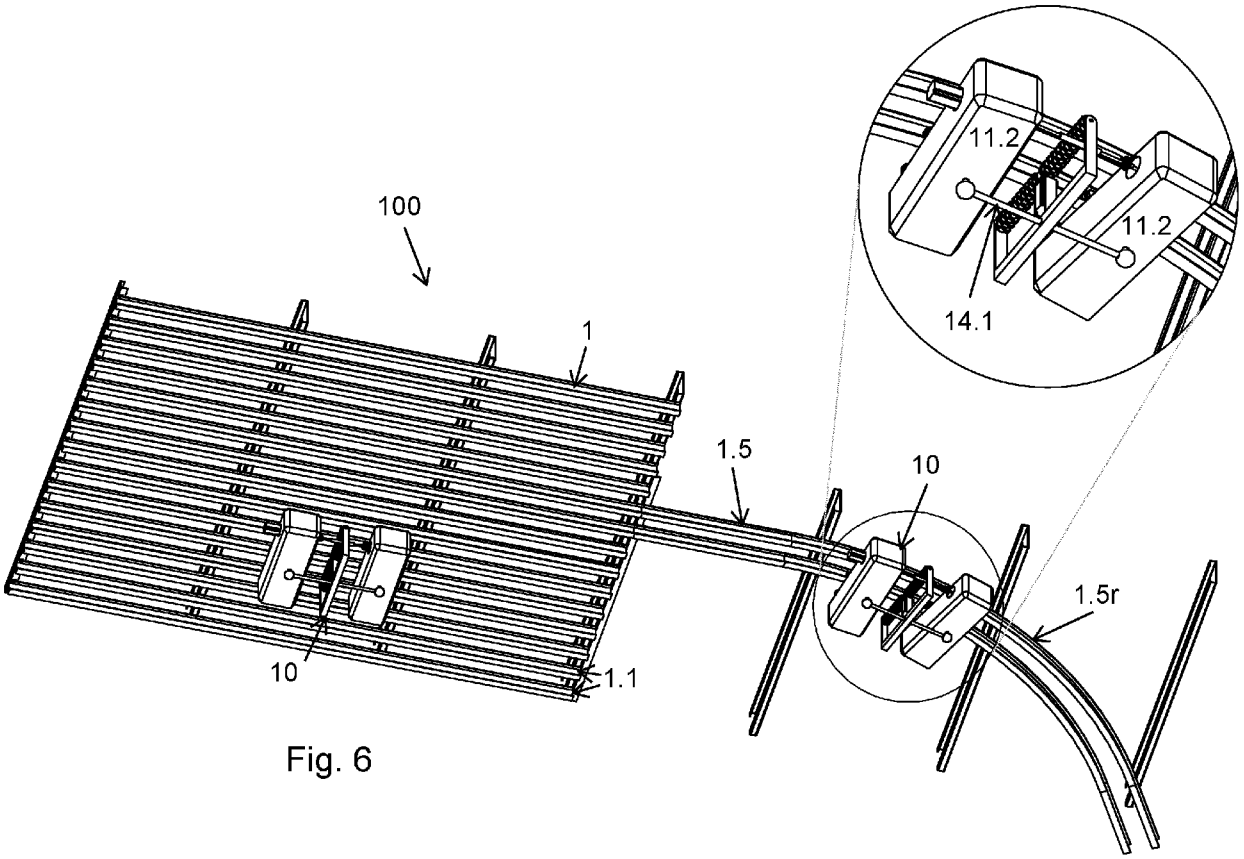


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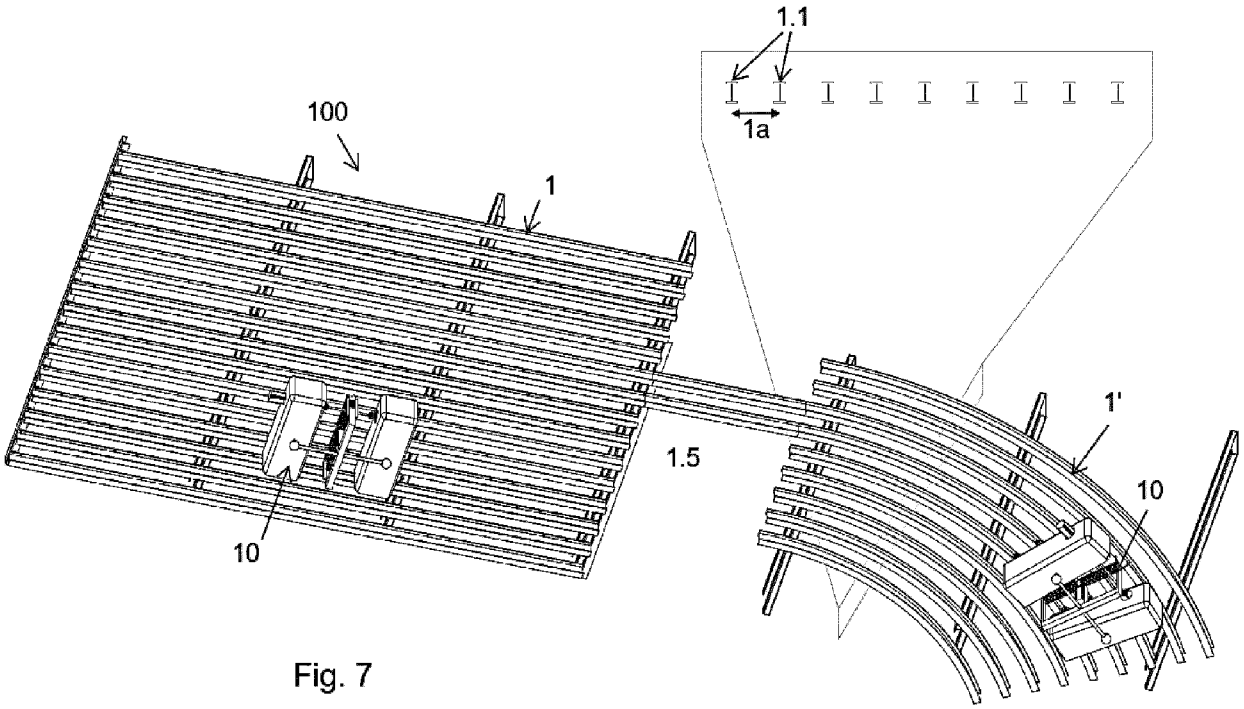


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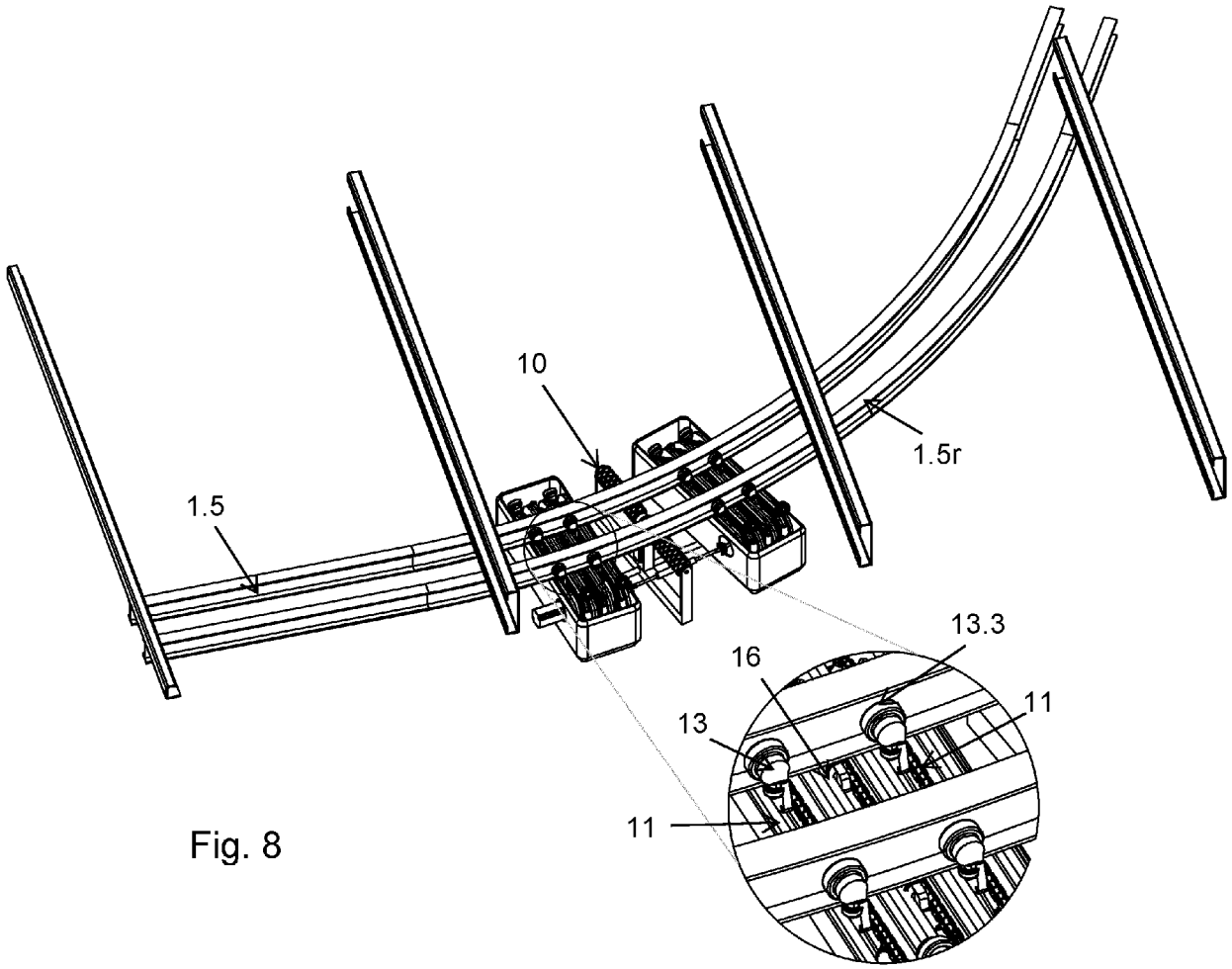


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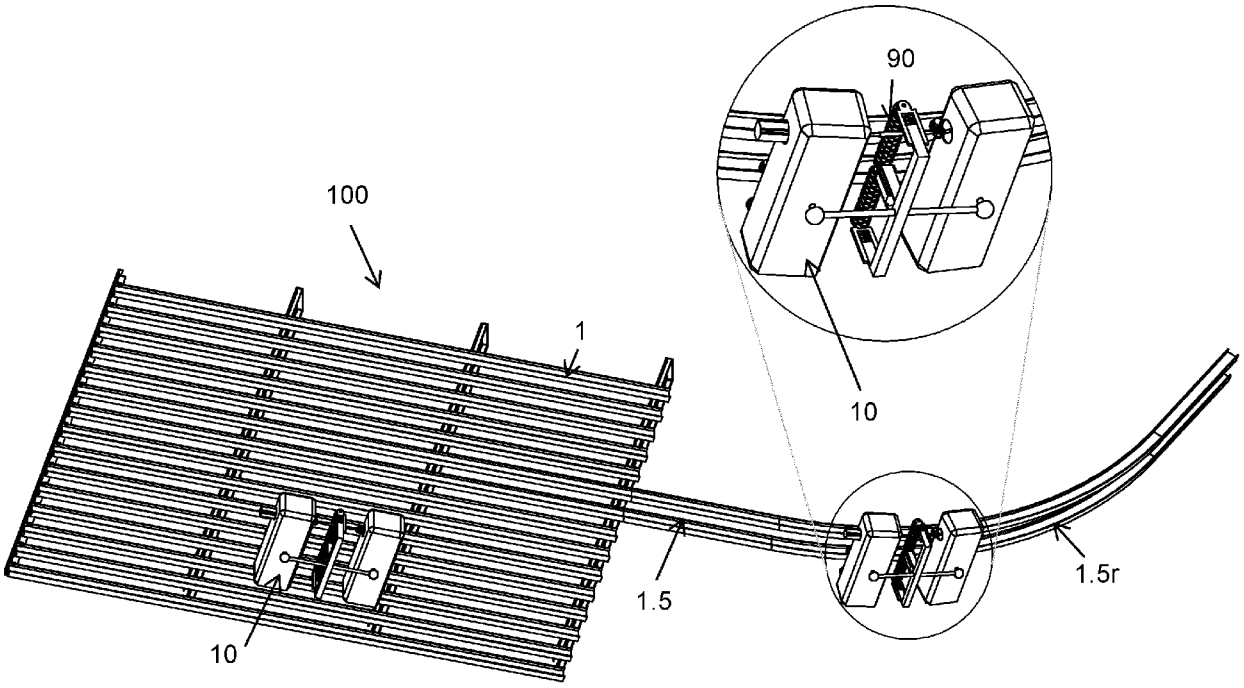


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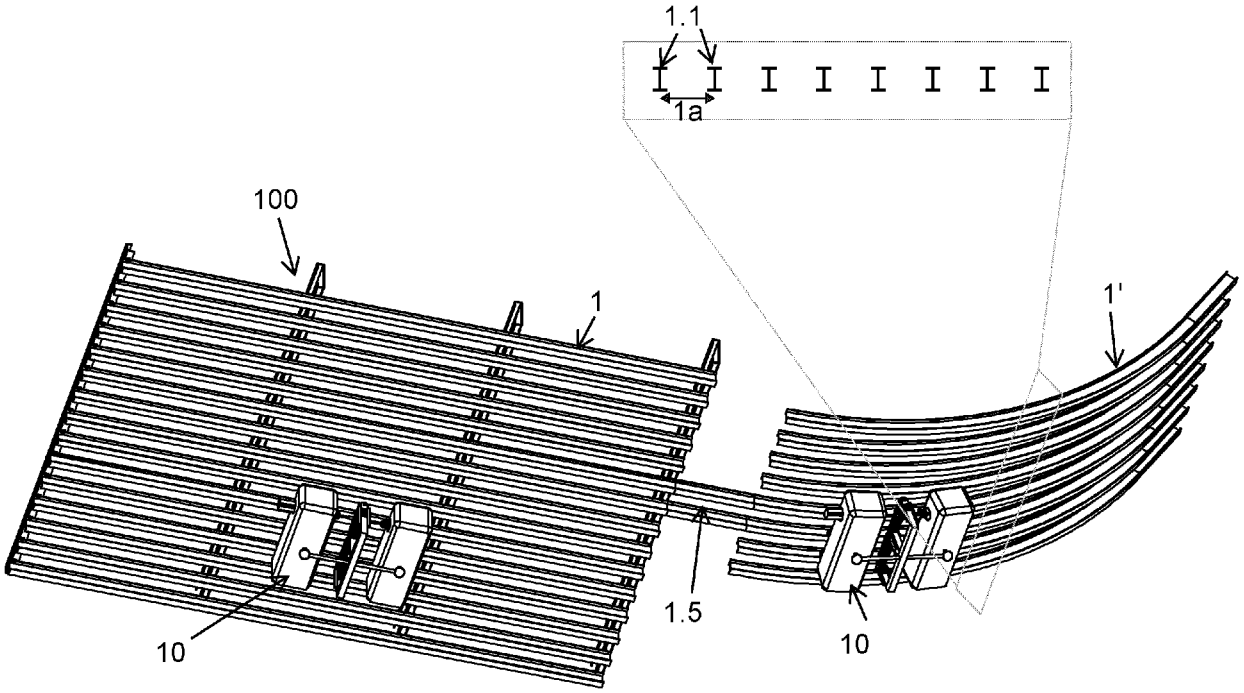


Fig. 10

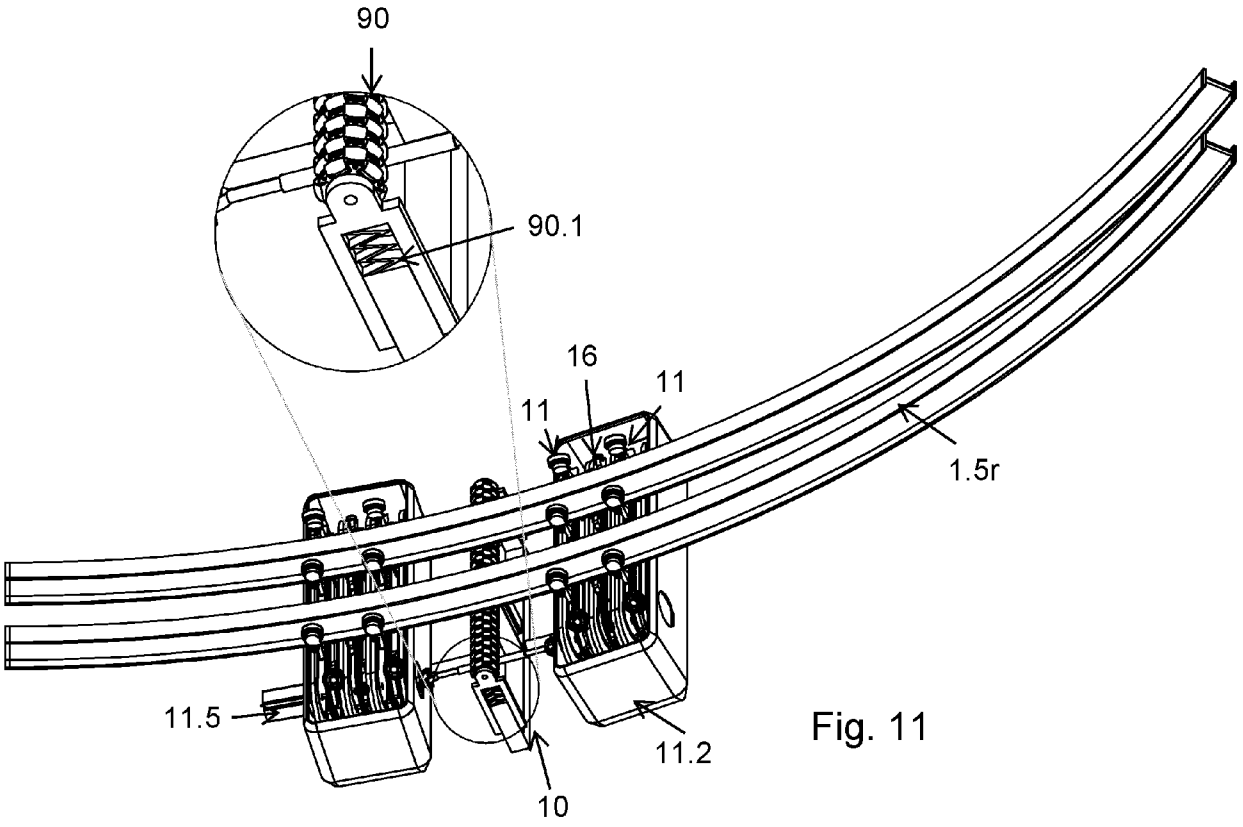


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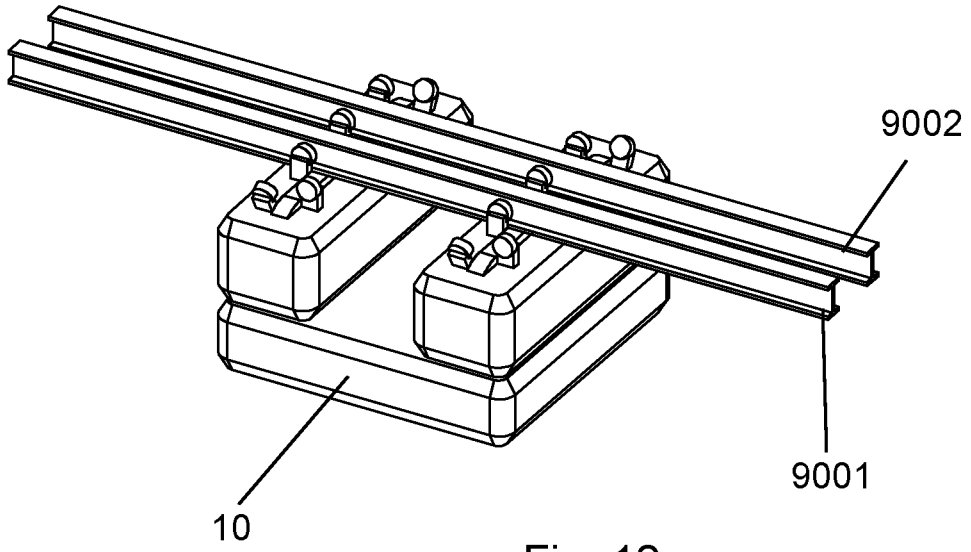


Fig. 12 a

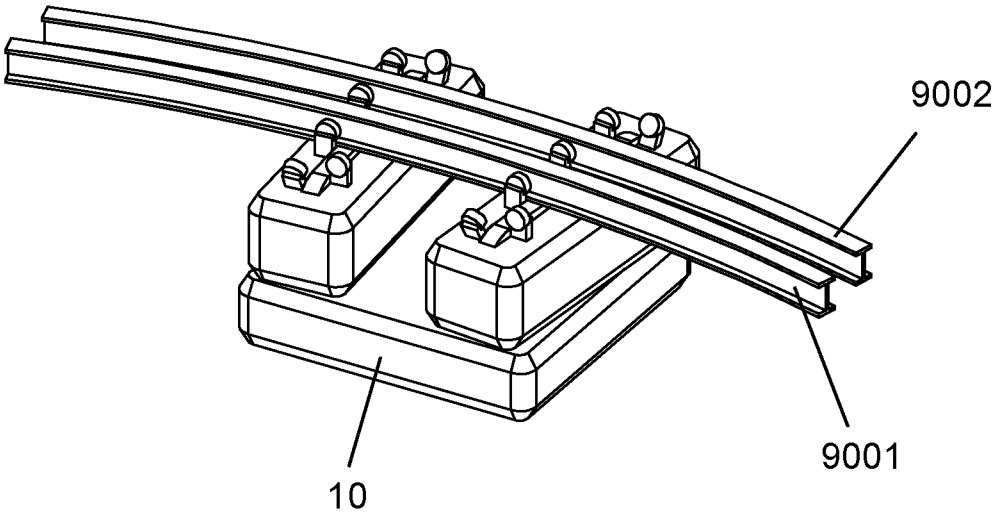


Fig. 12 b

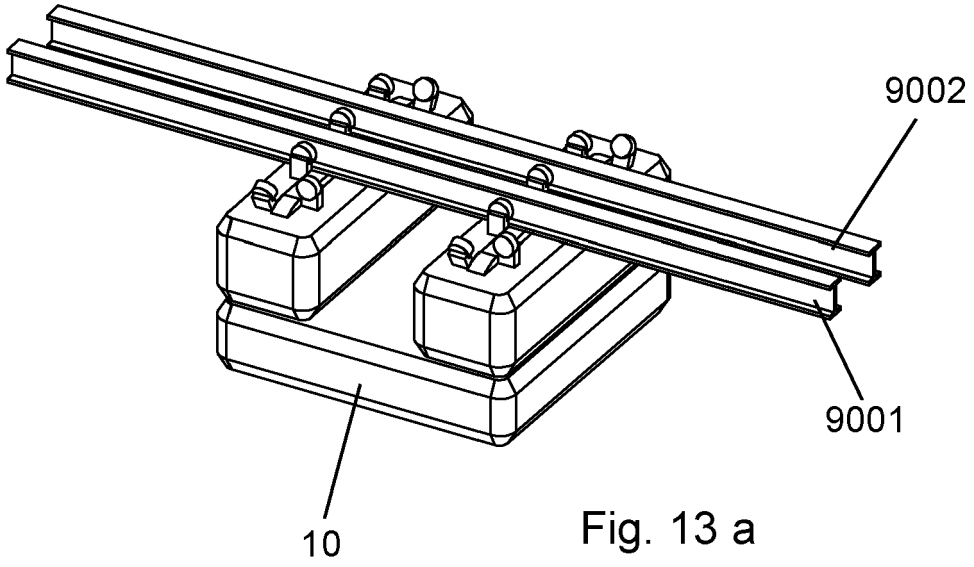


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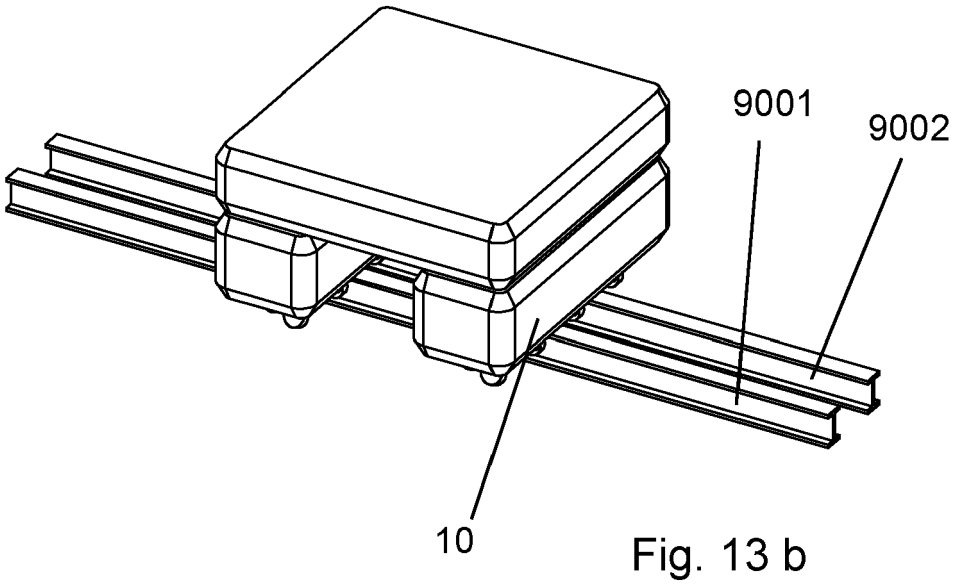


Fig. 13 b

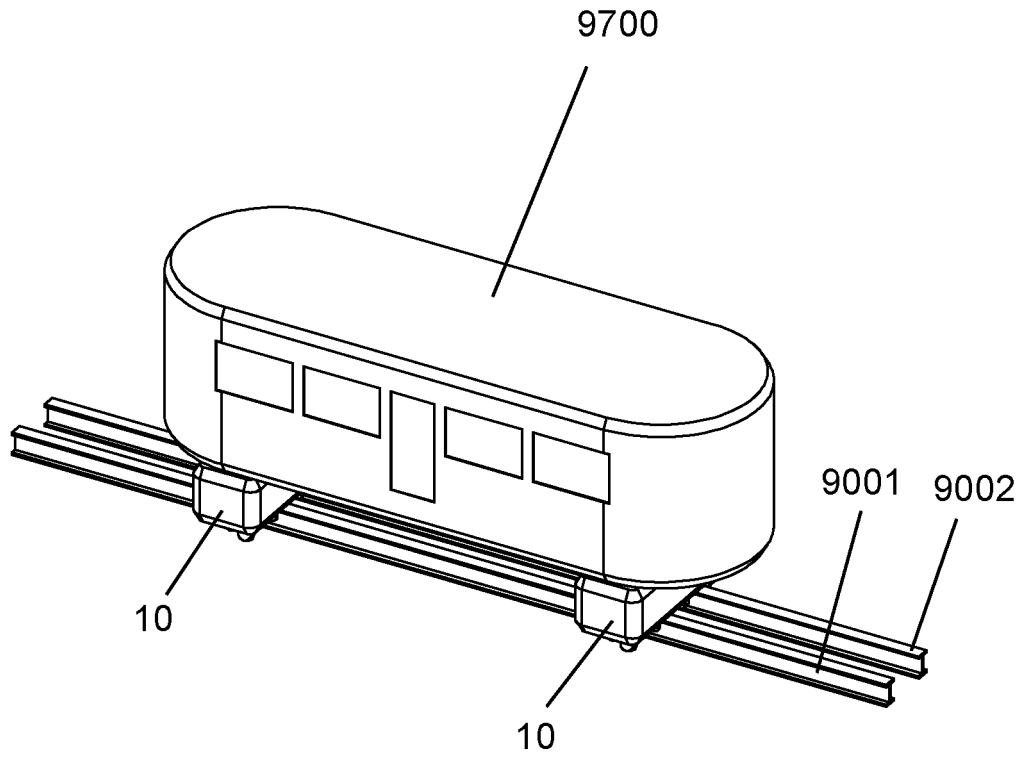


Fig. 14 a

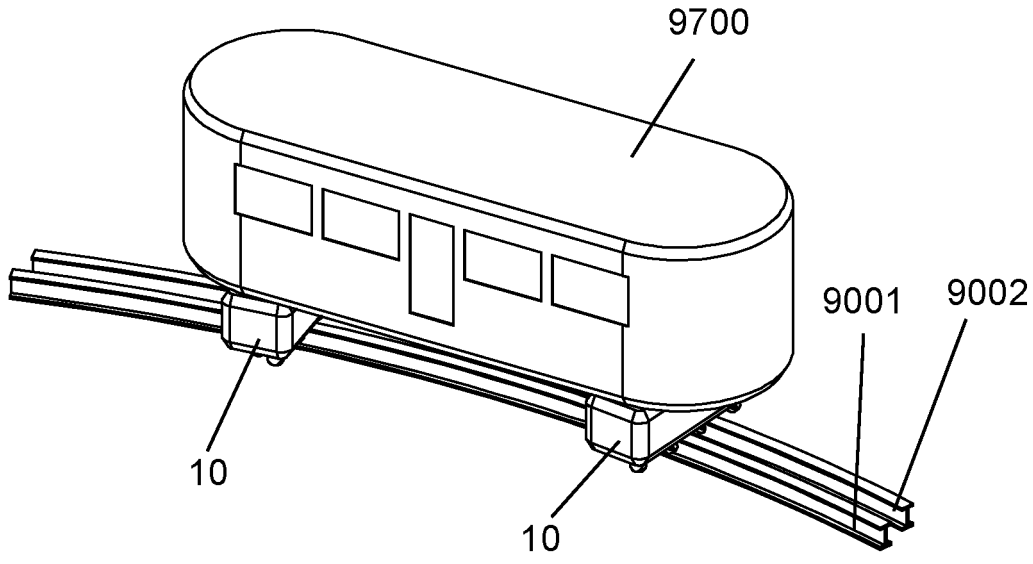


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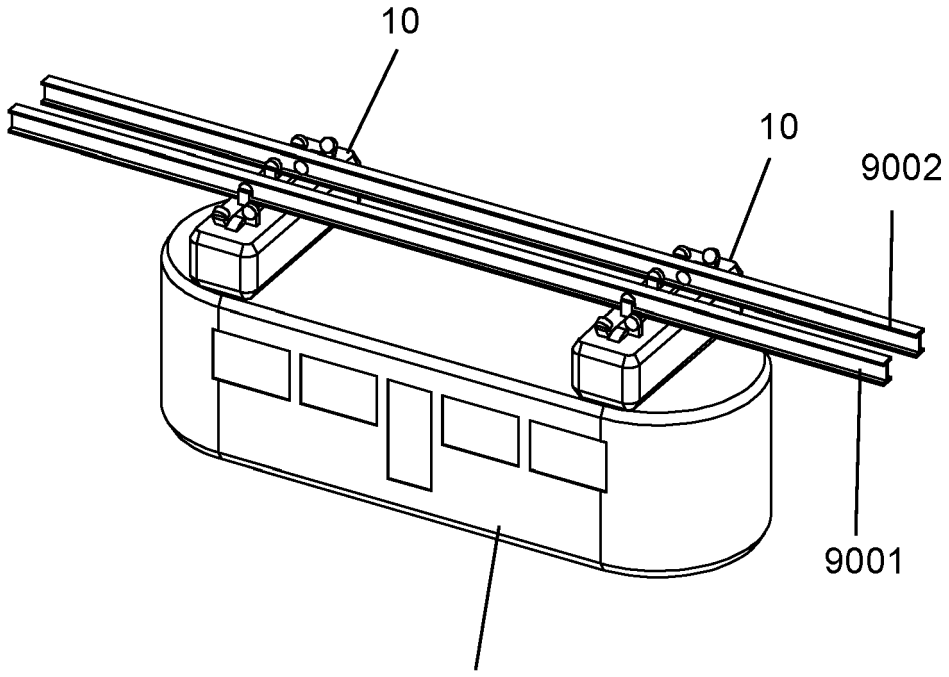


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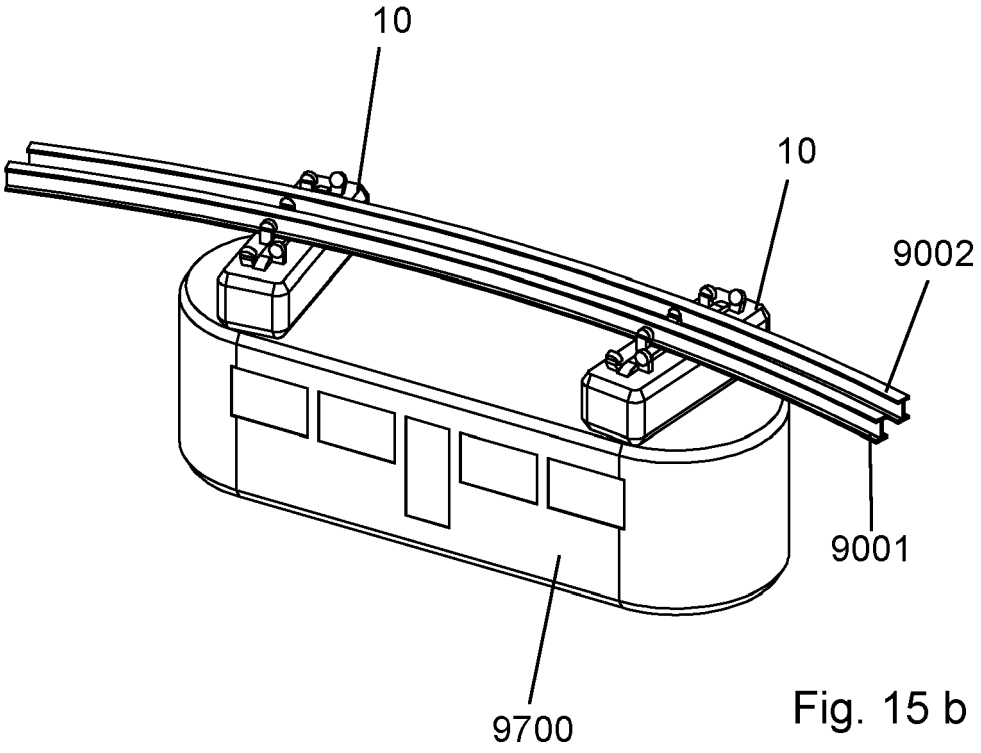


Fig. 15 b

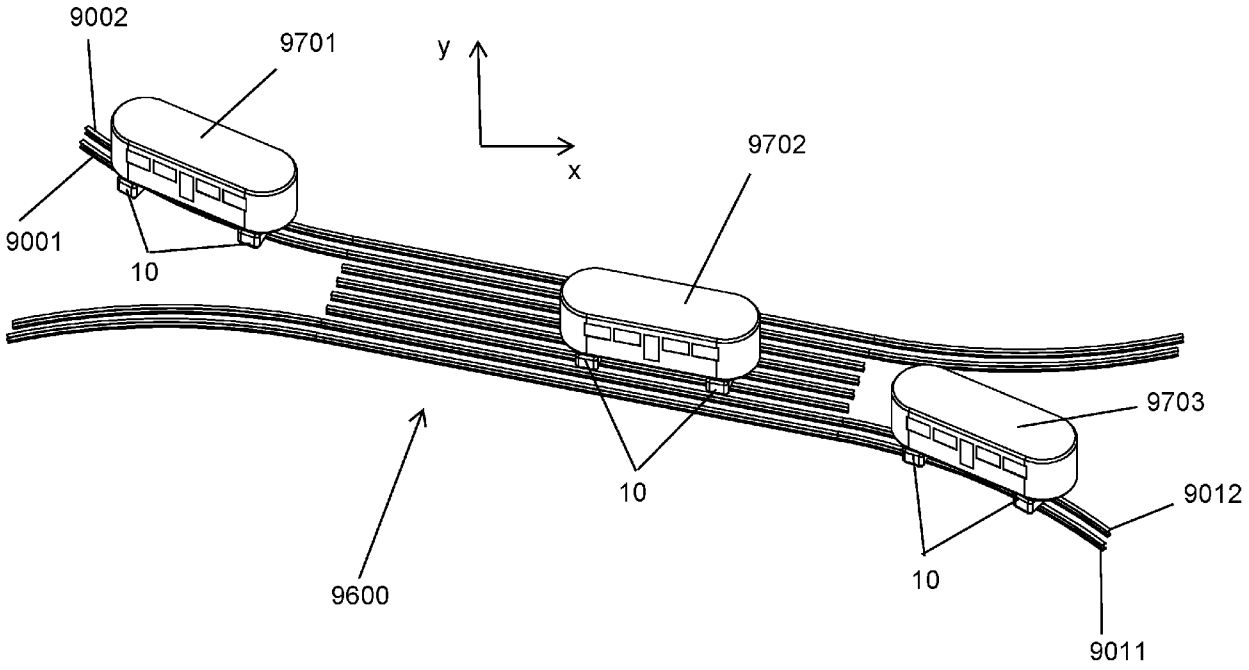


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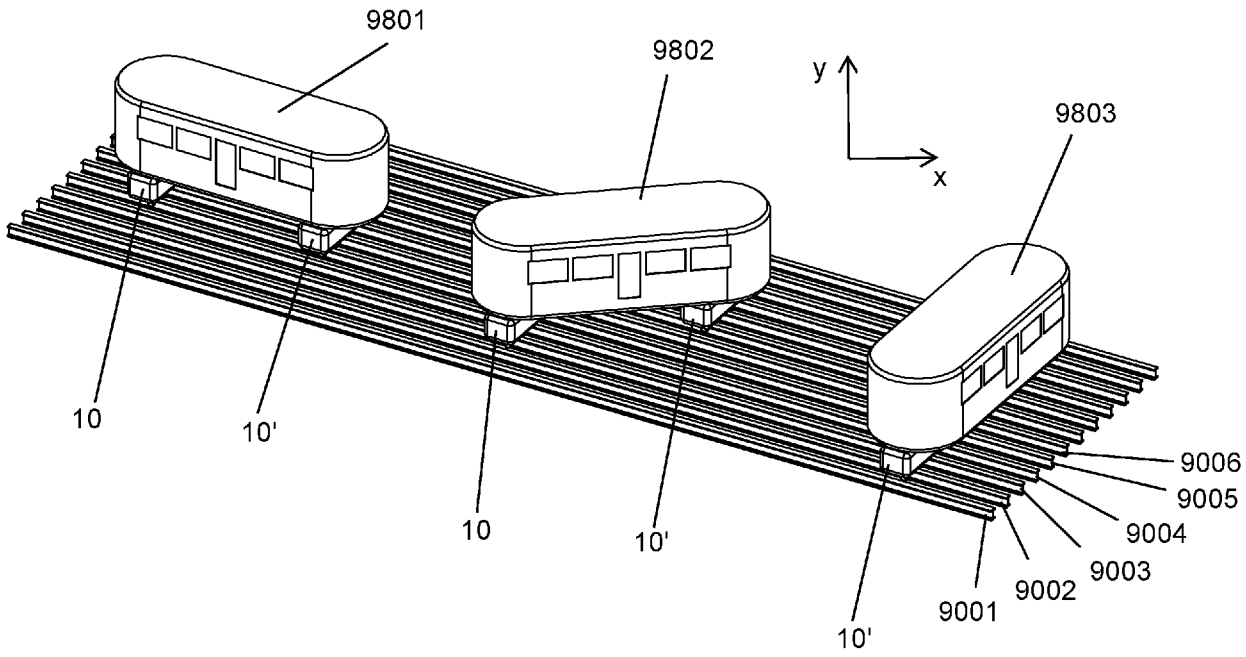


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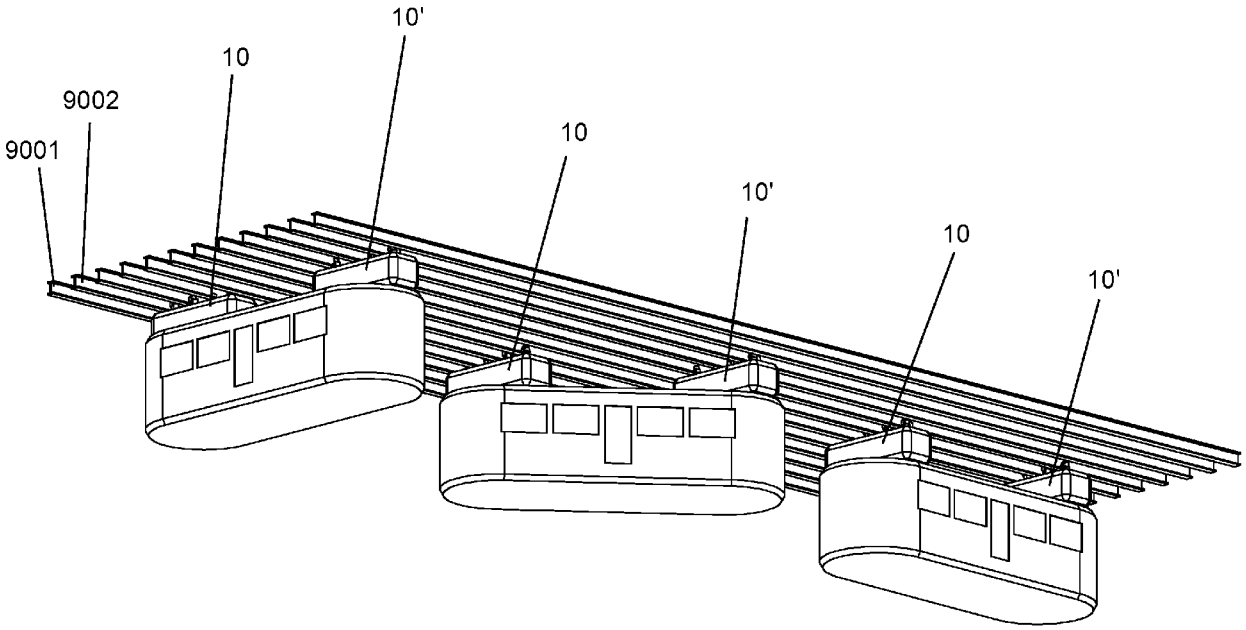


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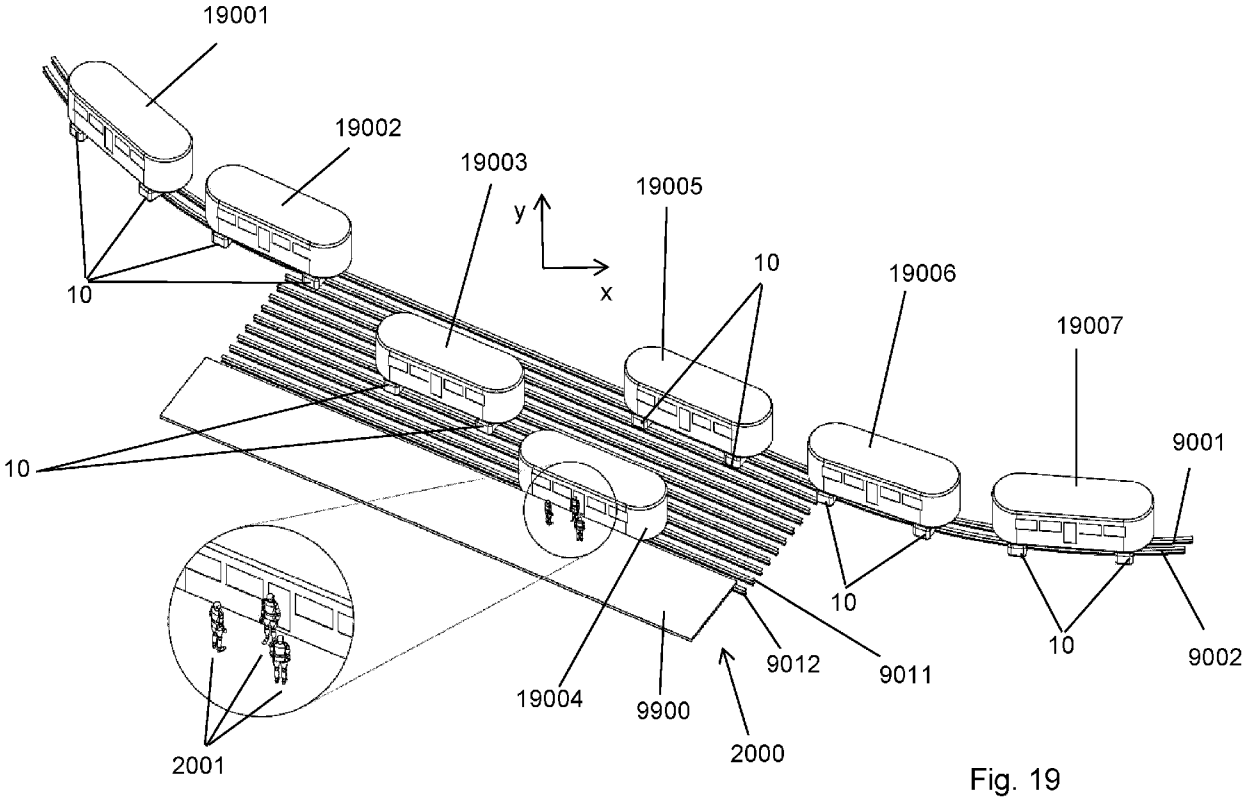

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Fig. 19

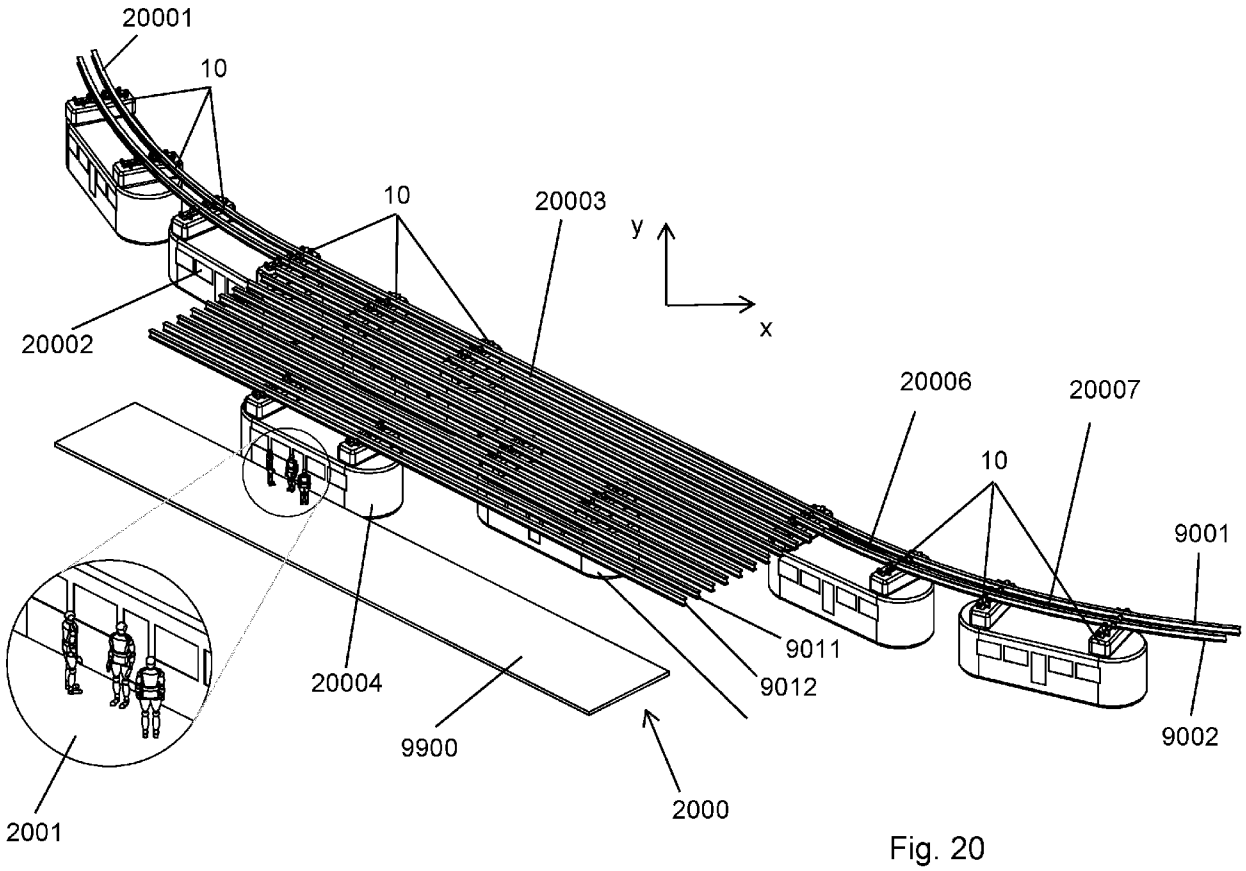

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Fig. 20

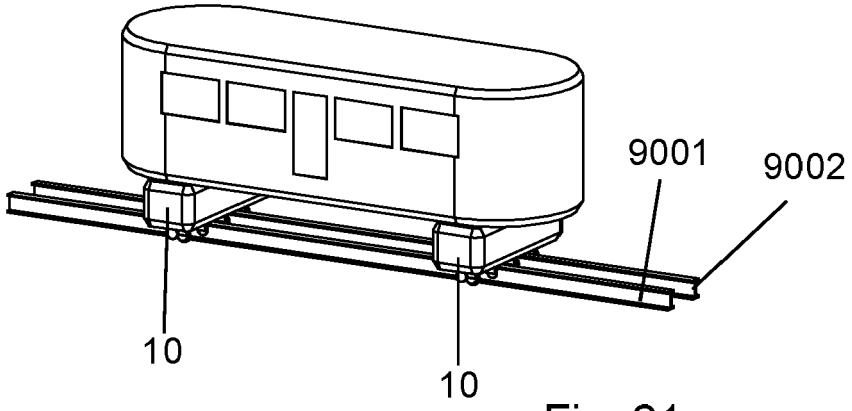


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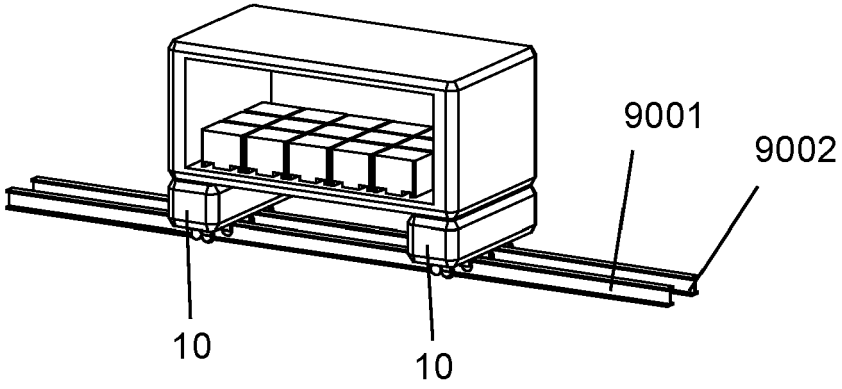


Fig. 21 b

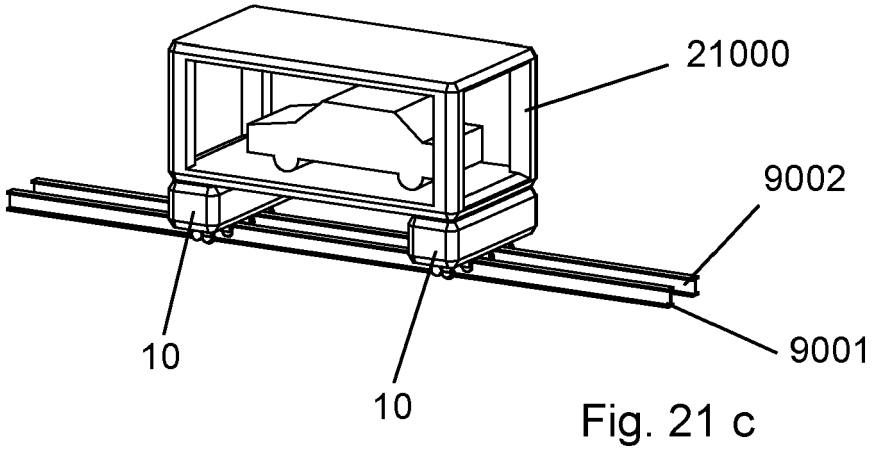


Fig. 21 c

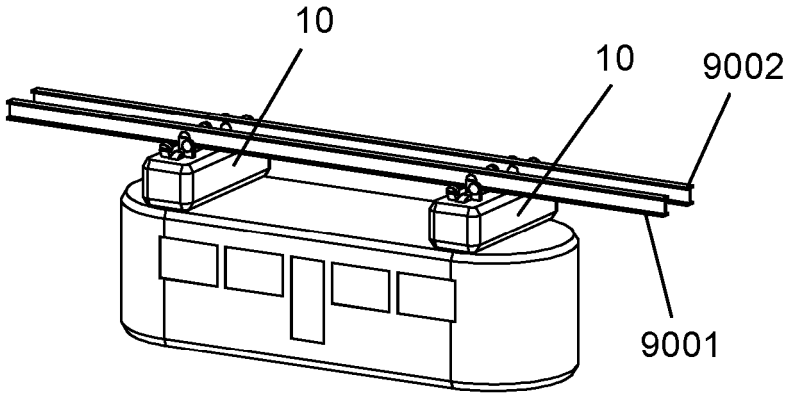


Fig. 22 a

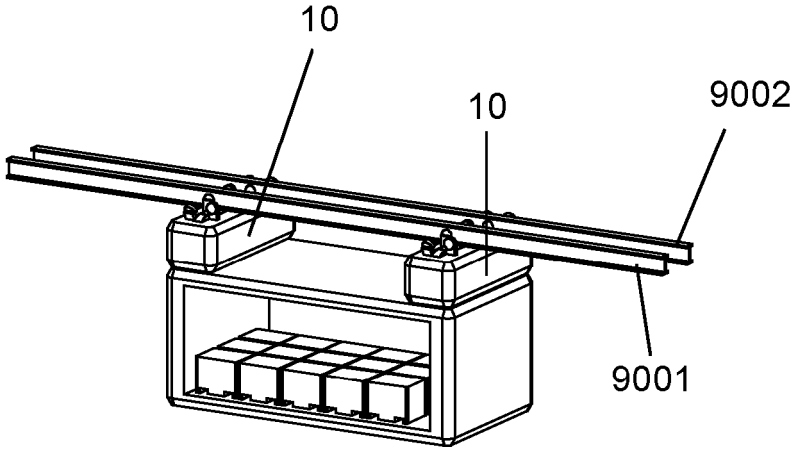


Fig. 22 b

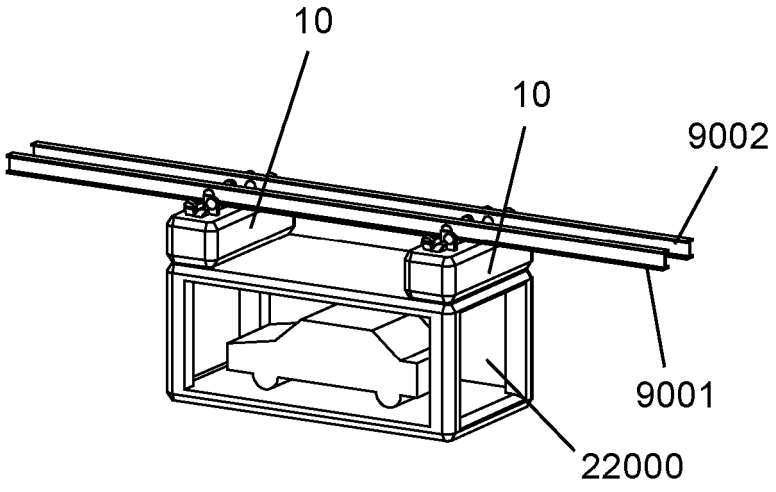


Fig. 22 c

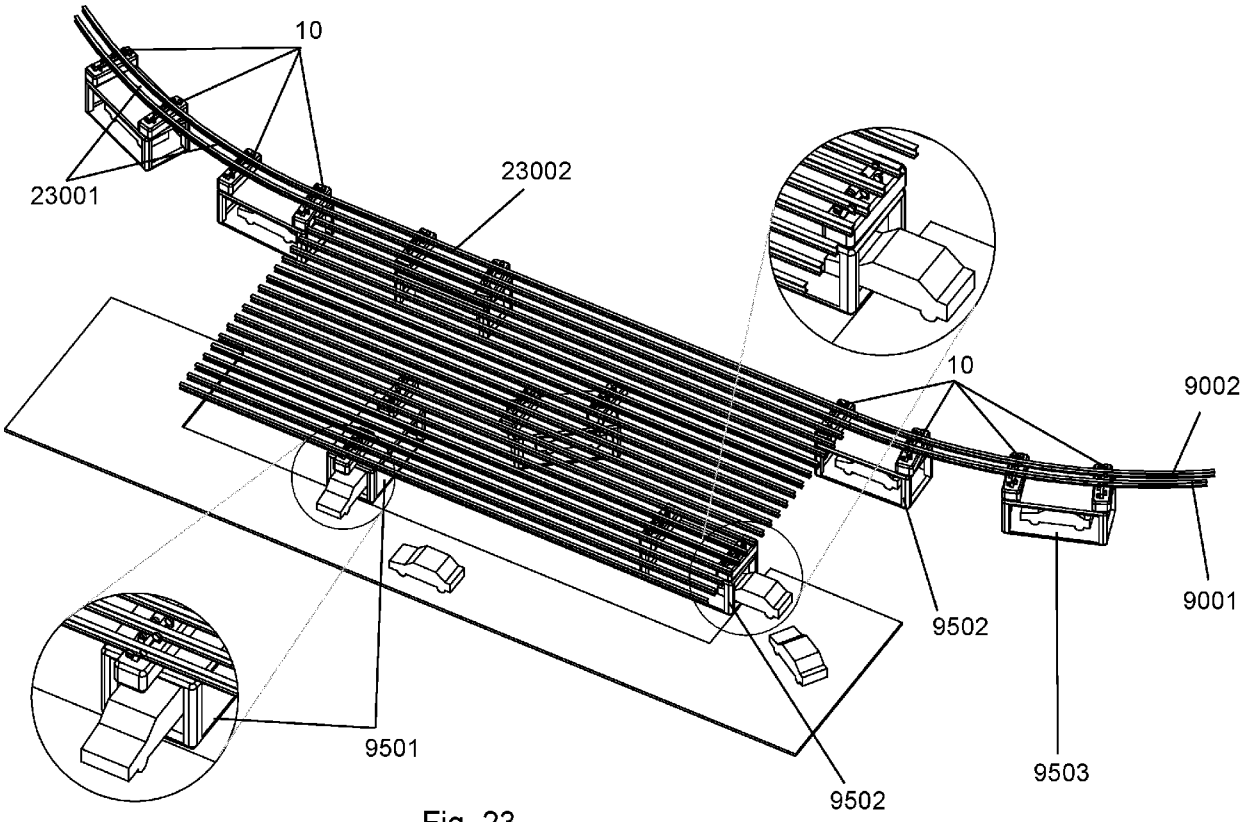


Fig. 23

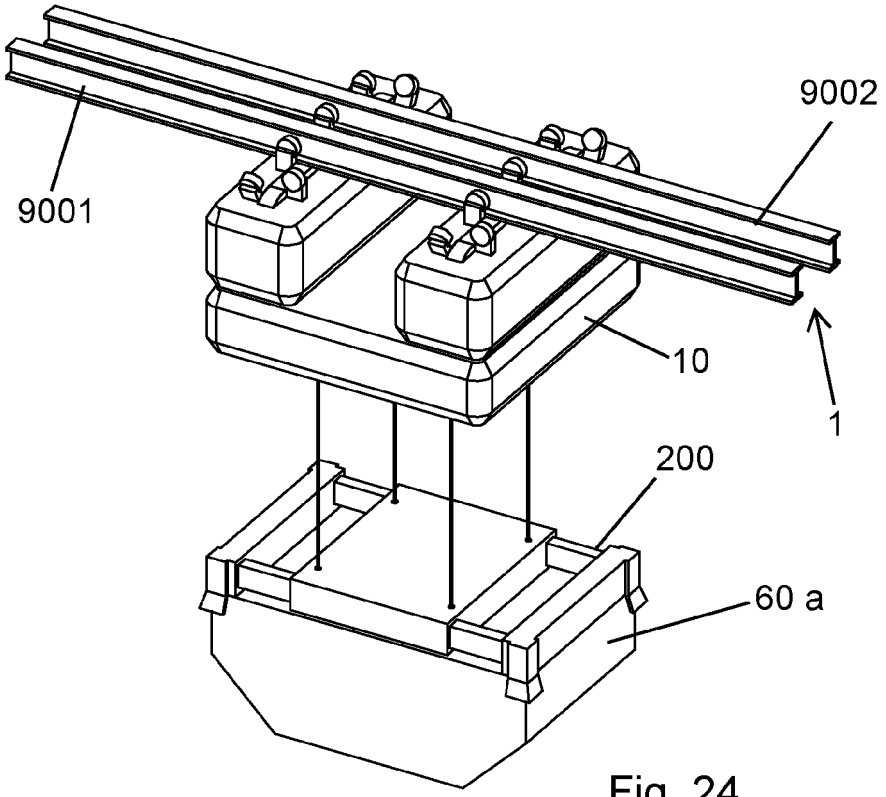


Fig. 24

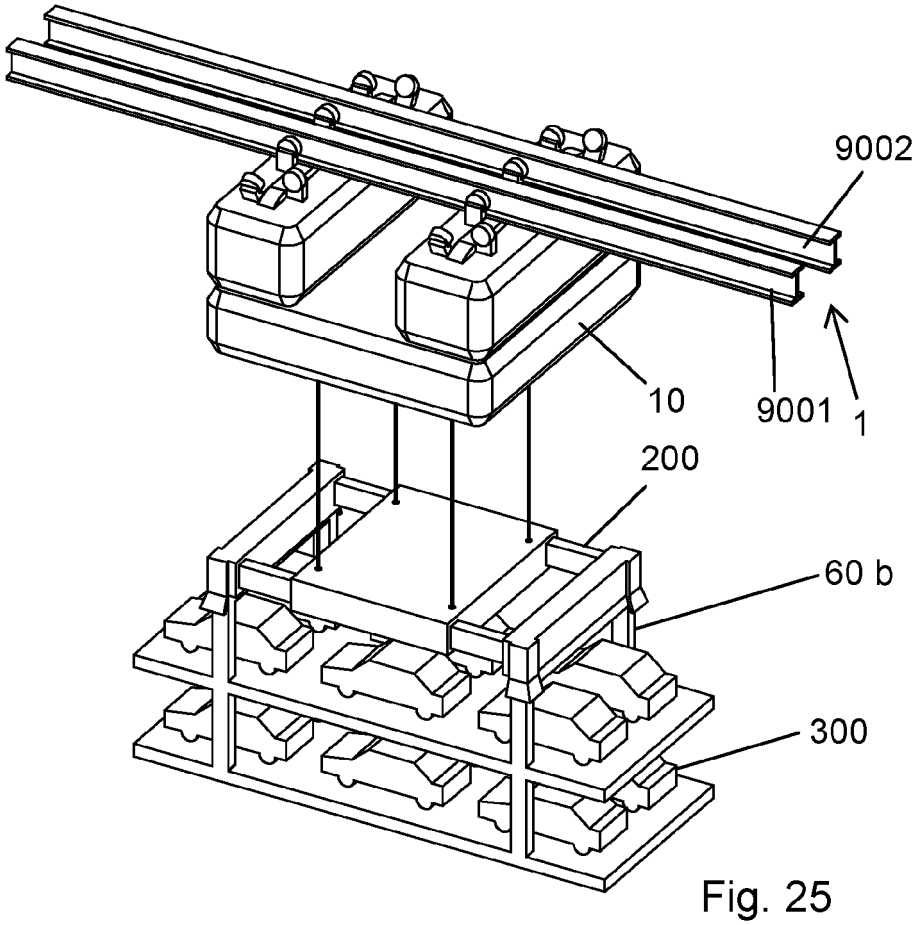


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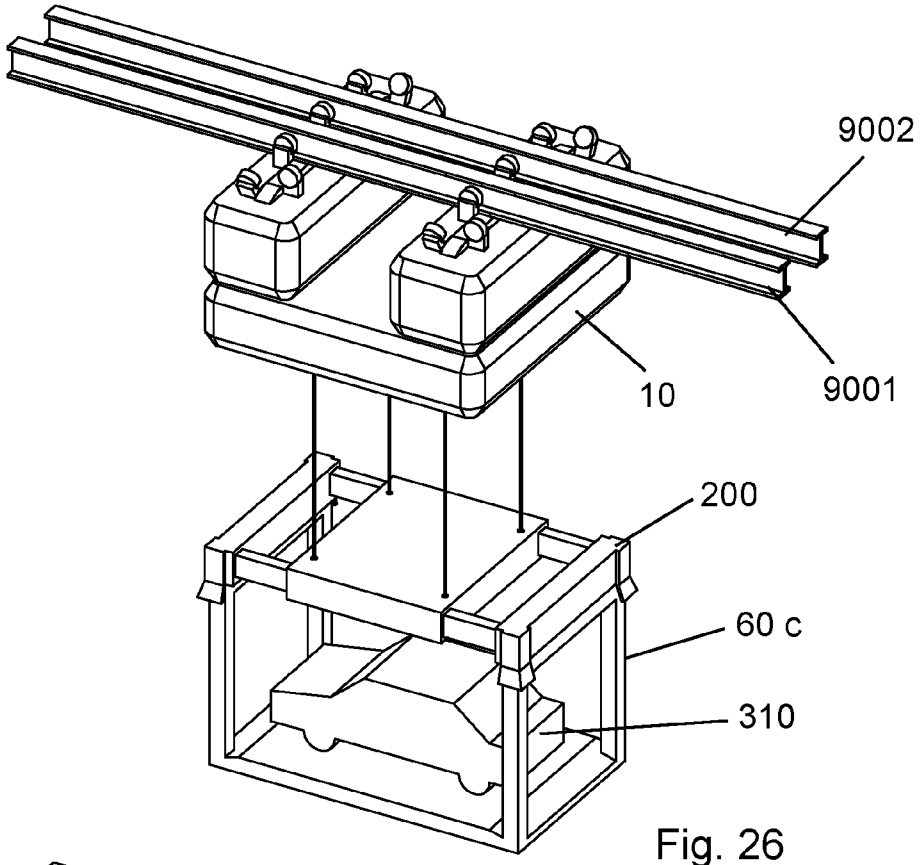


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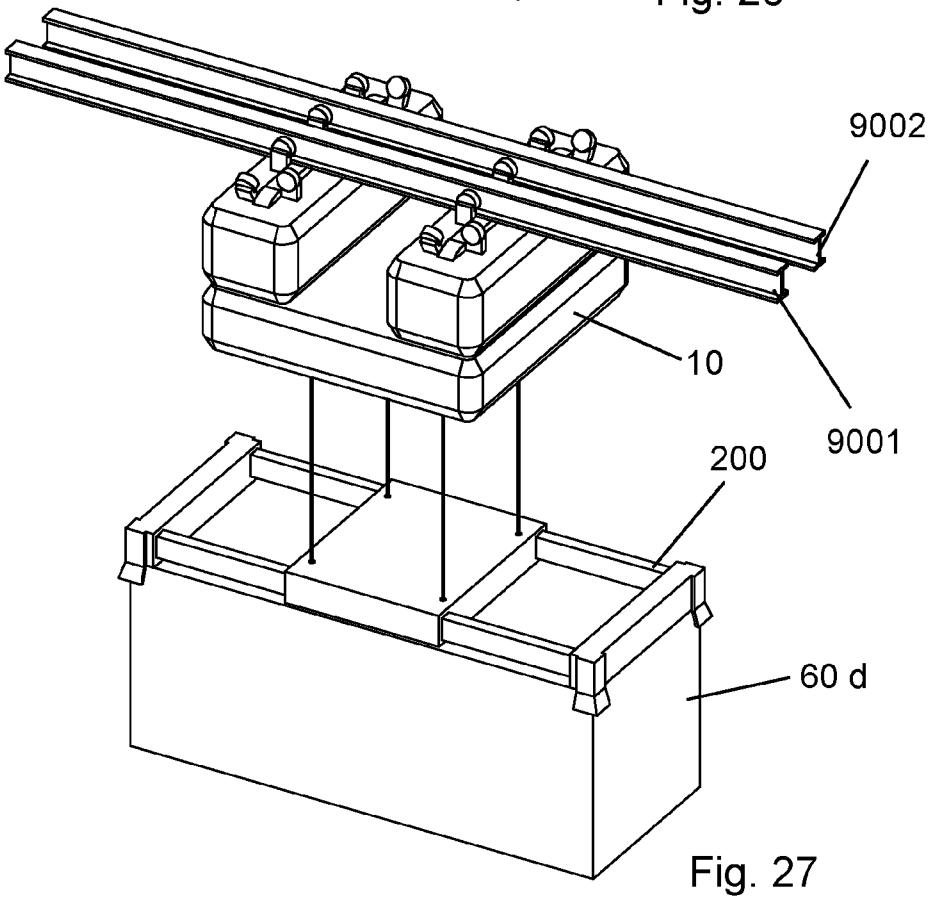


Fig. 27

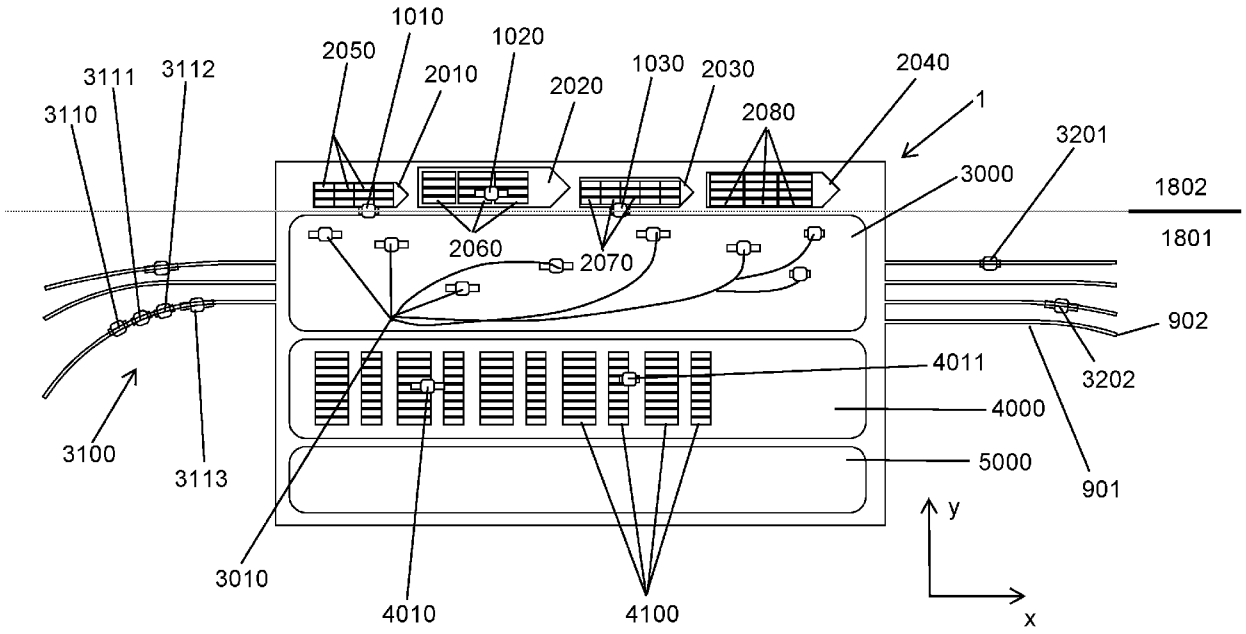

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Fig. 28

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EUROPEAN SEARCH REPORT

Application Number
EP 23 20 0943

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	US 2023/170238 A1 (ITO YASUHISA [JP])	1,2,	INV.
	1 June 2023 (2023-06-01)	4-13,15	B61B3/02
A	* the whole document *	3	B61B13/00
	-----		B62D55/00
X	JP 7 347695 B2 (MURATA MACHINERY LTD)	1,2,	
	20 September 2023 (2023-09-20)	4-13,15	
A	* the whole document *	3	

A	JP 2018 192896 A (UNIV TOKYO)	1	
	6 December 2018 (2018-12-06)		
	* paragraphs [0019] - [0021]; figures *		

TECHNICAL FIELDS SEARCHED (IPC)

B61B
B62D
E01B
H01L

~~The present search report has been drawn up for all claims~~

Place of search	Date of completion of the search	Examiner
The Hague	12 March 2024	Schultze, Yves

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

EPO FORM 1503 03.82 (P04C01)

Europäisches Patentamt
European Patent Office
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Application Number
EP 23 20 0943

CLAIMS INCURRING FEES

The present European patent application comprised at the time of filing claims for which payment was due.

☐ Only part of the claims have been paid within the prescribed time limit. The present European search report has been drawn up for those claims for which no payment was due and for those claims for which claims fees have been paid, namely claim(s):

☐ No claims fees have been paid within the prescribed time limit. The present European search report has been drawn up for those claims for which no payment was due.

LACK OF UNITY OF INVENTION

The Search Division considers that the present European patent application does not comply with the requirements of unity of invention and relates to several inventions or groups of inventions, namely:

see sheet B

☐ All further search fees have been paid within the fixed time limit. The present European search report has been drawn up for all claims.

☐ As all searchable claims could be searched without effort justifying an additional fee, the Search Division did not invite payment of any additional fee.

☐ Only part of the further search fees have been paid within the fixed time limit. The present European search report has been drawn up for those parts of the European patent application which relate to the inventions in respect of which search fees have been paid, namely claims:

☒ None of the further search fees have been paid within the fixed time limit. The present European search report has been drawn up for those parts of the European patent application which relate to the invention first mentioned in the claims, namely claims:

1-13, 15

☐ The present supplementary European search report has been drawn up for those parts of the European patent application which relate to the invention first mentioned in the claims (Rule 164 (1) EPC).

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LACK OF UNITY OF INVENTION
SHEET B

Application Number
EP 23 20 0943

The Search Division considers that the present European patent application does not comply with the requirements of unity of invention and relates to several inventions or groups of inventions, namely:

1. claims: 1-13, 15

Automatable system for the transport of cabins comprising a structure extending in two spatial directions and a vehicle

---

2. claim: 14

Computer implemented method for route-planning for an automatable system for the transport of cabins

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ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 23 20 0943

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The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

12-03-2024

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EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

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- EP 3705409 A1 **[0004] [0023] [0024]**
- EP 3803727 B1 **[0005] [0109]**