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(54) **HOISTING AND HANDLING APPARATUS**

(57) The present invention relates to a hoisting and handling apparatus (300, 400), comprising at least one beam element (200) configured for being suspended and for supporting at least one mobile hoisting device (301), having a main direction of development, and comprising at least one bent metal sheet forming two profiles (201, 202), respectively facing each other along the main direction of development and contiguous (203) with each other at the top of the beam element (200), which define respective side faces (204, 205) of the beam element (200); the two profiles (201, 202) comprise respective support elements (206, 207) configured for supporting the mobile hoisting device (301) and for allowing it to slide along the main direction of development; the support elements (206, 207) are positioned externally to the side faces (204, 205), and the beam element (200) further comprises at least one spacer element (210) interposed between the two profiles (201, 202) and constrained thereto, which is adapted to hold in position the two respective side faces (204, 205) in the structure of the beam element (200), for applying a load to the support elements (206, 207).

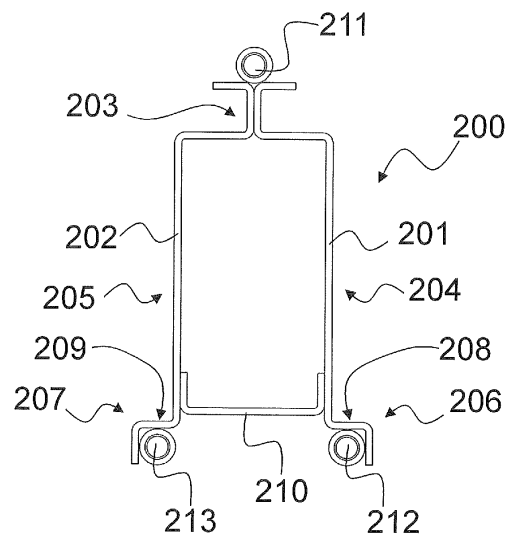


FIG. 2

Description

[TECHNICAL FIELD]

[0001] The present invention relates to a hoisting and handling apparatus; such apparatuses are typically employed in modular light-duty hoisting systems.

[0002] In general, the present invention concerns the field of hoisting and handling systems, comprising suspended tracks on which loads are made to travel, held up by sliding hoisting devices.

[PRIOR ART]

[0003] Hoisting and handling apparatuses are known, typically consisting of a system with sectional tracks and a winch or hoist, whether electric or manual, that slides on tracks for hoisting and handling loads. In this market sector, metal structures with load-bearing beams are irreplaceable when building overhead sliding installations, because they are the structural elements that support the entire hoisting system and allow it to translate.

[0004] Such apparatuses are suitable for hoisting and handling moderate loads, typically up to 2,000 Kg. For this very reason, such hoisting and handling apparatuses can be associated with electrified or manual hoisting devices. In particular, trolleys transporting moderate loads up to 2,000 kg are often moved, for practicality and cost reasons, by manually pushing them. Hoisting and handling apparatuses are used, in particular, for handling loads in manufacturing facilities, i.e. for moving products between processing stations, since such products may be quite heavy and otherwise difficult to move with ease.

[0005] The hoisting and handling devices known in the art are therefore different from other apparatuses intended for hoisting and moving materials, such as, for example, travelling crane systems. In fact, travelling crane systems, which comprise a beam on which a winch is installed, wherein the beam slides on suitable rails (travel ways), are used for handling heavier loads, and are secured to load-bearing structures of the installation environment, e.g. pillars.

[0006] On the contrary, the typology of hoisting and handling apparatuses addressed by the present invention can be secured to suitable nodes constrained to different structures, such as pillars, ceilings, etc., by means of adjustable oscillating suspensions, so as to improve the sliding action of the load being handled.

[0007] In some known solutions, a hoisting and handling apparatus is used which comprises profiled guides made from bent metal sheet. In some known solutions of hoisting apparatuses, two metal sheets are shaped and abutted against each other to create a substantially box-like beam profile. Such metal sheets are joined at the top of the beam, leaving an open channel at the bottom of the beam. In this way, the inside of the beam can be used as a support for a hoisting device, which slides along the channel formed at the bottom the beam.

[0008] In order to minimize the values of the forces required for pushing and moving the loads, the sliding surfaces for the trolley wheels of the load-bearing beams on which the trolleys run should offer the least possible resistance to rolling. To attain this, the construction of beam-type metal structures must be characterized by high quality standards, according to which the geometrical tolerances of the cross-sections and longitudinal sections of the beams stay within rigorous limits, and the sliding surfaces for the trolley wheels must have little roughness.

[0009] However, the solutions adopted by the hoisting and handling apparatuses known in the art have not proven to be fully satisfactory.

[0010] For example, in some known hoisting and handling apparatuses the mobile hoisting device is subject to sliding problems, since the beam structures known in the art may undergo dynamic deformation under the loads being handled, resulting in reduced smoothness of the beam portions on which the trolleys must slide. This problem translates into difficulty in operating the hoisting and handling apparatus, which may adversely affect the production activities being carried out in the place where the apparatus has been installed.

[0011] Moreover, some known hoisting and handling apparatuses employ mobile hoisting devices comprising trolleys whose wheels or rollers are positioned inside the beam structure. Such known configuration may imply difficult access to the trolley wheels, should they seize in operation or for general maintenance purposes. In addition, some known hoisting and handling apparatuses employ mobile hoisting devices comprising motorized trolleys; however, with the solutions known in the art it is difficult to integrate motor means into the trolley, and it is necessary to provide a tractor which is separate from the trolley, moving along the same line defined by the beam.

[0012] In general, access to the beam structure of some known hoisting and handling apparatuses proves difficult, so that many activities, including maintenance, inspection, subsequent electrification, etc. become uncomfortable.

[0013] Other drawbacks of an example of a known type of hoisting and handling apparatus will be discussed below by referring to Figures 1A, 1B, 1C and 1D.

[OBJECTS AND SUMMARY OF THE INVENTION]

[0014] It is one object of the present invention is to provide a hoisting and handling apparatus that solves some of the problems suffered by the prior art.

[0015] In particular, it is one object of the present invention to provide a hoisting and handling apparatus wherein the smoothness of the portions that support the mobile hoisting devices is improved.

[0016] It is another object of the present invention to provide a hoisting and handling apparatus which is easier to assemble.

[0017] It is a further object of the present invention to provide a hoisting and handling apparatus with improved accessibility for maintenance and inspection activities.

[0018] It is yet another object of the present invention to provide a hoisting and handling apparatus wherein the components can be electrified more easily, even at a later time, for supplying power to electric motors associated with the hoisting and handling devices.

[0019] These and other objects are achieved through a hoisting and handling apparatus as set out in the appended claims, which are an integral part of the present description.

[0020] One idea at the basis of the present invention is to provide a hoisting and handling apparatus comprising at least one beam element configured for being suspended and for supporting at least one mobile hoisting device, wherein the beam element has a main direction of development, along which at least one bent metal sheet forms two profiles respectively facing each other and contiguous with each other at the top of the beam element; the two profiles define respective side faces of the beam element, and comprise respective support elements configured for supporting the mobile hoisting device and for allowing it to slide along the main direction of development of the beam element; the respective support elements are positioned externally to the respective side faces, and the beam element further comprises at least one spacer element interposed between the two profiles and constrained thereto, so as to hold in position the two respective side faces in the structure of the beam element, even when a load is applied to the support elements through the action of the mobile hoisting device. This solution allows to provide a hoisting and handling apparatus wherein the sliding action of the mobile hoisting device is improved, since the latter slides on support elements that are external to the beam and the beam itself is deformed less under the action of the dynamic load, thanks to the presence of the spacer element.

[0021] Since the support elements can be manufactured in a controlled manner because they are external to the beam, the hoisting and handling apparatus can handle loads more smoothly. This translates into less mechanical stresses for all elements of the system, and particularly for the user in case of manual handling.

[0022] Furthermore, because the hoisting and handling apparatus is made by using at least one bent and shaped metal sheet, an advantage is provided by the better surface finish of the bent metal sheet compared with other elements obtained by rolling.

[0023] In addition, the present invention allows to create a hoisting and handling apparatus which is easier to assemble, because also the mobile hoisting devices are engaged with the beam structure in a more practical and favourable manner, particularly due to the fact that they are supported by external support elements.

[0024] Preferably, the hoisting and handling apparatus comprises two bent metal sheets that form the two profiles respectively facing each other and contiguous with

each other at the top of the beam element; such profiles are preferably symmetrical; the two bent metal sheets are preferably joined at the top of the beam element. In this manner, more accurate profiles can be made by numerically controlled press bending, starting from precisely cut (preferably by laser cutting) flat metal sheets. Thus, the present invention takes advantage of better dimensional stability, which translates into improved efficiency in operation.

[0025] Preferably, the two profiles facing each other form a box-like structure which is at least partially open on the side of the spacer element, wherein the two side faces face each other and are separated from each other by the inside of the beam element; in fact, the spacer element is positioned on a side of the beam element which is opposite to the top of the same. A structure that can be easily inspected is thus created, with advantages during production (e.g. painting or inspection), maintenance or installation.

[0026] Preferably, the box-like structure is so configured as to allow cables and/or pipes to run inside of it without affecting the support elements and without hindering the motion of the mobile hoisting device. Thus, the hoisting and handling apparatus according to the present invention proves to be an advantageous element when used in a production environment, since power cables and water or compressed air pipes can run within its inner space - which is not occupied by any element - without disturbing the underlying areas and also without hindering the handling of the loads.

[0027] Preferably, the hoisting and handling apparatus according to the present invention may be modular, i.e. it may comprise a plurality of beam elements having equal or different height dimensions, which are connected together to allow the mobile hoisting device to slide along the whole line. A modular system simplifies the installation of the hoisting and handling apparatus; in addition, in a modular system including beam elements having different height dimensions, stronger beam elements can be used in the areas subject to higher stress, and lighter beam elements can be used in less stressed areas. In this manner, furthermore, a hoisting and handling apparatus is created which is more flexible and suitable for adaptation and customization according to different particular requirements of the place of installation, including any structural constraints which may be present in the environment concerned. Preferably, the beam elements are connected together by means of connection elements at the interface between different beam elements of different height. Such connection elements contribute to ensuring higher reliability of the combined beam elements, resulting in better performance of the hoisting and handling apparatus.

[0028] Preferably, the support elements comprise each a respective horizontal sliding track adjacent and external to the respective one of the two side faces, and adapted to allow the mobile hoisting device to slide, also between adjacent beam elements. Thus, loads can be

handled in a reliable manner even in wide spaces, while still preserving the utmost flexibility of configuration by starting from modular elements.

[0029] Preferably, the hoisting and handling apparatus further comprises electrification means constrained to the at least one spacer element, for supplying power to electric units of the mobile hoisting device. Preferably, the electrification means comprise electrified tracks in the lower portion of the beam element, to be coupled to electric contacts of the mobile hoisting device; preferably, the electrified tracks run higher than the bottom ends of the support elements. In this manner, the hoisting device and/or the handling device can be electrified during installation or at a later time.

[0030] Preferably, the hoisting and handling apparatus comprises at least two beam elements parallel to each other, and the mobile hoisting device in turn comprises at least one beam element; the mobile hoisting device is supported at its sides by the two parallel beam elements and can slide thereon. In this manner, if the mobile hoisting device is equipped with a hook sliding on the same beam, it is possible to create a very effective and flexible hoisting and handling apparatus that can be used for handling loads with respect to three orthogonal axes, much like a travelling crane or bridge crane.

[0031] Preferably, each beam element comprises a plurality of centering pins constrained thereto; said centering pins are configured for allowing a plurality of head-to-head beam elements to be assembled together, in a modular manner as aforementioned.

[0032] Further advantageous and particular aspects will become more apparent from the following detailed description.

[BRIEF DESCRIPTION OF THE DRAWINGS]

[0033] Some preferred and advantageous embodiments will now be described by way of nonlimiting example with reference to the annexed drawings, wherein:

- Figures 1A, 1B, 1C and 1D show some examples of beam elements included in hoisting and handling apparatuses according to the prior art.
- Figure 2 shows one embodiment of a cross-section of a beam element included in a hoisting and handling apparatus according to the present invention.
- Figure 3 shows a first embodiment of a hoisting and handling apparatus according to the present invention.
- Figure 4 shows further embodiments of cross-sections of beam elements included in a hoisting and handling apparatus according to the present invention.
- Figure 5 shows a second embodiment of a hoisting and handling apparatus according to the present invention.
- Figure 6 shows a detail of the hoisting and handling apparatus of Figure 5.

- Figure 7 shows an alternative view of the hoisting and handling apparatus of Figure 5.
- Figure 8 shows a further embodiment of a cross-section of a beam element included in a hoisting and handling apparatus according to the present invention.

[0034] The drawings show different aspects and embodiments of the present invention and, where appropriate, similar structures, components, materials and/or elements are designated in the various drawings by the same reference numerals.

[DETAILED DESCRIPTION OF THE INVENTION]

[0035] In order to highlight the effectiveness of the present invention, it is appropriate to state beforehand that metal structures with load-bearing beams intended for hoisting and handling loads exist in the prior art, which however differ from the present invention.

[0036] In particular, the following detailed description of some known solutions will make clear that the characteristics of the currently most common solutions with load-bearing beams are less advantageous than those of the present invention, as will be accurately shown below.

[0037] Figure 1A shows three examples of hoisting and handling apparatuses according to the prior art, which utilize load-bearing metal beams 1, 2 and 3 consisting of commercial rolled sections.

[0038] As exemplified herein, the load is applied to sliding trolleys respectively mounted to the beams 1, 2 and 3 through wheels resting on the lower flange of the section.

[0039] Load translation, in particular when effected manually, is adversely affected by a high friction coefficient due to the large geometrical tolerances of the beams 1, 2 and 3 and to the high roughness of the rolling surfaces, which are typical of the rolling process used for manufacturing the sections.

[0040] Moreover, since the rolled sections 1, 2 and 3 in question are solid, they cannot incorporate any supply systems or electric/pneumatic/hydraulic units or balance counterweights. Such systems must therefore be arranged externally to the profile of the beams 1, 2 and 3; this results in increased overall dimensions and, since they remain unprotected, in the possibility of external dangers such as interferences, collisions, etc.

[0041] Figure 1B shows two examples of hoisting and handling apparatuses according to the prior art, which utilize load-bearing metal beams 4 and 5, consisting of structures made by using profiles formed by bent metal sheets with an external sliding track for a trolley, wherein the load applied to the trolley can slide, via the wheels of the latter, on the lower flange of the beam.

[0042] Profiles made from bent metal sheets assembled together form the beams 4 and 5, which however, for construction reasons, suffer from a few drawbacks.

[0043] In particular, the beams 4 and 5 are not suitable for being equipped with "standard" trolleys, whether manual or electric, thus requiring the use of complex and expensive specially designed trolleys that are not easily available on the market.

[0044] Furthermore, in the case of the beam 5, wherein profiles made from bent metal sheets are matched close together to form a single central web; for reasons related to the necessary horizontal inertia values, the lower flange has much overhang; this fact, also because of the thinness of the metal sheets used in the cold-rolling process (typically 4 or 5 mm), leads to very high local stresses.

[0045] In the case of the beam 4, wherein the profiles made from bent metal sheets are not matched close together in order to reduce the overhang of the lower flange and hence the local stresses, the two sheets must be assembled together by using costly internal spacers.

[0046] In both beams 4 and 5, electric power systems cannot be incorporated in the beam, and unavoidably take up external space so that, according to the case: they limit the inner span of the beam 5, which is useful for the passage of the trolley, thus requiring the use of very tall and heavy beams even for light loads; or they take up room under the beam 4, thus remaining uncovered and unprotected and requiring the construction of special trolleys.

[0047] Furthermore, in the beams 4 and 5 any electric/pneumatic/hydraulic units or balance counterweights can hardly be incorporated into the beam, due to little room available. All of the above-mentioned pieces of equipment, since they must necessarily be arranged externally to the beam made from bent metal sheet with an external sliding track for the trolley, cause an unfavourable dimensional increase and, since they are not protected, remain exposed to external dangers such as interferences, collisions, etc.

[0048] Figure 1C shows three examples of hoisting and handling apparatuses according to the prior art, which utilize load-bearing metal beams 7, 8 and 10 consisting of profiles made from bent metal sheets forming a "closed-channel" tubular section, wherein the trolley slides inside the beam. The box-like cross-section of the "closed-channel" beam adversely affects the maintenance of the apparatus, because it does not allow direct access to the region occupied by the wheels of the trolleys, thus making them difficult to inspect. The "closed-channel" shape of the beams 7, 8 and 10, which only have a narrow opening at the bottom through which the plates of the trolley can exit, makes any surface treatment processes within the beam, such as sand-blasting and painting, very difficult or even impossible, and/or leads to poor quality thereof.

[0049] Also in terms of mechanical strength, the "closed-channel" shape of the beams 7, 8 and 10 is very critical because the profiles are only joined at their upper ends, while the sliding tracks for the trolley, since they are not constrained to each other, might stretch apart and allow the trolley to exit/fall, if subjected to horizontal

stresses caused by loads not perfectly aligned vertically.

[0050] The "closed-channel" tubular beams 7, 8 and 10 are unfit for being equipped with "standard" electrified translating trolleys, thus requiring the adoption of costly special solutions with auxiliary tractors.

[0051] Furthermore, the "closed-channel" tubular beams 7, 8 and 10 are unfit for being equipped with electric power systems, which, except for some rare instances schematized in the beam 8, where inspection would be difficult, cannot be incorporated into the beam.

[0052] In addition, the "closed-channel" tubular beams 7, 8 and 10 are not suitable for housing electric/pneumatic/hydraulic units or for positioning counterweights, which cannot be incorporated into the cross-section of the beams 7, 8 and 10 because the trolley runs therein. All of the above-described pieces of equipment must therefore be arranged externally to the "closed-channel" tubular beams 7, 8 and 10; this unfavourably results in increased overall dimensions and, since they remain unprotected, in exposition to external dangers such as interferences, collisions, etc.

[0053] Figure 1D shows in more detail the cross-section of the beam element 10 included in a hoisting and handling apparatus according to the prior art. The beam element 10 has a main direction of development along which an exemplificative section is obtained, as shown in the drawing. The beam element 10 is constituted by a first bent metal sheet 11 and a second bent metal sheet 12, which form two respective profiles 11 and 12. The profiles 11 and 12 are joined at the top 13 of the beam element 10, and define a structure with two side faces 14 and 15. Underneath the side faces 14 and 15, the beam element 10 according to the prior art comprises two reinforcement profiles 16 and 17, the function of which is to further stiffen the structure of the beam element 10. Between the reinforcement profiles 16 and 17 there is a channel 18, which runs throughout the length of the beam element 10. A trolley (not shown in the drawing) of a mobile hoisting device can be inserted into the beam element 10 through the channel 18. In particular, the trolley comprises wheels or rollers resting on support elements 19 and 20, defined within the beam element 10 by the bends of the profiles 11 and 12. In particular, the support elements 19 and 20 within the profiles are adapted to receive the wheels of the trolley, in order to hold up and move the hoisted load.

[0054] As aforementioned, the structure of the beam element 10 according to the prior art is not optimal for load hoisting and handling purposes.

[0055] In fact, the known beam element 10 suffers from poor smoothness in the portions of the support elements 19 and 20 on which the trolley slides. This problem is caused by the use of a portion internal to the beam element, which is difficult to make and which has non-optimal tolerances, and by the method employed for manufacturing the beam element 10, which typically makes use of profiles obtained by rolling.

[0056] In addition, in the known type of beam element

10 the wheels or rollers of the trolley (not shown) are positioned inside the beam structure, leading to accessibility problems. Furthermore, the known type of beam element 10 is difficult to electrify, because the electric lines possibly needed for powering motor means associated with the trolley would typically be positioned inside the beam element 10, thus being poorly accessible for installation and maintenance purposes.

[0057] The above-mentioned drawbacks and other problems are overcome by a hoisting and handling apparatus according to the present invention, which will be described in detail below.

[0058] Figure 2 shows one embodiment of a cross-section of a beam element 200 included in a hoisting and handling apparatus according to the present invention.

[0059] The beam element 200 has a main direction of development along which an exemplificative cross-section is obtained, as shown in Figure 2. The beam element 200 comprises two bent metal sheets 201 and 202, suitably shaped for creating two respective profiles 201 and 202; such bent metal sheets are joined at the top 203 of the beam element 200, and are preferably symmetrical. In an alternative embodiment, a single metal sheet may be used for forming both profiles 201 and 202, i.e. without the junction 203.

[0060] The profiles 201 and 202 respectively face each other along the main direction of development of the beam element 200, and are contiguous with each other at the top of the beam element 200. In this manner, the profiles 201 and 202 contiguous with each other at the top of the beam element 200 create a box-like structure that is partially open in its bottom part, the characteristics of which will be described below.

[0061] The profiles 201 and 202 define two side faces 204 and 205 of the beam element 200. Said side faces are preferably flat or substantially flat, but may also comprise a curvature, preferably convex outwards.

[0062] The side faces 204 and 205 face each other along the main direction of development of the beam element 200, and are separated from each other by the inside portion of the beam element 200.

[0063] The profiles 201 and 202 comprise respective support elements 206 and 207, which are positioned externally to the side faces 204 and 205. In particular, the support elements 206 and 207 are positioned externally to the side faces 204 and 205 with respect to the body of the beam element 200, i.e. they are not turned inwards or contained within the beam element 200 as in the prior art. More in particular, the support elements 206 and 207 are positioned externally to the bottom edges of the side faces 204 and 205, i.e. they are turned outwards from the beam element 200.

[0064] The support elements 206 and 207 comprise each a respective horizontal sliding track 208 and 209. Such horizontal tracks 208 and 209 are adjacent to the side faces 204 and 205 and external thereto. Such horizontal tracks 208 and 209 are adapted to allow a mobile hoisting device to slide along the main direction of devel-

opment of the beam element 200.

[0065] More in particular, the horizontal tracks 208 and 209 are configured for allowing the sliding of trolleys comprising rolling elements, such as guide rollers, positioned externally to the beam element 200, in order to improve the smoothness of the sliding action of mobile hoisting devices on the horizontal tracks 208 and 209.

[0066] At the same time, the support elements 207 and 208 are sized for supporting the total weight of the mobile hoisting device and of the load associated therewith, thus making the beam element 200 become a part of a more effective hoisting and handling apparatus.

[0067] The support elements 206 and 207, and their horizontal tracks 208 and 209, offer a big advantage in terms of load handling smoothness. In particular, the metal sheets 201 and 202 have optimal surface roughness, better than that of the solutions obtained by using rolled beams. In this regard, the solution adopted by the present invention improves the sliding action of the loads, which can be handled more easily even manually (i.e. without using motorized actuators for moving the hoisting device).

[0068] Advantageously, the metal sheets 201 and 202 are preferably obtained by laser cutting, starting from a bigger flat metal sheet; this will provide profiles with no cutting burrs. Furthermore, the metal sheets are preferably subjected to bending, in particular numerically controlled press bending, in order to obtain shaped profiles 201 and 202 with very good geometrical tolerances.

[0069] The beam element 200 further comprises at least one spacer element 210 interposed between the profiles 201 and 202 and constrained thereto. The spacer element 210 is preferably made from metal sheet and is welded to the inner portions of the profiles 201 and 202. Preferably, the spacer element 210 is positioned in the lower portion of the beam element 200, in the proximity of the support elements 206 and 207.

[0070] The spacer element 210 contributes to the structural strength of the beam element 200, in particular by keeping the side faces 204 and 205 in their respective positions even when a load is applied to the support elements 206 and 207. In fact, when a load is applied to the support elements 206 and 207 in the direction imposed by the weight force, the cross-section of the beam element 200 will tend to slightly close onto itself; by fitting the beam element 200 with at least one spacer element 210, the strength of the structure is restored, and a load, even a heavy one, can be applied to be hoisted and handled by the apparatus.

[0071] Preferably, the beam element 200 comprises a plurality of spacer elements 210 arranged along different cross-sections of the beam element 200. Preferably, the beam element 200 comprises a plurality of spacer elements 210 spaced by a distance preferably equal to 500 mm; such spacer elements 201 are thus distributed along the main direction of development of the beam element 200, as can also be seen in the example of Figure 5. As will be better appreciated below, this particular arrange-

ment of the spacer elements 201 offers some specific advantages.

[0072] As an alternative, there may be a single spacer element running along the entire length of the beam element, but such a configuration would be disadvantageous because it would prevent access to the inside of the beam. As a further alternative, there may be one or two spacer elements positioned at the ends of the beam element 200, e.g. welded plates that secure the beam ends to contribute to the structural rigidity of the assembly.

[0073] Preferably, the metal sheet from which the profiles 201 and 202 are obtained is a steel sheet, but it may also preferably be made of other materials, in particular metal materials such as aluminium.

[0074] Preferably, the metal sheet from which the profiles 201 and 202 are obtained has a length of 4,000 mm; hence the resulting beam element 200 has a length of 4,000 mm, which size is a very good compromise between extension of the element in the assembled configuration and transportability thereof in the disassembled configuration.

[0075] The beam element 200 further comprises one or more centering pins, preferably an upper centering pin 211 and two lower centering pins 212 and 213; the function of such centering pins is to improve the alignment of the modular beam elements when installing a hoisting and handling apparatus, as will be described more in detail below.

[0076] Figure 3 shows a first embodiment of a hoisting and handling apparatus 300 according to the present invention.

[0077] Said hoisting and handling apparatus comprises three beam elements 200, 200d and 200c assembled together to form a single structural element, which is suspended through the nodes 302 constrained to a load-bearing structure. Preferably, the nodes 302 comprise oscillating suspensions to improve the sliding action of the loads on the hoisting and handling apparatus. Preferably, the hoisting apparatus 300 comprises a mobile hoisting device 301, supported by the support elements 207, 207d and 207c and by the respective guide elements, which are not visible in the drawings because they are hidden behind the hoisting apparatus 300. Preferably, the beam elements of an apparatus according to the present invention are modular, i.e. they may have different height dimensions, as shown in the examples of beam elements 200b, 200c, 200 and 200d of Figure 4.

[0078] The beam elements 200b, 200c, 200 and 200d have the same width, designated as "b" in the drawing, and include compatible support elements having a height dimension designated as "a" in the drawing, as well as compatible widths. The beam elements 200b, 200c, 200 and 200d preferably have profiles of the same thickness, i.e. obtained from equally thick metal sheets.

[0079] In other words, the beam elements 200b, 200c, 200 and 200d differ from one another essentially for their height dimension.

[0080] In particular, the height of the beam elements is different so that they can give different contributions through the static moments of inertia of their cross-sections. As will be appreciated by those skilled in the art, a higher modular beam element will be heavier per length unit, but at the same time it will have more flexural rigidity, thus being able to withstand higher bending stresses. In other words, by providing modular beam elements having different height dimensions in accordance with the present invention, it is possible to vary the inertia of the structural elements in order to best adapt it to specific operating conditions.

[0081] Moreover, the compatibility among the beam elements 200b, 200c, 200 and 200d is also useful when needing to cope with non-optimal installation conditions, wherein the height available for installation of the beam element is critical in some places and not in others. In such critical places, in fact, a modular beam element having a smaller height dimension could be used, with the advantage of immediately obtaining a more flexible configuration of the hoisting and handling apparatus.

[0082] Therefore, in the example of Figure 3 the beam element 200d positioned at the centre of the beam will have greater flexural rigidity than the perimetric beam elements 200 and 200c; advantageously, this means that the centre of the beam of the apparatus 300 will be more resistant to bending stresses, which are higher in the area it occupies within the structure of the hoisting apparatus 300, considering the peripheral position of the support nodes 302. Therefore, according to the present invention it is possible to configure a hoisting and handling apparatus with narrower and lower beam elements in the peripheral and/or less stressed areas, resulting in the hoisting and handling apparatus being lighter as a whole. Preferably, beam elements like the elements 200 and 200c are assembled together with the beam element 200d by means of suitable connection elements 303 and 303c, at the interface between the different beam elements.

[0083] Preferably, the connection elements 303 and 303c are also modular and exploit the centering pins 211d of the central beam elements 200d, even in connection with lower beam elements, such as the beam elements 200 and 200c. In other words, the connection elements 303 and 303c (and the respective analogous elements for different modules, with due modifications) allow the structure to be connected together in order to create a perfectly structured modular assembly.

[0084] Preferably, the beam elements are bolted together through threaded junctions located at the centering pins.

[0085] Preferably, the connection elements 303 and 303c are constrained, inserted and/or welded to the top of the beam elements 200 and 200c, respectively.

[0086] The drawing shows that the horizontal guides consisting of the support elements 207, 207d and 207c allow the mobile hoisting device 301 to slide uninterruptedly for the whole length of the apparatus 300. To this

end, the mobile hoisting device 301 comprises a plurality of wheels or rollers resting on the horizontal track of the beam element, preferably arranged into opposite banks of rolling elements on both sides of the beam elements. Preferably, the mobile hoisting device comprises one, more preferably two, pair(s) of wheels 304 and 304b on each side of the beam element. Advantageously, the plurality of wheels 304 and 304b is easily accessible for inspection and maintenance, since they run on external support elements.

[0087] Also preferably, the mobile hoisting device comprises a hook-shaped element 305 whereto a load can be hooked, which can then be hoisted by suitably powered motor means 306.

[0088] In a preferred embodiment, the trolley of the mobile hoisting device may also be electrified, so as to allow for mechanized and electrified load handling.

[0089] Figure 5 shows a second embodiment of a hoisting and handling apparatus 400 according to the present invention.

[0090] The hoisting and handling apparatus 400 comprises a first beam element 401 and a second beam element 402, parallel to each other, suspended from and constrained to suitable structural elements 41 and 42 of the installation environment, e.g. two iron girders. In the lower portion of the beam element 401, one can appreciate the previously described plurality of spacer elements 210.

[0091] The hoisting and handling apparatus 400 further comprises a mobile hoisting device 403, in turn comprising a beam element 404, preferably similar to the elements 401 and 402. The mobile hoisting device is slideably supported at its peripheral regions by the support elements of the beam elements 401 and 402.

[0092] The mobile hoisting device 403 thus creates a "travelling crane" configuration, i.e. with a crossmember movable on parallel guides.

[0093] In its turn, the mobile hoisting device 403 comprises hoisting means 405 that comprise a motor for hoisting a load. Preferably, power is supplied to the motor via electrification of a part of the hoisting and handling apparatus 400, as will be explained below.

[0094] The beam element 402 comprises electrification means, such as electrified tracks in the lower portion of the beam element 402, arranged higher than the bottom ends of the support elements 206 and 207. Such electrified tracks are more clearly visible in the enlarged detail 50 shown in Figure 6.

[0095] The electrified tracks 501 are configured for coupling to electric contacts 502 of the mobile hoisting device 403. Preferably, the motor of the hoisting device 405 receives power through the festoon-type electric connection 406. The festoon 406 is supported by suitable supports inserted in the beam element 404.

Figure 7 shows an alternative view of the hoisting and handling apparatus of Figure 5.

Figure 8 shows a further embodiment of a cross-

section of a beam element 200a included in a hoisting and handling apparatus according to the present invention. The beam element 200a substantially corresponds to the beam element 200 already described with reference to Figure 2.

[0096] In addition, the beam element 200a comprises electrification means 501, such as the already described electrified tracks 501, constrained to the spacer element 210, in particular to the lower portion thereof.

[0097] The box-like structure of the beam element 200a is also configured for allowing cables and/or pipes to run inside of it without affecting the external support elements 206 and 207.

[0098] For example, the beam element 200a may contain an electric power cable 801 laid on the spacer element 210, and a compressed air pipe 802 constrained in a known manner inside the box-like structure formed by the beam element 200a.

[0099] Furthermore, in an embodiment not shown in the drawings, a counterweight may be inserted and constrained within the housing formed in the box-like structure of the beam element 200a.

[0100] The above-described solutions cannot be adopted in prior-art apparatuses, wherein the beam structure must necessarily remain empty inside in order to allow the trolley to pass.

[0101] The solution of the present invention allows making beam elements for hoisting and handling apparatuses which ensure low rolling surface roughness for the trolley wheels, reduced dimensional tolerances and controlled construction geometries, easy sand-blasting and painting inside the beam, and high stability of the beam against horizontal forces caused by loads being hoisted not perfectly vertically.

[0102] The solution of the present invention also allows making beam elements for hoisting and handling apparatuses which comprise beam elements that can be connected together, even with profiles having different height dimensions.

[0103] The solution of the present invention allows making beam elements for hoisting and handling apparatuses which can be fully inspected during production and for installation and maintenance purposes, in particular the busway trolleys and their sliding contacts, the wheels of the translating trolleys, and the inside of the beam, in order to check for corrosion.

[0104] The solution of the present invention allows making beam elements for hoisting and handling apparatuses into which balance counterweights or electric/pneumatic/hydraulic units can be inserted.

[0105] The solution of the present invention further allows arranging electrification means, to be secured under the beam element, for supplying power to motor means associated with the hoisting and handling apparatus. Such electrification can advantageously be provided at a later time without requiring the beam elements to be disassembled from their suspension supports.

[0106] Furthermore, the solution of the present invention allows using, for the mobile hoisting devices, trolleys without guide flanges but comprising a plurality of external guide rollers, which operate more smoothly and can be easily inspected. In general, the solution of the present invention allows using standard push-type or electric translating trolleys having compact dimensions.

[0107] In the light of the above description of some preferred and advantageous embodiments of the present invention, it will be apparent to the man skilled in the art that the invention may be subject to further modifications and variations.

[0108] For example, beam elements are conceivable with cross-sections having different height dimensions and/or not having a substantially rectangular shape, e.g. octagonal. The rectangular cross-section remains, however, the best compromise between strength and ease of bending during production.

[0109] Finally, a hoisting and handling apparatus according to the present invention may also, because of its modular nature, be very different from the examples shown herein for illustration purposes. Therefore, the most important element to be taken into account is the beam used for making the hoisting and handling apparatus.

[0110] In fact, the beam element is the essential component of the hoisting and handling apparatus, to which numerous accessory devices can then be added depending on the required configuration.

Claims

1. A hoisting and handling apparatus (300, 400), comprising at least one beam element (200) configured for being suspended and for supporting at least one mobile hoisting device (301), said at least one beam element (200) having a main direction of development and comprising at least one bent metal sheet forming two profiles (201, 202), respectively facing each other along said main direction of development and contiguous (203) with each other at the top of said beam element (200), said two profiles (201, 202) defining respective side faces (204, 205) of said beam element (200), said two profiles (201, 202) comprising respective support elements (206, 207) configured for supporting said mobile hoisting device (301) and for allowing it to slide along said main direction of development, **characterized in that** said respective support elements (206, 207) are positioned externally to said respective side faces (204, 205), and **in that** said beam element (200) further comprises at least one spacer element (210) interposed between said two profiles (201, 202) and constrained thereto, said at least one spacer element (210) being adapted to hold in position said two respective side faces (204, 205) in the structure of said beam element (200), for applying a load to said sup-

port elements (206, 207).

2. An apparatus according to claim 1, comprising two bent metal sheets forming said two profiles (201, 202) respectively facing each other, preferably symmetrically, said two bent metal sheets (201, 202) being joined (203) at the top of said beam element (200).
3. An apparatus according to claim 1 or 2, wherein said at least one spacer element (210) is positioned on one side of said beam element (200) opposite to said top (203), and wherein said two profiles (201, 202) facing each other form a box-like structure which is at least partially open on the side of said spacer element (210), wherein said two side faces (204, 205) face each other and are separated from each other by the inside of said beam element (200).
4. An apparatus according to claim 3, wherein said box-like structure is configured for allowing cables and/or pipes (801, 802) to run without affecting said support elements (206, 207) and without hindering the motion of said mobile hoisting device (301).
5. An apparatus according to any one of claims 1 to 4, comprising a plurality of said beam elements (200, 200d, 200c), said beam elements (200, 200d, 200c) being modular and having equal or different height dimensions, said beam elements (200, 200d, 200c) being connected together (211, 311) in order to allow said mobile hoisting device (301) to slide.
6. An apparatus according to claim 5, wherein said beam elements (200, 200d, 200c) are connected together by means of connection elements (303, 303c) at the interface between different beam elements (200, 200d, 200c) having different height dimensions.
7. An apparatus according to any one of claims 1 to 6, wherein said support elements (206, 207) comprise each a respective horizontal sliding track (208, 209) adjacent and external to the respective one of said side faces (204, 205) and adapted to allow said mobile hoisting device (301) to slide, even between adjacent beam elements (200, 200d, 200c).
8. An apparatus according to any one of claims 1 to 7, further comprising electrification means (501) constrained to said at least one spacer element (210), said electrification means being configured for supplying power to electric units (502, 306) of said mobile hoisting device (301).
9. An apparatus according to claim 8, wherein said electrification means (501) comprise electrified tracks positioned in the lower portion of said beam

element, higher than the bottom ends of said support element (206, 207), said electrified tracks being configured for being coupled to electric contacts (502) of said mobile hoisting device (301, 403).

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- 10.** An apparatus according to any one of claims 1 to 9, comprising at least two of said beam elements (401, 402) parallel to each other, and wherein said mobile hoisting device (403) in turn comprises at least one such beam element (404), said mobile hoisting device (403) being supported by said two parallel beam elements (401, 402) and being also slideable on respective support elements of said two parallel beam elements (401, 402).

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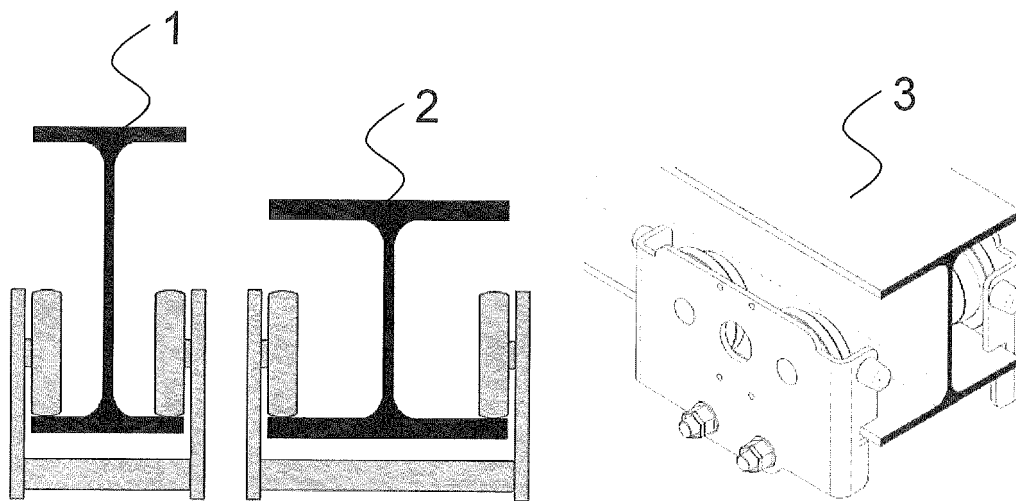
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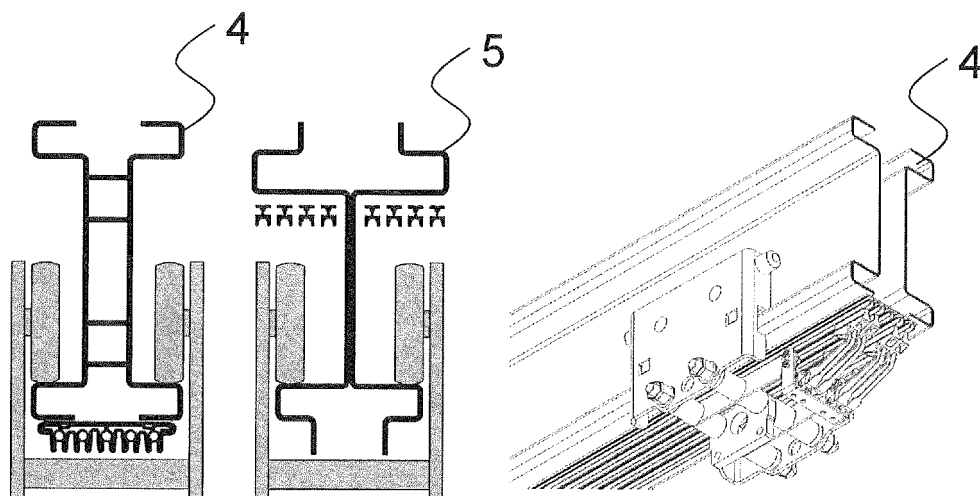
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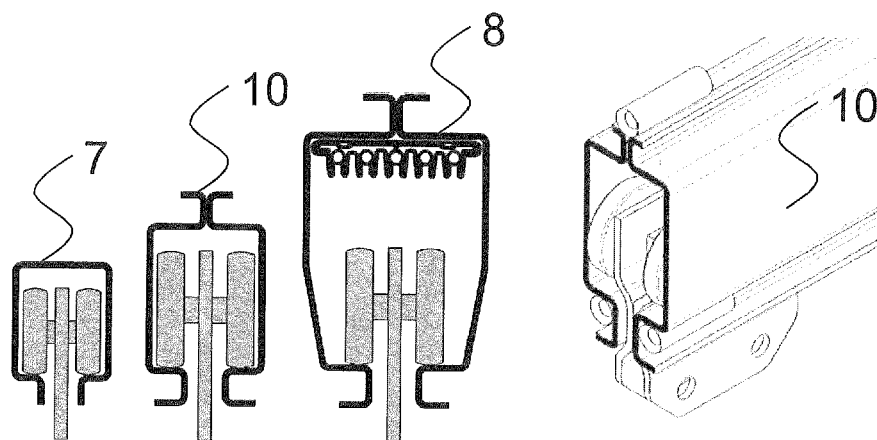
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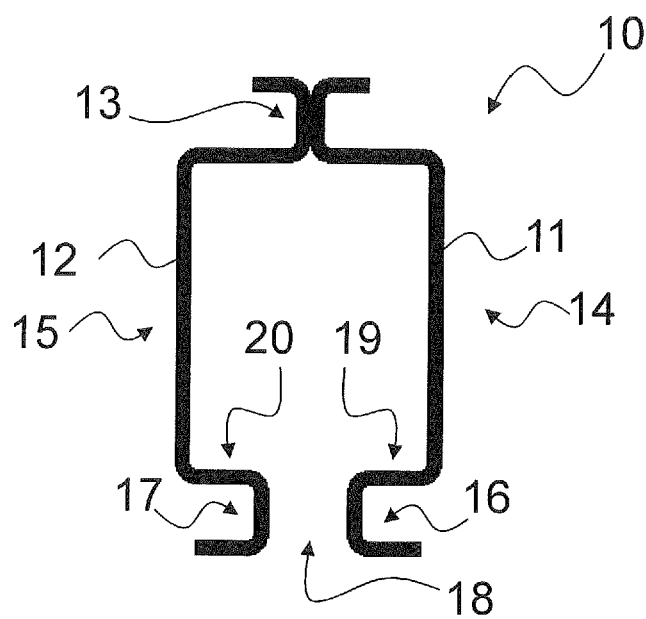
- PRIOR ART -
FIG. 1A



- PRIOR ART -
FIG. 1B



- PRIOR ART -
FIG. 1C



- PRIOR ART -
FIG. 1D

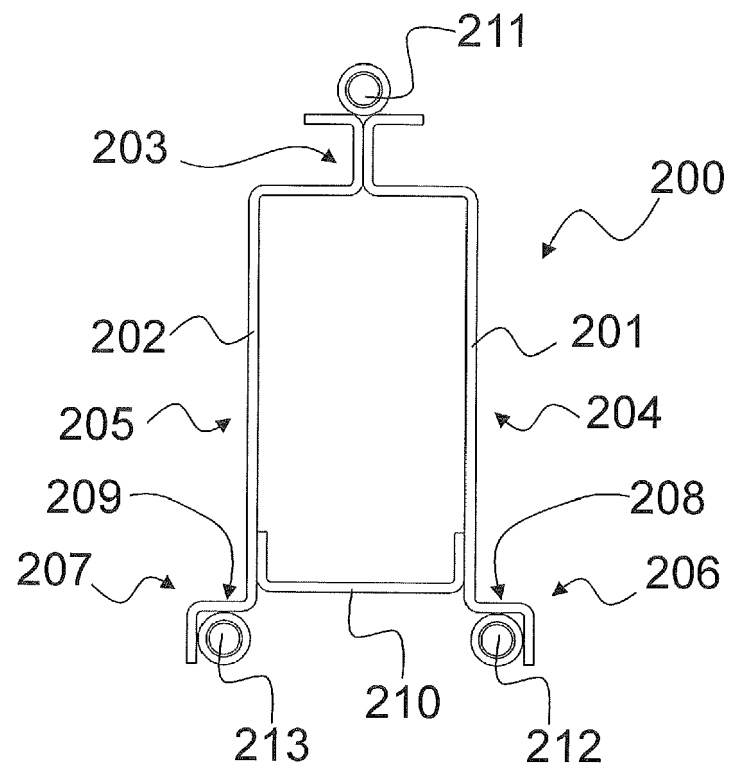


FIG. 2

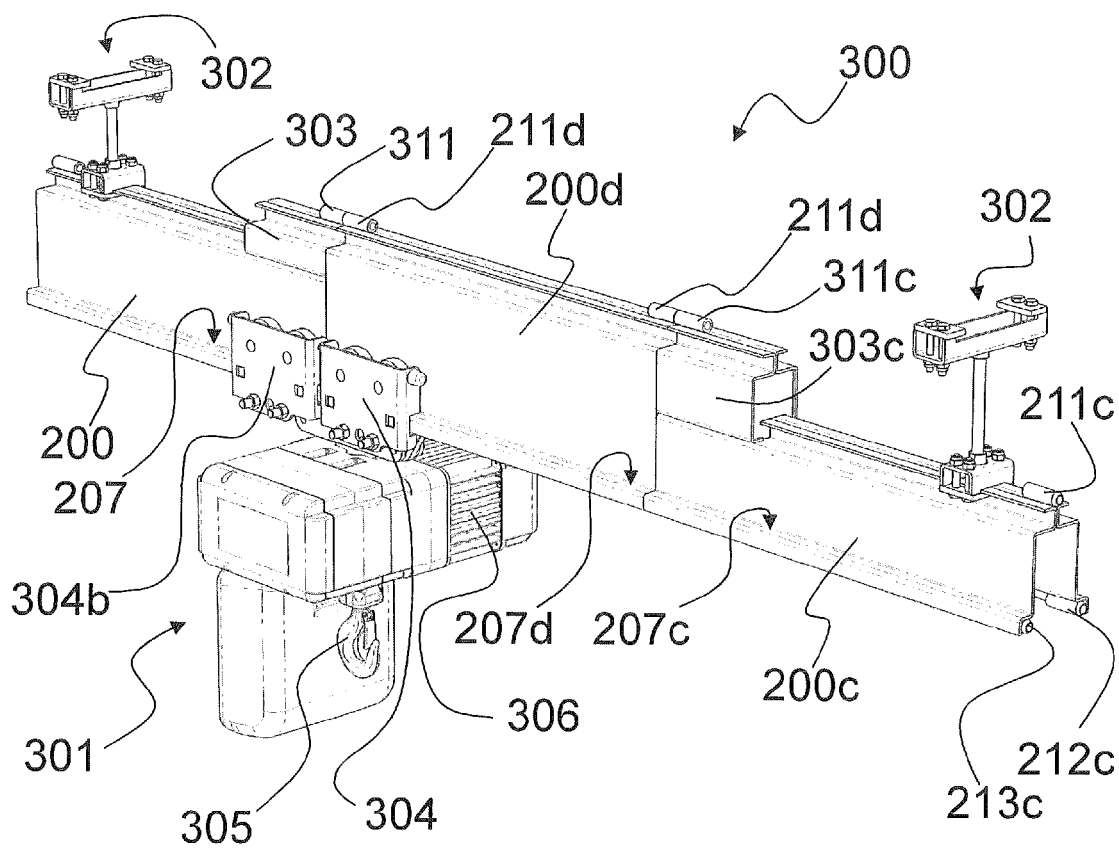


FIG. 3

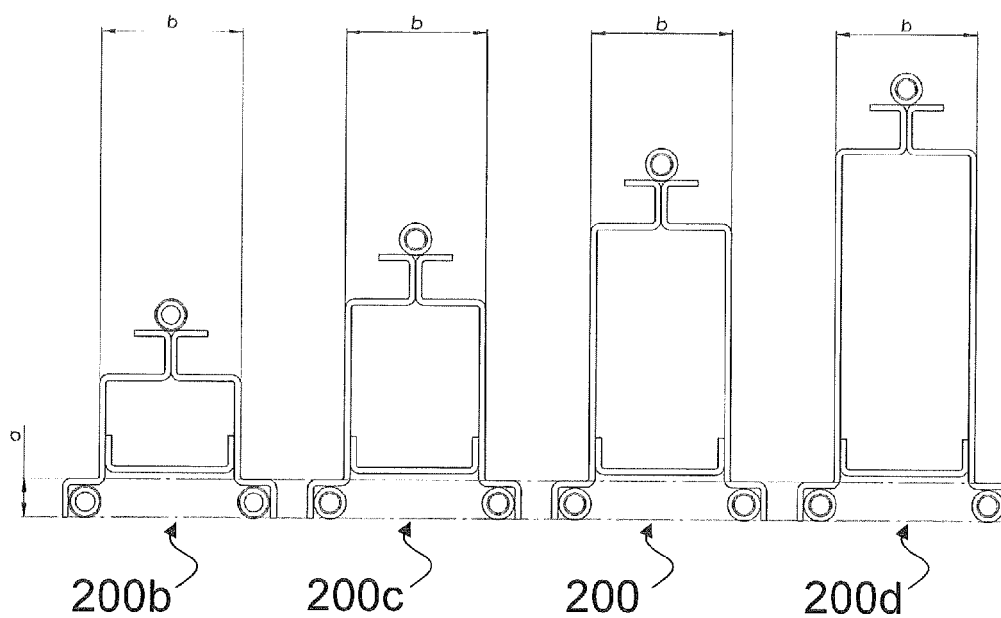


FIG. 4

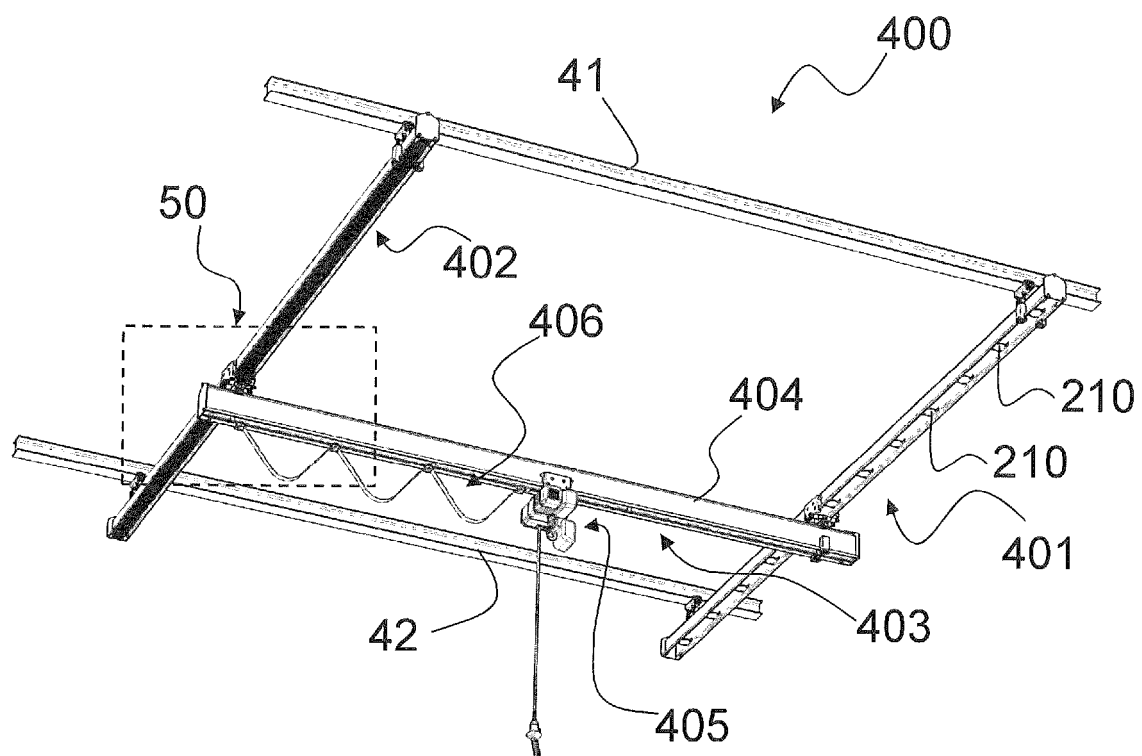


FIG. 5

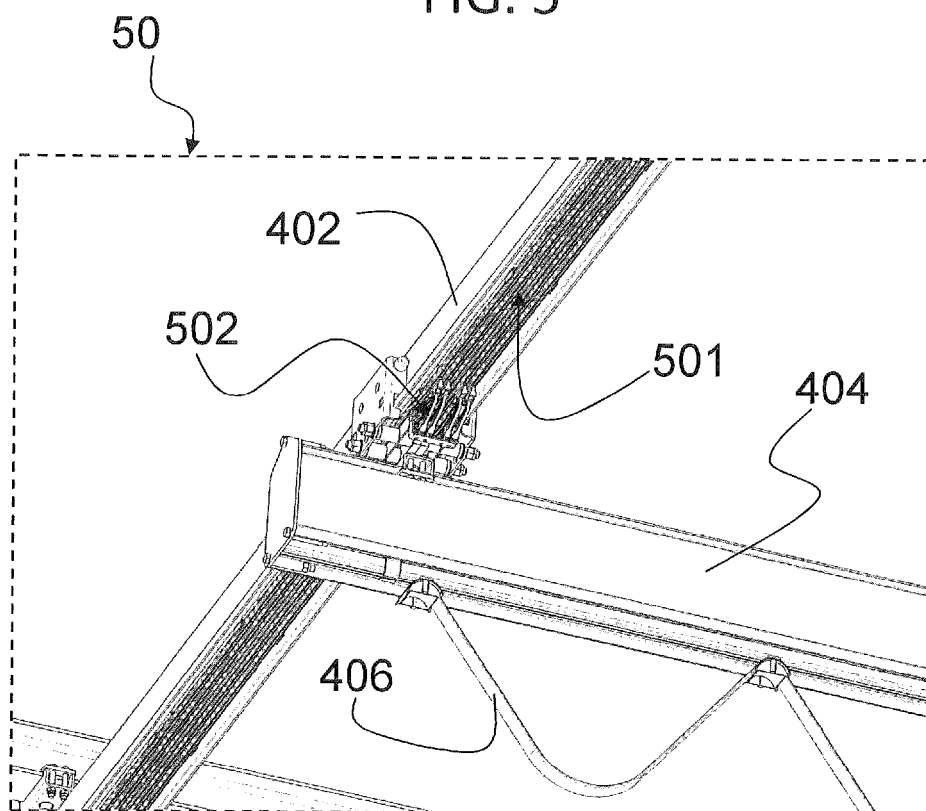


FIG. 6

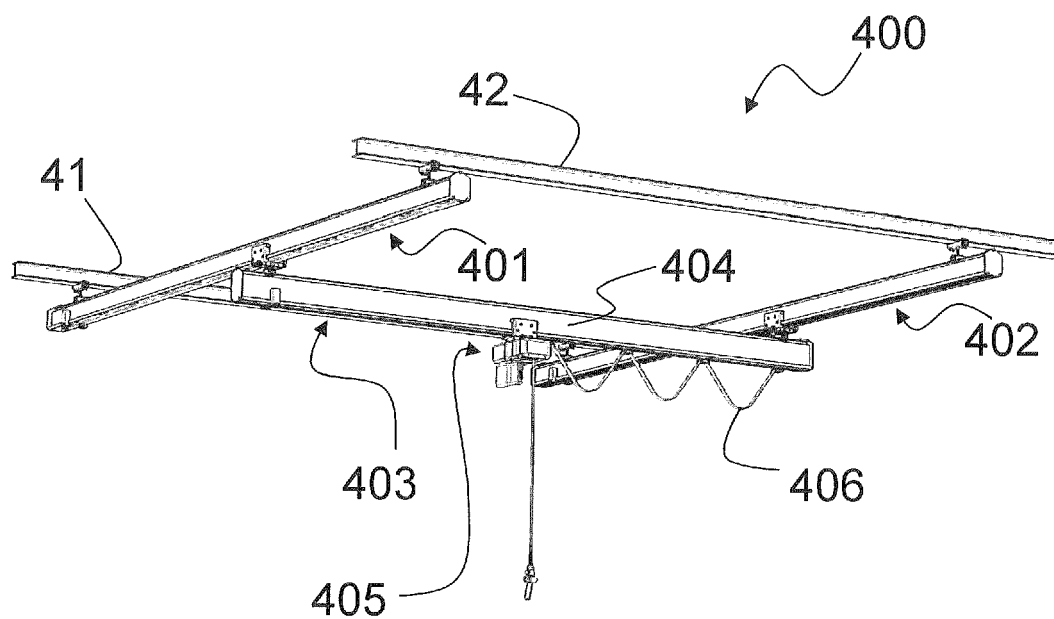


FIG. 7

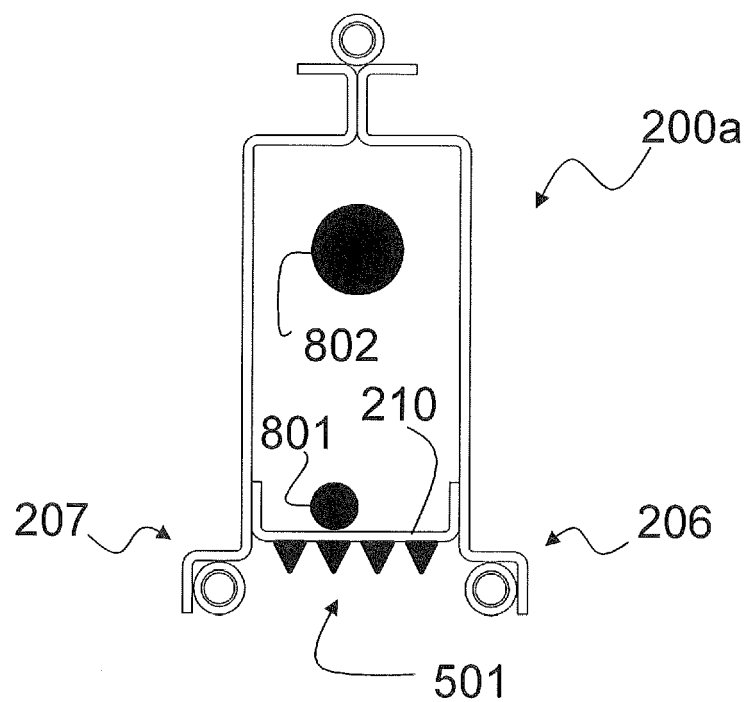


FIG. 8



EUROPEAN SEARCH REPORT

Application Number
EP 15 16 7370

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Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
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The present search report has been drawn up for all claims			
Place of search		Date of completion of the search	Examiner
The Hague		7 September 2015	Rupcic, Zoran
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

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**ANNEX TO THE EUROPEAN SEARCH REPORT
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EP 15 16 7370

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