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Maintenance device

The invention relates to a maintenance device for large-area steel construction surfaces, in particular of interior regions of ships or tank installations, having at least one carrier system movable along a vertical carrier, wherein at least one arm system is arranged on the carrier system, the at least one carrier system is movable via a lifting cylinder system along the vertical carrier, wherein extensions are provided on the vertical carrier, in which the at least one carrier system engages, and the lifting cylinder system of the at least one carrier system has two independently movable lifting cylinders whose piston rods interact with the extensions of the vertical carrier.

In EP 1 879 793 B1 a device for processing a tank container is described, wherein working platforms are pivoted via extension arms, which are held by a mast which is insertable through an upper opening of the tank space. In this case, at least the upper part of the mast is formed as a tube, and the extension arms are movable through the tube together with a support member on which they are articulated. A disadvantage of this system is that it has an expensive and complicated structure.

GB 861,733 A, which is regarded as the closest prior art, describes a tower crane which has a carrier system which can be moved by means of a hydraulic system, in which lifting cylinders engage in extensions arranged on a vertical carrier. A similar device can also be found in US 4,196,814 A.

In WO 2010/049326 A2 a maintenance system is described which has a working platform which is vertically movable within a scaffold-free interior of the maintenance device via a climbing device.

EP 0 516 938 A1 discloses a climbing device for a tower slewing crane with a lifting cylinder system, wherein two climbing devices arranged in tandem are installed in a guide piece comprising the tower.

The devices known from the prior art require a lot of space and are expensive to set up and difficult to transport.

It is therefore an object of the invention to provide a maintenance device that allows accessing all places in interior areas of ships or tank installations, for example, but at the same time has a simple and inexpensive construction, which is also easy to transport and assemble.

This object is achieved according to the invention in that the piston rods of the two lifting cylinders are each movable along at least one guide on the at least one carrier system, wherein the guide preferably has at least one change in direction and/or is formed in the manner of a connecting link.

The carrier system according to the invention is arranged on the vertical carrier and is movable along said carrier. In this case, the at least one arm system can be arranged on the carrier system such that it is oriented essentially parallel to the longitudinal axis of the vertical carrier when the system according to the invention is introduced, for example, into the interior of a tank. The lifting cylinder system according to the invention is particularly well suited due to its simple structure to move the at least one carrier system safely and reproducibly along the vertical carrier.

For this purpose, extensions are provided on the vertical carrier, in which the at least one carrier system engages. The extensions are in this case hook-like and arranged horizontally offset from one another on the vertical carrier. In this case, during movement of the carrier system, it engages in the extensions, wherein a stepped-like climbing of the carrier system by means of the lifting cylinder system along the vertical carrier is carried out by the horizontally offset arrangement of these extensions on the vertical carrier.

According to the invention, it is provided that the lifting cylinder system of the at least one carrier system has two independently movable lifting cylinders whose piston rods interact with the extensions of the vertical carrier. In this case, the distal ends of the piston rods engage in the hook-like extensions, wherein upon movement of the carrier system along the vertical carrier first a first piston rod engages in a first extension, while the piston rod of a second lifting cylinder, depending on the direction of movement, is extended or retracted in order to engage in one extension above or below the first extension. For this purpose, the extensions may be arranged one above the other along a

line parallel to the longitudinal axis of the vertical carrier or may be offset diagonally relative to one another.

In order to move the piston rods of the two lifting cylinders along defined paths, it is provided according to the invention that the piston rods of the two lifting cylinders are each movable along a guide on the at least one carrier system, wherein the guide has at least one change in direction and/or is formed in the manner of a connecting link. Due to this bending in the guide, it is possible to guide the distal ends of the piston rods out of the respective, preferably hook-like extensions.

In a particularly preferred embodiment of the invention, the vertical carrier has a substantially polygonal, preferably a square or rectangular cross-section, on whose side walls the extensions are arranged parallel to the longitudinal axis of the vertical carrier horizontally offset from one another. According to the invention, it is provided in this embodiment that the carrier system is arranged on at least one side wall of the vertical carrier and engages in these extensions.

In a particularly preferred embodiment of the invention, a working platform is arranged on the at least one arm system of the at least one carrier system, which can be used by two persons, for example. In this case, for example, one person is responsible for the movement and control of the working platform, while the second person carries out the inspection and/or processing of the steel construction area. Alternatively, it can also be provided that on the at least one arm system of the at least one carrier system, a tool holder is arranged for receiving maintenance tools, such as a combined washing/stripping tool for removing surface layers, in particular a water-jet and/or sandblasting tool, a flushing lance or a painting tool.

In order to ensure an accurate and secure advancement of the working platform or of the tool to the surface to be processed, the at least one arm system arranged on the at least one carrier system is formed as a multiple articulated arm system in a particularly preferred embodiment of the invention, preferably as a toggle lever system.

In order to be able to adapt the maintenance device according to the invention to different requirements, in particular with regard to its range, it is provided according to

the invention in a further embodiment that the at least one arm system is arranged in a segment-like manner, wherein the distal end segment of the arm system facing away from the carrier system has at least two pivot axes. Due to the segment-like structure of the arm system, the arm system can be adapted to the respective conditions by adding and/or removing individual segments. Due to the at least two pivot axes of the end segment, the working platform or tool holder can be brought with high precision to the surface to be processed, wherein this positioning accuracy is further increased in that in a preferred embodiment of the invention, the working platform and/or tool holder is additionally rotatably mounted on the distal end segment.

In practice, the embodiment of the invention has especially proven its worth in which at least one, preferably two carrier systems are arranged on the vertical carrier, wherein each carrier system has two arm systems, each having at its distal end segment a working platform. Thus, four arms, each with a working platform preferably for two people, are arranged on the vertical carrier, which can act substantially independently of each other, so that rapid processing of an interior of a ship, for example, is possible. In this case, in the case of two carrier systems, each with two arm systems, they can be movable independently of each other or depending on one another along the vertical carrier.

The invention is explained in more detail below with reference to a non-limiting embodiment with associated figures, wherein:

Fig. 1 shows a perspective view of the maintenance device according to the invention;

Fig. 2 shows a plan view of the base element of the maintenance device of Fig. 1;

Fig. 3 shows a side view of the vertical carrier;

Fig. 4 shows a sectional view of the vertical carrier of Fig. 3;

Fig. 5 shows the carrier system from Fig. 3 and Fig. 4 in a view from above, and

Fig. 6 shows a sectional view of the end segment of the arm system.

Fig. 1 shows the maintenance device 100 according to the invention, wherein a carrier system 200 with four arm systems 300 arranged thereon is arranged on a vertical carrier 110. The vertical carrier 110 is fixed in a base element 120, which in the present embodiment has a substantially square layout, at the corner points of each of which a roller 121 and a pedestal 122 is arranged. By means of the rollers 121, the maintenance device 100 can be moved in a simple manner, while the adjustable pedestals 122 serve to stably set up the maintenance device 100 at the intended location, for example in the interior of a ship's tank.

In Fig. 2, the base element 120 is shown in a view from above, wherein the vertical carrier 110 is insertable into a receptacle 123 of the base element 120.

As shown in Figs. 3 and 4, the vertical carrier 110 has extensions 111 which are arranged along a fall line F parallel to the longitudinal axis A of the vertical carrier 110. These hook-like extensions 111 are arranged on the side walls 112 of the vertical carrier 110 such that they each extend horizontally offset from one another.

On the vertical carrier 110, a carrier system 200 is arranged, which has two hydraulic cylinders 210, 210' with piston rods 211, 211'. The distal end 212, 212' of the piston rod 211, 211' remote from the lifting cylinder 210, 210' can be moved along a guide 213, 213' with a bend and engages in a recess 111a, 111a' of an extension 111, 111'.

If the carrier system 200 is now to be moved downwards as shown in Fig. 4, first the piston rod 211 of the first hydraulic cylinder 210 shown in the left half of the drawing is retracted, so that it is removed from the recess 111a of the extension 111. Simultaneously, the piston rod 211' of the second hydraulic cylinder 210' is extended along the guide 213' until its distal end 212' engages in the recess 111a' of the extension 111'.

Upon further downward movement along the vertical carrier 110, in turn, the piston rod 211' is retracted, while the piston rod 211 of the first hydraulic cylinder 210 is extended so that it can engage in the extension 111 situated adjacently below the first extension 111. In this way, the carrier system 200 is gradually moved downward. The upward

movement of the carrier system 200 along the vertical carrier 110 takes place in an analogous manner.

Fig. 5 again shows the carrier system 200 in a view from above, wherein it can be seen that the carrier system 200 encloses the vertical carrier 110, wherein the vertical carrier 110 has a substantially square cross-section.

As shown in particular in Fig. 1, the arm systems 300 are attached to the carrier system 200. The arm system 300 is constructed for this purpose segment-like, wherein the individual segments 310 are fastened to each other, for example via bolt connections. Furthermore, each arm segment 310 is preferably connected to the adjacent segment 310 by means of a hydraulic pivoting system 320, which, in the manner of a toggle, allows the segments 310 to bend toward one another. In addition, each arm system 300 is mounted on the carrier system 200 such that it is pivotable in the horizontal plane through an angle of more than 180°.

At the distal end 330 of the arm system 300, an end segment 340 is arranged to which a work cage 350 is attached. The end segment 340 (see Fig. 6) can be pivoted via two axes, wherein the pivoting takes place about a first pivot axis S1 with the aid of a double-chain drive 341. A second pivot axis S2 extends substantially normal to the first pivot axis S1. Finally, the work cage 350 is additionally attachable via a rotating shaft to the end segment 340 (not shown).

Of course, the present invention is not limited to the illustrated embodiment. In fact, it can also be provided that not a single carrier system 200 comprising the vertical carrier 110 is provided, but that it is designed, for example, in two parts, wherein in each case one carrier system surrounds at least one side with two adjacent edges. Likewise, the extensions can be designed differently, as well as their horizontal and/or vertical arrangement can vary on the vertical carrier.

VEDLIGEHOLDELSESENHED

Krav

1. Vedligeholdelsesenhed (100) til overflader med stort areal i stålkonstruktioner og specielt i indvendige områder af skibe eller tankinstallationer, som har mindst et bærersystem (200), der kan bevæges langs en vertikal bærer (110), hvori mindst ét armsystem (300) er arrangeret på bærersystemet (200), og mindst ét bærersystem (200) kan bevæges via et løftecylindersystem langs den vertikale bærer (110), hvori udvidelserne (111, 111') er placeret på den vertikale bærer (110), hvorpå mindst ét bærersystem (200) går i indgreb, og løftecylindersystemet på mindst ét bærersystem (200) har to uafhængigt flytbare løftecylindere (210, 210'), hvis stempelstænger (211, 211') interagerer med udvidelserne (111, 111') på den vertikale bærer (110), **kendetegnet derved, at** stempelstængerne (211, 211') på de to løftecylindere (210, 210') hver kan bevæges langs mindst ét styr (213, 213') på mindst ét bærersystem (200), hvori styret (213, 213') helst har mindst én ændring i retning og/eller er udformet som et forbindelsesled.

2. Vedligeholdelsesenhed (100) i henhold til krav 1, **kendetegnet derved, at** udvidelserne (111, 111') er dannet i en kroglignende måde og er arrangeret vandret forskudt for hinanden på den vertikale bærer (110).

3. Vedligeholdelsesenhed (100) i henhold til ét af kravene 1 eller 2, **kendetegnet derved, at** den vertikale bærer (110) har en hovedsageligt polygonal, helst firkantet eller rektangulær tværsnit på hvis sidevægge udvidelserne (111, 111') er arrangeret parallelt med den langsgående akse (A) på den vertikale bærer (110) og horisontalt forskudt fra hinanden.

4. Vedligeholdelsesenhed (100) i henhold til ét af kravene 1 til 3, **kendetegnet derved, at** der er arrangeret en arbejdsplatform (350) på mindst ét armsystem (300) på mindst ét bærersystem (200).

5. Vedligeholdelsesenhed (100) i henhold til ét af kravene 1 til 4, **kendetegnet derved, at** på mindst ét armsystem (300) på mindst ét bærersystem (200) er arrangeret en værktøjsholder til modtagelse af vedligeholdelsesværktøjer, f.eks. et kombineret vaske-/aftagningsværktøj til aftagning af overfladelag, og særligt et vandstråle- og/eller sandblæsningsværktøj, en skyllelanse eller et maleværktøj.

6. Vedligeholdelsesenhed (100) i henhold til ét af kravene 1 til 5, **kendetegnet derved, at** på mindst ét bærersystem (200) er mindst ét arrangeret armsystem (300) udformet som et system med flere ledarme og helst som et system med skiftegreb.

7. Vedligeholdelsesenhed (100) i henhold til ét af kravene 1 til 6, **kendetegnet derved, at** armsystemet (300) er arrangeret på en segmentlignende måde, hvori det distale endesegment (340) på armsystemet (300), der vender væk fra bærersystemet (200), har mindst to pivotakser (S1, S2), og helst arbejdsplatformen (350) og/eller værktøjsholderen er desuden monteret med mulighed for at rotere på det distale endesegment (340).

8. Vedligeholdelsesenhed (100) i henhold til ét af kravene 1 til 7, **kendetegnet derved, at** på den vertikale bærer (210) er der arrangeret mindst ét, men helst to bærersystemer (200), hvori hvert bærersystem (200) omfatter mindst ét, men helst to armsystemer (300), som hver i dets distale endesegment (340) har en arbejdsplatform (350).

9. Vedligeholdelsesenhed (100) i henhold til krav 8, **kendetegnet derved, at** hvert armsystem (300) er bevægeligt hovedsageligt uafhængigt af de andre armsystemer (300).

10. Vedligeholdelsesenhed (100) i henhold til ét af kravene 8 eller 9, **kendetegnet derved, at** afhængigt af hinanden eller uafhængigt af hinanden kan de to bærersystemer (200) bevæges langs den vertikale bærer (110).

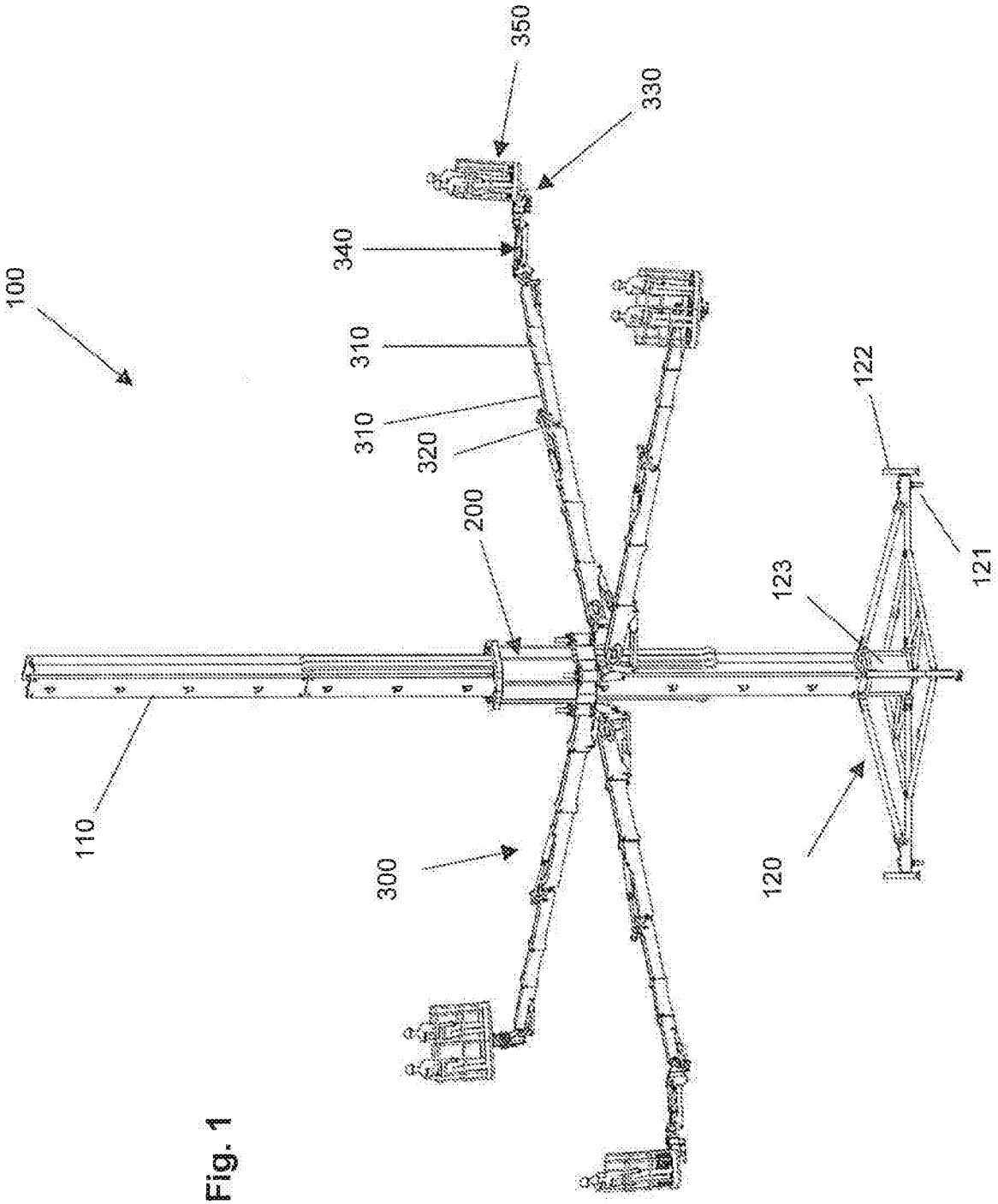

Fig. 1

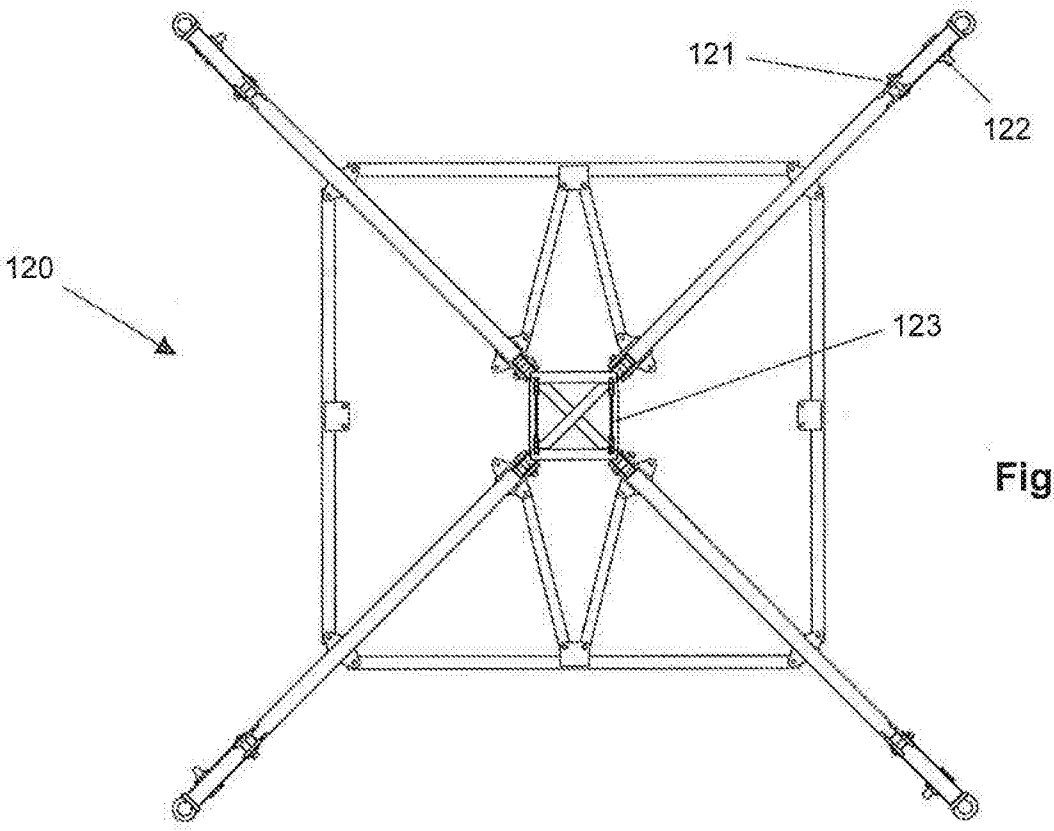

Fig. 2

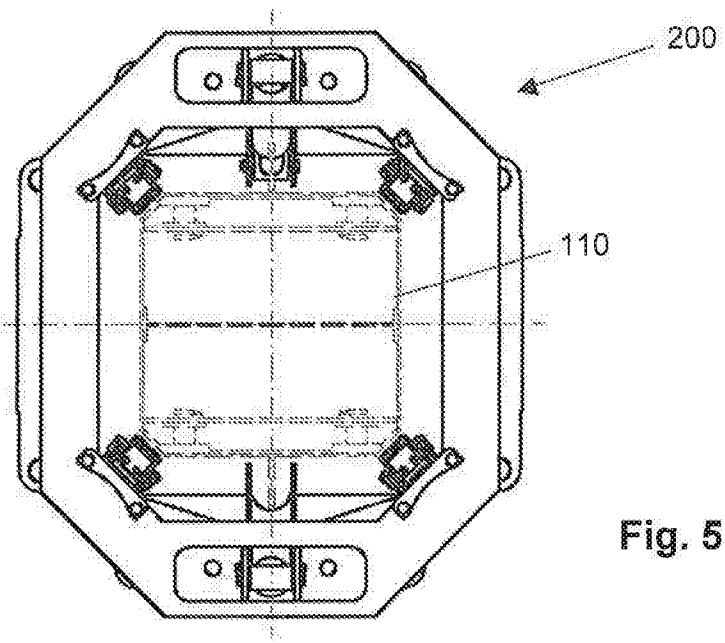

Fig. 5

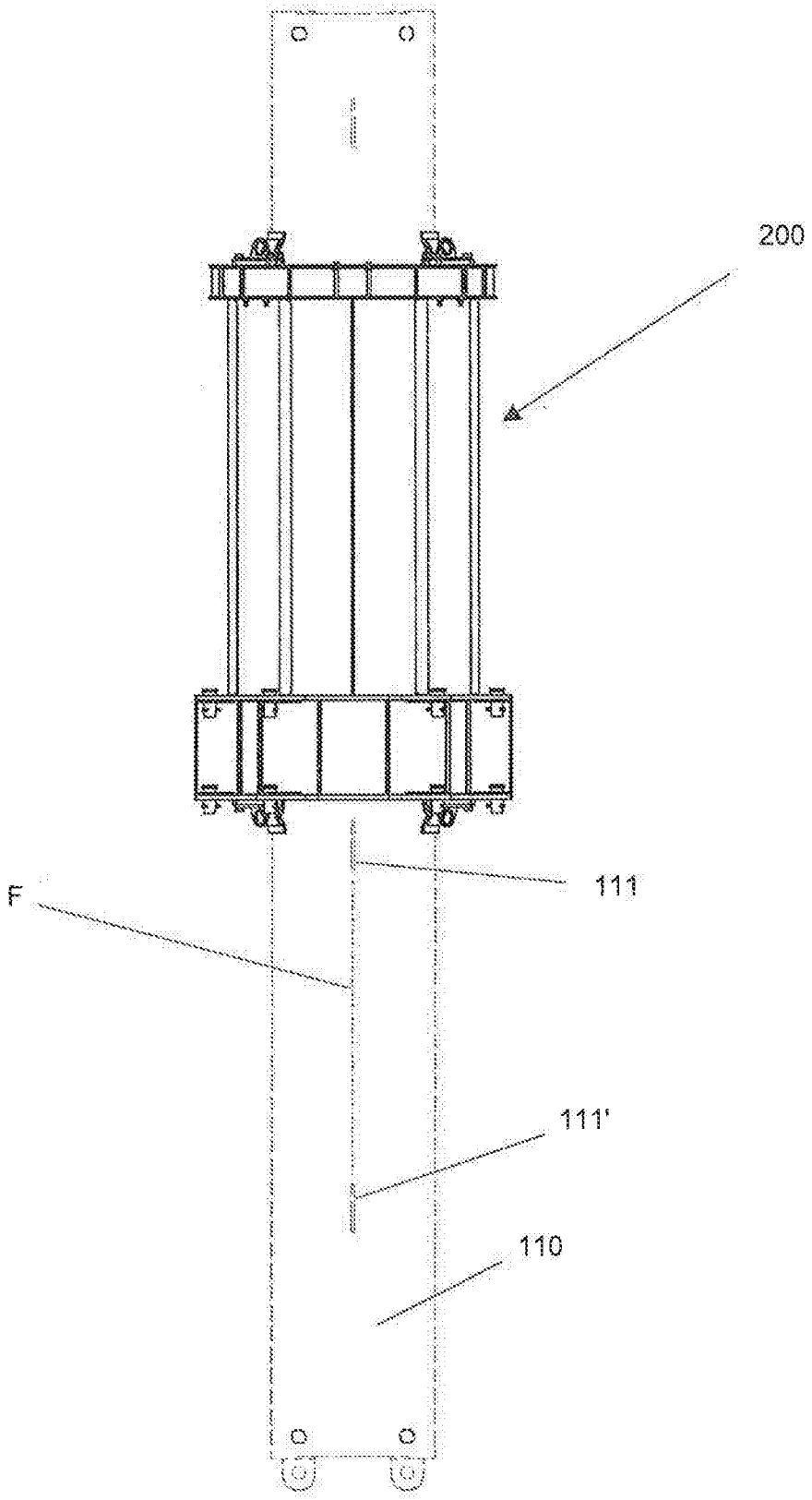

Fig. 3

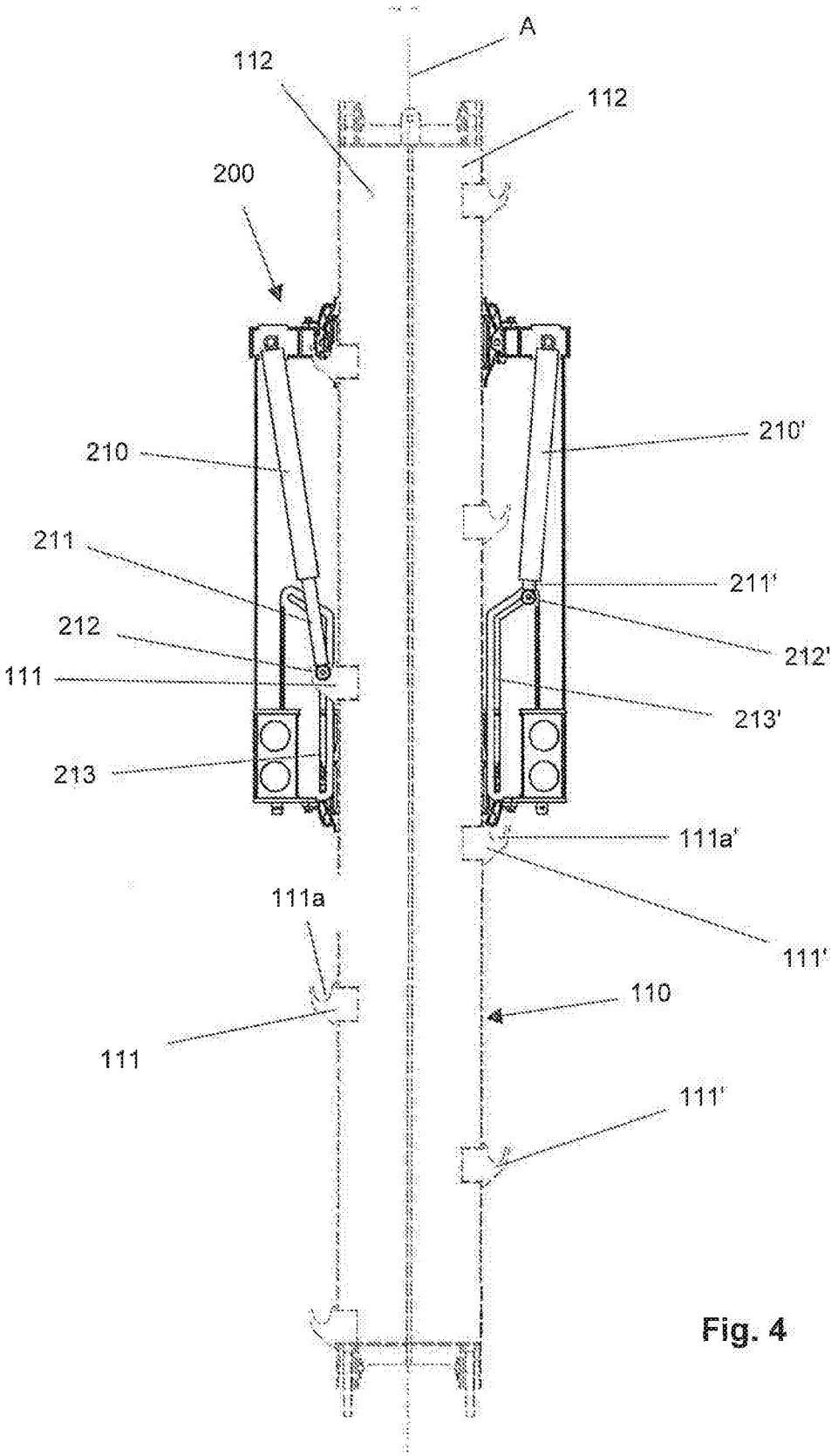
A
112
112
200
210
210'
211
211'
212
212'
111
213'
213
111a'
111a
111'
110
111
111''

Fig. 4

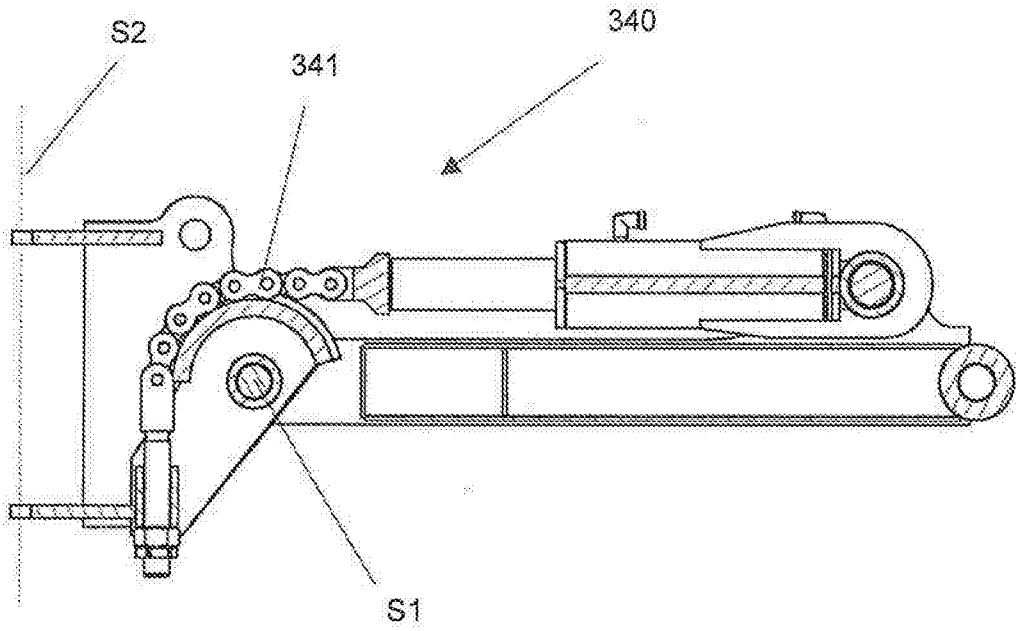

Fig. 6