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(54) **Two-member structure with a two-member connecting device**

Zweiteilige Struktur mit einer zweiteiligen Verbindungsvorrichtung

Structure à deux éléments avec dispositif de connexion à deux éléments

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Description

TECHNICAL FIELD

[0001] The present invention relates to a two-member connecting device which is suitably used in connecting together two members of such as a plurality of booms used in, for example, a hydraulic excavator.

BACKGROUND ART

[0002] In general, in a case where a structure having a large ground height such as a high-rise building is demolished, a hydraulic excavator equipped with a working mechanism for demolition work is suitably used. This working mechanism for demolition work generally has a plurality of booms, which is called a multi-boom, and an arm is mounted to a distal end side of an uppermost-stage boom among the booms, a working tool such as a crusher, a grapple, or the like being attached to a distal end side of the arm.

[0003] Two adjacent booms in the multi-boom for demolition work are arranged to be connected to each other by inserting connecting pins into pin insertion holes provided in one boom and pin insertion holes provided in the other boom.

[0004] In this case, as a multi-boom according to the prior art, one has been proposed which is constructed such that a positioning pin is fixedly provided on one of the two adjacent booms at a position different from that of the connecting pin, and a hook member which engages the positioning pin fixed on the one boom is provided on the other one of the booms.

[0005] With the multi-boom according to this conventional art, when one boom and the other boom are connected by using connecting pins, the one boom is lifted up by engaging the hook member provided on the other boom with the positioning pin on the one boom to rotate the one boom about the positioning pin. In consequence, the pin insertion holes of the one boom and the pin insertion holes of the other boom can be aligned, whereby the two adjacent booms are arranged to be connected by inserting the connecting pins into the pin insertion holes of these booms (e.g., see Japanese Utility Model Laid-Open No. H4-134566).

[0006] In US 2006 157605 a modular system for connecting attachments to the extension arm of a construction machine is described, wherein each module has a standardized coupling arrangement. It is an object to provide a design that will provide the machine owner with the flexibility of a single set of attachments that may be suitable for use with any of a variety of construction machines from different manufacturers.

DISCLOSURE OF THE INVENTION

[0007] However, with the above-described prior art, the positioning pin fixed on one boom is arranged at a position spaced apart from the pin insertion hole. For this reason, there is a problem in that when after the engagement of the hook member provided on the other boom with the positioning pin, the one boom is lifted up and is thereby rotated about the positioning pin, it is difficult to effect the positioning of the pin insertion hole of the one boom and the pin insertion hole of the other boom.

[0008] For this reason, much time is required in the operation of inserting the connecting pin into the pin insertion hole provided in one boom and the pin insertion hole provided in the other boom, and therefore there is a problem in that workability declines at the time of connecting the two adjacent booms.

[0009] In view of the above-discussed problems with the prior art, it is and object of the present invention to provide a two-member connecting device which makes it possible to smoothly insert the connecting pin into the pin insertion holes respectively provided in the two members when the two members are connected by using the connecting pin.

(1) To overcome the above-described problems, there is provided a two-member connecting device comprising: left and right first brackets provided on a first member in such a manner as to oppose each other in a left-right direction; upper and lower first pin insertion holes respectively provided in the left and right first brackets In such a manner as to be vertically spaced apart from each other; left and right second brackets provided on a second member which is connected to the first member, the left and right second brackets respectively opposing the first brackets; upper and lower second pin insertion holes respectively provided in the left and right second brackets in such a manner as to be vertically spaced apart from each other, the upper and lower second pin insertion holes being capable of being respectively arranged coaxially with the upper and lower first pin insertion holes; upper and lower connecting pins respectively inserted into the upper and lower first pin insertion holes and the upper and lower second pin insertion holes; and upper and lower pin inserting/withdrawing mechanisms which are disposed between the left and right first brackets and are inserted and withdrawn with respect to the upper and lower second pin insertion holes in a state in which the upper and lower connecting pins are inserted In the upper and lower first pin insertion holes.

The characteristic of the present invention lies in that an upper centering member for aligning an axis of the upper connecting pins with an axis of the upper second pin insertion holes when the upper connecting pins are inserted into the upper first pin insertion holes and the upper second pin insertion holes, and a lower centering member for aligning an axis of the lower connecting pins with an axis of the lower second pin insertion holes when the lower connecting pins are inserted into the lower first pin insertion holes and the lower second pin insertion holes, are provided at positions respectively opposing the second brackets in the second member.

With this arrangement, when the upper connecting pins are inserted into the upper first pin insertion holes of the first brackets and the upper second pin insertion holes of the second brackets, the axis of the upper connecting pins can be aligned with the axis of the upper second pin insertion holes by the upper centering members. In addition, when the lower connecting pins are inserted into the lower first pin insertion holes of the first brackets and the lower second pin insertion holes of the second brackets, the axis of the lower connecting pins can be aligned with the axis of the lower second pin insertion holes by the lower centering members. As a result, the upper connecting pins can be smoothly inserted into the upper first pin insertion holes and the upper second pin insertion holes, and the lower connecting pins can be smoothly inserted into the lower first pin insertion holes and the lower second pin insertion holes. Therefore, it is possible to enhance workability at the time of connecting the first brackets and the second brackets by using these upper and lower connecting pins.

(2) According to the invention, the upper centering member is formed by a plate extending from an upper corner portion of the second member in parallel to the second bracket and having an engaging groove portion which is curved in a circular arc shape by surrounding the upper second pin insertion hole and is adapted to be engaged with the upper connecting pin, and/or the lower centering member is formed by a plate extending from a lower corner portion of the second member in parallel to the second bracket and having an abutting groove portion which is curved in a circular arc shape along the lower second pin insertion hole and is adapted to abut against the lower connecting pin.

With this arrangement, as the engaging groove portions of the upper centering members provided on the second member are engaged with the upper connecting pins inserted in the upper first pin insertion holes of the first brackets, the second member is rotated about the upper connecting pins, and the abutting groove portions of the lower centering members abut against the lower connecting pins inserted in the lower first pin insertion holes of the first brackets. Thus, as the engaging groove portions of the upper centering members are engaged with the upper connecting pins, and the abutting groove portions of the lower centering members are abutted against the lower connecting pins, the axis of the upper connecting pins and the axis of the upper second pin insertion holes can be aligned, and the axis of the lower connecting pins and the axis of the lower second pin insertion holes can be aligned by the lower centering members.

(3) According to a preferred aspect, each of the upper and lower connecting pins is constituted by a large diameter portion which is inserted into a corresponding one of the upper and lowerfirst pin insertion holes and a corresponding one of the upper and lower second pin insertion holes, and/or a small diameter portion which has a smaller outside dimension than the large diameter portion and forms a clearance with respect to a corresponding one of the upper and lower centering members in a state in which the large diameter portion is inserted in the corresponding one of the upper and lower first pin insertion holes and the corresponding one of the upper and lower second pin Insertion holes.

With this arrangement, a clearance is formed between the small diameter portion of the upper connecting pin and the upper centering member in the state in which the large diameter portion of the upper connecting pin is inserted in the upper first pin insertion hole of the first bracket and the upper second pin insertion hole of the second bracket. In consequence, the load which is transmitted between the first and second brackets through the upper connecting pins can be suppressed from being transmitted to the upper centering members. Likewise, the load which is transmitted between the first and second brackets through the lower connecting pins can be suppressed from being transmitter to the lower centering members. As a result, the upper centering members and the lower centering members can be formed by use of thin-walled plates, so that it is possible to attain a reduction in their weight.

(4) Further, according to a preferred aspect, the upper pin inserting/withdrawing mechanism is constituted by: a hydraulic cylinder disposed telescopically at a position spaced apart from a position of the axis of the upper connecting pins; a floating link disposed at a position spaced apart in a same direction as the hydraulic cylinder from the position of the axis of the upper connecting pins, In a floating state in which the floating link is capable of moving in at least a direction perpendicular to the axis of the upper connecting pins; a left link connecting the left upper connecting pin inserted in the left upper first pin insertion hole of the left first bracket and the hydraulic cylinder by means of the floating link; and/or a right link connecting the right upper connecting pin inserted in the right upper first pin insertion hole of the right first bracket and the hydraulic cylinder by means of the floating link, and/or wherein the lower pin inserting/withdrawing mechanism is constituted by: a hydraulic cylinder disposed telescopically at a position spaced apart from a position of the axis of the lower connecting pins; a floating link disposed at a position spaced apart in a same direction as the hydraulic cylinder from the position of the axis of the lower connecting pins, in a floating

state in which the floating link is capable of moving in at least a direction perpendicular to the axis of the lower connecting pins; a left link connecting the left lower connecting pin inserted in the left lower first pin insertion hole of the left first bracket and the hydraulic cylinder by means of the floating link; and/or a right link connecting the right lower connecting pin inserted in the right lower first pin insertion hole of the right first bracket and the hydraulic cylinder by means of the floating link.

With this arrangement, if the hydraulic cylinder of the upper pin inserting/withdrawing mechanism is extended or contracted, the left and right links rotate in the left-right direction with the floating link as a fulcrum, and the left and right upper connecting pins connected to these left and right links move in the left-right direction, thereby making it possible to insert and withdraw the left and right upper connecting pins with respect to the left and right upper first pin insertion holes and the left and right upper second pin insertion holes. Meanwhile, if the hydraulic cylinder of the lower pin inserting/withdrawing mechanism is extended or contracted, the left and right links rotate in the left-right direction with the floating link as a fulcrum, and the left and right lower connecting pins connected to these left and right links move in the left-right direction, thereby making it possible to insert and withdraw the left and right lower connecting pins with respect to the left and right lower first pin insertion holes and the left and right lower second pin insertion holes. Thus, since the operation of inserting and withdrawing the upper and lower connecting pins with respect to the left and right first brackets and the left and right second brackets can be performed easily by use of the hydraulic cylinders, it is possible to enhance workability at the time of connecting or disconnecting the first member and the second member,

(5) According to a preferred aspect, the upper pin inserting/withdrawing mechanism is supported in cantilevered state by the left upper connecting pin inserted in the left upper first pin insertion hole of the left first bracket and by the right upper connecting pin inserted in the right upper first pin insertion hole of the right first bracket, and the lower pin inserting/withdrawing mechanism is supported in cantilevered state by the left lower connecting pin inserted in the left lower first pin insertion hole of the left first bracket and by the right lower connecting pin inserted in the right lower first pin insertion hole of the right first bracket.

In consequence, the upper pin inserting/withdrawing mechanisms can be supported in a cantilevered state by making use of the left and right upper connecting pins, and the lower pin inserting/withdrawing mechanisms can be supported in a cantilevered state by making use of the left and right lower connecting pins. As a result, members for mounting the upper and lower pin inserting/withdrawing mechanisms between the left and right first brackets can be made unnecessary, thereby making it possible to enhance workability at the time of mounting the upper and lower pin inserting/withdrawing mechanisms.

(6) According to a preferred aspect, the hydraulic cylinder of the upper pin inserting/withdrawing mechanism is disposed so as to be capable of extending and contracting in a same direction as the axis of the left upper connecting pin and the right upper connecting pin, and the left and right links of the upper pin inserting/withdrawing mechanism are each constituted by one link so as to connect the hydraulic cylinder and the floating fink to the upper connecting pins, respectively, and wherein the hydraulic cylinder of the lower pin inserting/withdrawing mechanism is disposed so as to be capable of extending and contracting in a same direction as the axis of the left slower connecting pin and the right lower connecting pin, and the left and right links of the lower pin inserting/withdrawing mechanism are each constituted by one link so as to connect the hydraulic cylinder and the floating link to the lower connecting pins, respectively.

With this arrangement, in the case where the hydraulic cylinder of the upper pin inserting/withdrawing mechanism is extended or contracted in the same direction as the axis of the left and right upper connecting pins, the left and right links rotate in the left-right direction by using their portions of connection to the floating link as a fulcrum, thereby making it possible to insert or withdraw the left and right upper connecting pins with respect to the left and right upper second pin insertion holes. Meanwhile, in the case where the hydraulic cylinder of the lower pin inserting/withdrawing mechanism is extended or contracted in the same direction as the axis of the left and right lower connecting pins, the left and right links rotate in the left-right direction by using their portions of connection to the floating link as a fulcrum, thereby making it possible to insert or withdraw the left and right lower connecting pins with respect to the left and right lower second pin insertion holes.

(7) Further, according to a preferred aspect, the hydraulic cylinder of the upper pin inserting/withdrawing mechanism is disposed so as to be capable of extending and contracting in the direction perpendicular to the axis of the left upper connecting pin and the right upper connecting pin, the floating link is connected to one end of the hydraulic cylinder, and the left and right links of the upper pin inserting/withdrawing mechanism are constituted by left and right first links for respectively connecting each of the left and right upper connecting pins and the floating link, and left and right second links for connecting another end of the hydraulic cylinder and an intermediate portion of each of the left and right first links, and wherein the hydraulic cylinder of the lower pin inserting/withdrawing mechanism is disposed so as to be capable of extending and contracting in the direction perpendicular to the axis of the left lower connecting pin and the right lower connecting pin, the floating link is connected to one end of the hydraulic cylinder, and the left and right links of the lower pin inserting/withdrawing mechanism are constituted by left and

right first links for respectively connecting each of the left and right lower connecting pins and the floating link, and left and right second links for connecting another end of the hydraulic cylinder and an intermediate portion of each of the left and right first links.

[0010] According to this configuration, as the hydraulic cylinders for constituting the upper and lower pin inserting/withdrawing mechanisms are disposed so as to be capable of extending and contracting in the direction perpendicular to the axis of the left and right upper connecting pins and the left and right lower connecting pins, even in a case where the interval between the left and right first brackets is narrow, the upper and lower pin inserting/withdrawing mechanisms can be easily disposed between these left and right first brackets.
The above described preferred aspects of the present invention can be combined partly or as a whole to form further preferred aspects of the invention.

BRIEF DESCRIPTION OF THE DRAWINGS

[0011]

Fig. 1 is a front view illustrating a multi-boom type hydraulic excavator to which a two-member connecting device according to an embodiment of the invention is applied;
Fig. 2 is a front view illustrating a state in which an extension boom is connected to a lower boom;
Fig. 3 is a perspective view illustrating the lower boom, left and right first brackets, an upper pin inserting/withdrawing mechanism, and the like;
Fig. 4 is a fragmentary perspective view illustrating in enlarged scale upper connecting pins, the upper pin inserting/withdrawing mechanism, and the like;
Fig. 5 is a cross-sectional view, taken in the direction of arrows V - V in Fig. 2, of the left and right first brackets, the connecting pins, the pin inserting/withdrawing mechanisms, and the like in a state in which the connecting pins are at a disengaged position;
Fig. 6 is a cross-sectional view similar to Fig. 5 and illustrates a state in which the connecting pins have been moved to a connecting position;
Fig. 7 is a cross-sectional view, taken in the direction of arrows VII - VII in Fig. 5, of the connecting pins, the pin inserting/withdrawing mechanisms, and the like;
Fig. 8 is a perspective view illustrating the extension boom, left and right second brackets, upper centering members, lower centering members, and the like;
Fig. 9 is a cross-sectional view, taken in the direction of arrows IX -IX in Fig. 2, of the left and right second brackets, the upper centering members, the lower centering members, and the like;
Fig. 10 is a cross-sectional view, taken in the direction of arrows X - X in Fig. 9, of the second bracket, the upper centering member, the lower centering member, and the like;
Fig. 11 is a cross-sectional view taken from a position similar to that of Fig. 7 and illustrates a state in which the upper connecting pins are inserted in the first and second brackets;
Fig. 12 is a cross-sectional view taken in the direction of arrows XII - XII in Fig. 11 and illustrates the state in which the upper connecting pins are inserted in the first and second brackets;
Fig. 13 is a cross-sectional view similar to Fig. 11 and illustrates a state in which the upper connecting pins and lower connecting pins are inserted in the first and second brackets;
Fig. 14 is a cross-sectional view taken in the direction of arrows XIV - XIV in Fig. 13 and illustrates the state in which the upper connecting pins and the lower connecting pins are inserted in the first and second brackets; and
Fig. 15 is a cross-sectional view similar to Fig. 14 and illustrates a modification of the pin inserting/withdrawing mechanism.

DESCRIPTION OF REFERENCE NUMERALS

[0012]

5A:	Lower boom (first member)
5B:	Extension boom (second member)
11:	Two-member connecting device
12:	Left first bracket
12C:	Left upper first pin insertion hole
12D:	Left lower first pin insertion hole
13:	Right first bracket

13C:	Right upper first pin insertion hole
13D:	Right lower first pin insertion hole
14:	Left second bracket
14A:	Left upper second pin insertion hole
14B:	Left lower second pin insertion hole
15:	Right second bracket
15A:	Right upper second pin insertion hole
15B:	Right lower second pin insertion hole
16:	Left upper connecting pin
16A, 17A, 18A, 19A:	Large diameter portion
16B, 17B, 18B, 19B:	Small diameter portion
17:	Right upper connecting pin
18:	Left lower connecting pin
19:	Right lower connecting pin
20, 41:	Upper pin inserting/withdrawing mechanism
21, 43:	Hydraulic cylinder
22, 44:	Floating link
23:	Left link
26:	Right link
31, 42:	Lower pin inserting/withdrawing mechanism
33:	Upper centering member
33C:	Engaging groove portion
34:	Lower centering member
34C:	Abutting groove portion
45:	Left first link (link)
46:	Right first link (link)
47:	Left second link (link)
48:	Right second link (link)

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

[0013] Referring to the accompanying drawings, a detailed description will be given hereafter of the embodiments of a two-member connecting device in accordance with the invention by citing as an example a case in which two-stage booms constituting a multi-boom of a hydraulic excavator are connected together.

[0014] In the drawings, indicated at 1 is a hydraulic excavator, and the hydraulic excavator 1 is largely constituted by an automotive crawler-type lower traveling structure 2, an upper revolving structure 3 mounted rotatably on top of the lower traveling structure 2, and a multi-boom type working mechanism 4 provided tiltably on the front side of the upper revolving structure 3. This hydraulic excavator 1 is suitably used for demolishing a structure having a large ground height such as a high-rise building.

[0015] The working mechanism 4 is largely constituted by a boom 5 consisting of a lower boom 5A mounted rotatably on a front portion side of the upper revolving structure, an extension boom 5B, and an upper boom 5C; a middle arm 6 mounted rotatably on a distal end side of the upper boom 5C; an arm 7 consisting of a lower arm 7A and an upper arm 7B mounted rotatably on a distal end side of the middle arm 6; and a crusher 8 serving as a working tool mounted rotatably on a distal end side of the upper arm 7B.

[0016] In a case where the extension boom 5B is mounted to the lower boom 5A of the boom 5, the arrangement adopted is such that, as shown in Fig. 2, for example, the extension boom 5B is lifted by using a hydraulic crane 9 or the like, and the lower boom 5A and the extension boom 5B are connected by using a below-described two-member connecting device 11 in a state in which the extension boom 5B is disposed on a distal end side of the lower boom 5A.

[0017] Next, a detailed description will be given of the two-member connecting device 11 in accordance with this embodiment.

[0018] Designated at 11 is the two-member connecting device for connecting the lower boom 5A serving as a first member and the extension boom 5B serving as a second member. This two-member connecting device 11 is comprised of left and right first brackets 12 and 13, left and right upper first pin insertion holes 12C and 13C, left and right lower first pin insertion holes 12D and 13D, left and right second brackets 14 and 15, left and right upper second pin insertion holes 14A and 15A, left and right lower second pin insertion holes 14B and 15B, left and right upper connecting pins 16 and 17, left and right lower connecting pins 18 and 19, upper and lower pin inserting/withdrawing mechanisms 20 and 31, left and right upper centering members 33, and left and right lower centering members 34, and the like, which will be described hereinafter.

[0019] Indicated at 12 is the left first bracket provided on the left side of a distal end portion of the lower boom 5A serving as the first member. As shown in Figs. 3 to 7, this left first bracket 12 is constituted by a left inner first bracket 12A and a left outer first bracket 12B which are opposed to each other in the left-right direction at a fixed interval. The left inner first bracket 12A and the left outer first bracket 12B are each formed by use of a thick-walled steel plate or the like.

[0020] Further, the left inner first bracket 12A and the left outer first bracket 12B are secured to the distal end portion of the lower boom 5A with a rectangular tubular shape by welding or other similar means, and extend vertically from an upper corner portion 5A1 to a lower corner portion 5A2 of the lower boom 5A (see Fig. 3). The below-described left second bracket 14 is configured to be disposed between the left inner first bracket 12A and the left outer first bracket 12B.

[0021] Here, the left upper first pin insertion holes 12C, 12C are respectively bored in upper end portions of the left inner first bracket 12A and the left outer first bracket 12B, while the left lower first pin insertion holes 12D, 12D are respectively bored in lower end portions of the left inner first bracket 12A and the left outer first bracket 12B. Further, the below-described left upper connecting pin 16 is inserted in the left upper first pin insertion holes 12C in such a manner as to be capable of being inserted and withdrawn, while the below-described left lower connecting pin 18 is inserted in the left lower first pin insertion holes 12D in such a manner as to be capable of being inserted and withdrawn.

[0022] Designated at 13 is the right first bracket provided on the right side of a distal end portion of the lower boom 5A. This right first bracket 13 is constituted by a right inner first bracket 13A and a right outer first bracket 13B which are opposed to each other in the left-right direction at a fixed interval. The right inner first bracket 13A and the right outer first bracket 13B are each formed by use of a thick-walled steel plate or the like, and extend vertically from the upper corner portion 5A1 to the lower corner portion 5A2 of the lower boom 5A in a state in which the right inner first bracket 13A and the right outer first bracket 13B are secured to the distal end portion of the lower boom 5A by welding or other similar means. The below-described right second bracket 15 is configured to be disposed between the right inner first bracket 13A and the right outer first bracket 13B.

[0023] Here, the right upper first pin insertion holes 13C, 13C are respectively bored in upper end portions of the right inner first bracket 13A and the right outer first bracket 13B, while the right lower first pin insertion holes 13D, 13D are respectively bored in lower end portions of the right inner first bracket 13A and the right outer first bracket 13B. The below-described right upper connecting pin 17 is inserted in the right upper first pin insertion holes 13C in such a manner as to be capable of being inserted and withdrawn, while the below-described right lower connecting pin 19 is inserted in the right lower first pin insertion holes 13D in such a manner as to be capable of being inserted and withdrawn.

[0024] In this case, as shown in Fig. 5, the left upper first pin insertion holes 12C bored in the left inner first bracket 12A and the left outer first bracket 12B of the left first bracket 12 and the right upper first pin insertion holes 13C bored in the right inner first bracket 13A and the right outer first bracket 13B of the right first bracket 13 are disposed on an identical axis 01 - 01. Meanwhile, the left lower first pin insertion holes 12D bored in the left inner first bracket 12A and the left outer first bracket 12B of the left first bracket 12 and the right lower first pin insertion holes 13D bored in the right inner first bracket 13A and the right outer first bracket 13B of the right first bracket 13 are disposed on an identical axis 02 - 02.

[0025] Denoted at 14 is the left second bracket provided on the left side of a proximal end portion of the extension boom 5B serving as the second member, and this left second bracket 14 is formed by a thick-walled steel plate or the like. The left second bracket 14 is secured to the proximal end portion of the extension boom 5B with a rectangular tubular shape by welding or other similar means, and extends vertically from an upper corner portion 5B1 to a lower corner portion 5B2 of the extension boom 5B.

[0026] The left second bracket 14 is disposed between the left inner first bracket 12A and the left outer first bracket 12B of the left first bracket 12, and opposes the left inner first bracket 12A and the left outer first bracket 12B in the left-right direction (see Fig. 14). In an upper end portion of the left second bracket 14, the left upper second pin insertion hole 14A is bored at a position corresponding to the left upper first pin insertion holes 12C of the left first bracket 12, while, in a lower end portion of the left second bracket 14, the left lower second pin insertion hole 14B is bored at a position corresponding to the left lower first pin insertion holes 12D of the left first bracket 12.

[0027] Designated at 15 is the right second bracket provided on the right side of the proximal end portion of the extension boom 5B. This right second bracket 15 is formed by a thick-walled steel plate or the like, and extend vertically from the upper corner portion 5B1 to the lower corner portion 5B2 of the extension boom 5B in a state in which the right second bracket 15 is secured to the proximal end portion of the extension boom 5B by welding or other similar means.

[0028] The right second bracket 15 is disposed between the right inner first bracket 13A and the right outer first bracket 13B of the right first bracket 13, and opposes the right inner first bracket 13A and the right outer first bracket 13B in the left-right direction. In an upper end portion of the right second bracket 15, the right upper second pin insertion hole 15A is bored at a position corresponding to the right upper first pin insertion holes 13C of the right first bracket 13, while, in a lower end portion of the right second bracket 15, the right lower second pin insertion hole 15B is bored at a position corresponding to the right lower first pin insertion holes 13D of the right first bracket 13.

[0029] Here, as shown in Fig. 14, the left upper second pin insertion hole 14A of the left second bracket 14 and the right upper second pin insertion hole 15A of the right second bracket 15 are arranged to be aligned with the left upper

first pin insertion holes 12C of the left first bracket 12 and the right upper first pin insertion holes 13C of the right first bracket 13 as the identical axis 01 - 01. Meanwhile, the left lower second pin insertion hole 14B of the left second bracket 14 and the right lower second pin insertion hole 15B of the right second bracket 15 are arranged to be aligned with the left lower first pin insertion holes 12D of the left first bracket 12 and the right lower first pin insertion holes 13D of the right first bracket 13 as the identical axis 02 - 02. Further, the left and right upper centering members 33 and the left and right lower centering members 34, which will be described hereinafter, are arranged to be disposed between the left and right second brackets 14 and 15.

[0030] Denoted at 16 is the left upper connecting pin which is inserted in the left upper first pin insertion holes 12C of the left first bracket 12 and the left upper second pin insertion hole 14A of the left second bracket 14. As the left upper connecting pin 16 is moved between the disengaged position shown in Fig. 5 and the connecting position shown in Fig. 6, the left upper connecting pin 16 is inserted into and withdrawn from the left upper second pin insertion hole 14A. As shown in Fig. 6, the left upper connecting pin 16 is formed into a stepped cylindrical shape extending in the left-right direction by a large diameter portion 16A which is slidably inserted in the left upper first pin insertion holes 12C and the left upper second pin insertion hole 14A and by a small diameter portion 16B having a smaller outside dimension D2 (D1 > D2) than an outside dimension D1 of the large diameter portion 16A. A notched portion 16C which radially penetrates is formed in the small diameter portion 16B, and a distal end portion of a below-described left link 23 is arranged to be inserted in that notched portion 16C.

[0031] Indicated at 17 is the right upper connecting pin which is inserted in the right upper first pin insertion holes 13C of the right first bracket 13 and the right upper second pin insertion hole 15A of the right second bracket 15. The right upper connecting pin 17 is inserted into and withdrawn from the right upper second pin insertion hole 15A. In the same way as the left upper connecting pin 16, the right upper connecting pin 17 is also constituted by a large diameter portion 17A which is slidably inserted in the right upper first pin insertion holes 13C and the right upper second pin insertion hole 15A, a small diameter portion 17B having a smaller diameter than that large diameter portion 17A, and a notched portion 17C. A distal end portion of a below-described right link 26 is adapted to be inserted into the notched portion 17C.

[0032] Indicated at 18 is the left lower connecting pin which is inserted in the left lower first pin insertion holes 12D of the left first bracket 12 and the left lower second pin insertion hole 14B of the left second bracket 14. As the left lower connecting pin 18 is moved between the disengaged position shown in Fig. 5 and the connecting position shown in Fig. 6, the left lower connecting pin 18 is inserted into and withdrawn from the left lower second pin insertion hole 14B. As shown in Fig. 6, the left lower connecting pin 18 is formed into a stepped cylindrical shape extending in the left-right direction by a large diameter portion 18A which is slidably inserted in the left lower first pin insertion holes 12D and the left lower second pin insertion hole 14B and by a small diameter portion 18B having the smaller outside dimension D2 (D1 > D2) than the outside dimension D1 of the large diameter portion 18A. A notched portion 18C which radially penetrates is formed in the small diameter portion 18B, and a distal end portion of a below-described left link 23 is arranged to be inserted in that notched portion 18C.

[0033] Indicated at 19 is the right lower connecting pin which is inserted in the right lower first pin insertion holes 13D of the right first bracket 13 and the right lower second pin insertion hole 15B of the right second bracket 15. The right lower connecting pin 19 is inserted into and withdrawn from the right lower second pin insertion hole 15B. In the same way as the left lower connecting pin 18, the right lower connecting pin 19 is also constituted by a large diameter portion 19A which is slidably inserted in the right lower first pin insertion holes 13D and the right lower second pin insertion hole 15B, a small diameter portion 19B having a smaller diameter than that large diameter portion 19A, and a notched portion 19C. A distal end portion of the below-described left link 26 is adapted to be inserted into the notched portion 19C.

[0034] Next, a description will be given of the upper pin inserting/withdrawing mechanism 20 for inserting and withdrawing the left and right upper connecting pins 16 and 17 with respect to the left and right second brackets 14 and 15.

[0035] Designated at 20 is the upper pin inserting/withdrawing mechanism arranged between the left first bracket 12 and the right first bracket 13. This upper pin inserting/withdrawing mechanism 20 inserts and withdraws the left upper connecting pin 16 with respect to the left upper second pin insertion hole 14A of the left second bracket 14, and inserts and withdraws the right upper connecting pin 17 with respect to the right upper second pin insertion hole 15A of the right second bracket 15. As shown in Figs. 4 to 7, the upper pin inserting/withdrawing mechanism 20 is constituted by a hydraulic cylinder 21, a floating link 22, a left link 23, a right link 26, and the like, which will be described hereinafter.

[0036] Indicated at 21 is the hydraulic cylinder for constituting the upper pin inserting/withdrawing mechanism 20. This hydraulic cylinder 21 is constituted by a tube 21A, a piston (not shown), and a rod 21B having a proximal end side fixed to the piston and a distal end side projecting from the tube 21A. This hydraulic cylinder 21 is disposed in a state of being capable of extending and contracting in the same direction (left-right direction) as the axis 01 - 01 of the left and right upper connecting pins 16 and 17 at a position spaced apart vertically from the position of the axis 01 - 01 of the left and right upper connecting pins 16 and 17.

[0037] Indicated at 22 is the floating link which is disposed at a position vertically spaced apart from the position of the axis 01 - 01 of the left and right upper connecting pins 16 and 17. This floating link 22 is mounted to neither of the left and right first brackets 12 and 13, is set in a floating state with respect to these left and right first brackets 12 and

13, and extends in the left-right direction. Further, the floating link 22 constitutes a fulcrum for allowing the left and right upper connecting pins 16 and 17 respectively connected to the below-described left and right links 23 and 26 to move in the left-right direction in correspondence with the extension or contraction of the hydraulic cylinder 21.

[0038] In this case, the floating link 22 is formed in the shape of a rectangular rod extending in the left-right direction, and the lengthwise dimension in the left-right direction of the floating link 22 is set to be slightly smaller than the interval between the left inner first bracket 12A and the right inner first bracket 13A. In addition, a U-shaped recessed groove 22A is formed in each of both end portions in the left-right direction of the floating link 22, and the recessed groove 22A is slidably engaged with a below-described rotation restricting member 29. Further, the floating link 22 is disposed between the left and right upper connecting pins 16 and 17 and the hydraulic cylinder 21. One side in the left-right direction of the floating link 22 is rotatably pin-connected to the below-described left link 23, while the other side in the left-right direction of the floating link 22 is rotatably connected to the below-described right link 26.

[0039] Indicated at 23 is the left link for connecting the left upper connecting pin 16 and the hydraulic cylinder 21 through the floating link 22. The left link 23 as a whole is formed by a block extending in the vertical direction, and a proximal end side of the left link 23 is formed as a notched portion 23A by being notched into a bifurcated shape with a fixed interval. Further, a distal end portion of the rod 21B of the hydraulic cylinder 21 is rotatably pin-connected to the notched portion 23A of the left link 23 by use of a pin 24.

[0040] In addition, a distal end portion of the left link 23 in a state of being inserted in the notched portion 16C of the left upper connecting pin 16 is rotatably pin-connected to that left upper connecting pin 16 by use of a pin 25. Further, a stopper 23B projecting toward the left first bracket 12 is provided on the distal end side of the left link 23. The stopper 23B abuts against the left inner first bracket 12A when the left upper connecting pin 16 has moved to the connecting position shown in Fig. 6, to thereby set the connecting position of the left upper connecting pin 16.

[0041] Denoted at 26 is the right link for connecting the right upper connecting pin 17 and the hydraulic cylinder 21 through the floating link 22. This right link 26 as a whole is formed by a block extending in the vertical direction, and a proximal end side of the right link 26 is formed as a notched portion 26A by being notched into a bifurcated shape with a fixed interval. Further, the bottom side of the tube 21A of the hydraulic cylinder 21 is rotatably pin-connected to the notched portion 26A of the right link 26 by use of a pin 24.

[0042] A distal end portion of the right link 26 in a state of being inserted in the notched portion 17C of the right upper connecting pin 17 is rotatably pin-connected to that right upper connecting pin 17 by use of a pin 25. Further, a stopper 26B projecting toward the right first bracket 13 is provided on the distal end side of the right link 26. The stopper 26B abuts against the right inner first bracket 13A when the right upper connecting pin 17 has moved to the connecting position shown in Fig. 6, to thereby set the connecting position of the right upper connecting pin 17.

[0043] Further, one side (left side) in the left-right direction of the floating link 22 in a state of being inserted in the notched portion 23A of the left link 23 is rotatably pin-connected to a longitudinally intermediate portion of that left link 23 by use of a pin 27. Meanwhile, the other side (right side) in the left-right direction of the floating link 22 in a state of being inserted in the notched portion 26A of the right link 26 is rotatably pin-connected to a longitudinally intermediate portion of that right link 26 by use of a pin 28.

[0044] Accordingly, in the case where the hydraulic cylinder 21 is contracted, the left upper connecting pin 16 is inserted into the left upper first pin insertion holes 12C of the left first bracket 12 and the left upper second pin insertion hole 14A of the left second bracket 14. Meanwhile, the right upper connecting pin 17 is arranged to be inserted into the right upper first pin insertion holes 13C of the right first bracket 13 and the right upper second pin insertion hole 15A of the right second bracket 15 (see Fig. 14).

[0045] Meanwhile, in the case where the hydraulic cylinder 21 is extended, the left upper connecting pin 16 is withdrawn from the left upper first pin insertion holes 12C of the left outer first bracket 12A and the left upper second pin insertion hole 14A of the left second bracket 14. On the other hand, the right upper connecting pin 17 is arranged to be withdrawn from the right upper first pin insertion holes 13C of the right outer first bracket 13B and the right upper second pin insertion hole 15A of the right second bracket 15.

[0046] Indicated at 29 are the left and right rotation restricting members which are respectively provided on the left and right first brackets 12 and 13. These rotation restricting members 29 are constituted by elongated plates extending in the vertical direction, and are respectively secured to the inner side surface of the left inner first bracket 12A and the inner side surface of the right inner first bracket 13A by welding or other similar means. Meanwhile, the recessed grooves 22A provided in the both end portions of the floating link 22 are respectively slidably engaged with the left and right rotation restricting members 29.

[0047] Accordingly, the arrangement provided is such that when the left and right upper connecting pins 16 and 17 are moved between the connecting position and the disengaged position by the extension and contraction of the hydraulic cylinder 21, the recessed grooves 22A formed in the both end portions of the floating link 22 are engaged with the rotation restricting members 29, thereby making it possible to prevent the upper pin inserting/withdrawing mechanism 20 from rotating about the left and right upper connecting pins 16 and 17.

[0048] Designated at 30 is a tabular upper stopper which is provided on the lower boom 5A by being positioned

between the left and right first brackets 12 and 13. This upper stopper 30 has a proximal end side secured to the upper end portion of the lower boom 5A by using welding or other similar means and a distal end side extending to a position where it opposes the left and right upper connecting pins 16 and 17. Further, as shown in Fig. 5, as the small diameter portions 16B and 17B of the left and right upper connecting pins 16 and 17 abut against this upper stopper 30, the upper stopper 30 sets the disengaging position of the left and right upper connecting pins 16 and 17.

[0049] In this case, when the small diameter portions 16B and 17B of the left and right upper connecting pins 16 and 17 have respectively abutted against this upper stopper 30, a state is kept in which the left upper connecting pin 16 is inserted only in the left upper first pin insertion hole 12C of the left inner first bracket 12A, and the right upper connecting pin 17 is inserted only in the right upper first pin insertion hole 13C of the right inner first bracket 13A. Accordingly, the arrangement provided is such that the upper pin inserting/withdrawing mechanism 20 is held in a cantilevered state between the left inner first bracket 12A and the right inner first bracket 13A through the left and right upper connecting pins 16 and 17.

[0050] Next, a description will be given of the lower pin inserting/withdrawing mechanism 31 for inserting and withdrawing the left and right lower connecting pins 18 and 19 with respect to the left and right second brackets 14 and 15.

[0051] Denoted at 31 is the lower pin inserting/withdrawing mechanism arranged between the left first bracket 12 and the right first bracket 13. This lower pin inserting/withdrawing mechanism 31 inserts and withdraws the left lower connecting pin 18 with respect to the left lower second pin insertion hole 14B of the left second bracket 14, and inserts and withdraws the right lower connecting pin 19 with respect to the right lower second pin insertion hole 15B of the right second bracket 15.

[0052] In the same way as the upper pin inserting/withdrawing mechanism 20, the lower pin inserting/withdrawing mechanism 31 is constituted by the hydraulic cylinder 21 disposed at a position spaced apart vertically from the position of the axis 02 - 02 of the left and right lower connecting pins 18 and 19, the floating link 22 disposed in a floating state between the hydraulic cylinder 21 and the left and right lower connecting pins 18 and 19, and the left and right links 23 and 26 for connecting the left and right lower connecting pins 18 and 19 and the hydraulic cylinder 21 through the floating link 22.

[0053] In this case, the notched portion 23A on the proximal end side of the left link 23 is pin-connected to the rod 21B of the hydraulic cylinder 21 by use of the pin 24; the distal end portion of the left link 23 is pin-connected to the left lower connecting pin 18 by use of the pin 25; and a longitudinally intermediate portion of the left link 23 is pin-connected to the floating link 22 by use of the pin 27. On the other hand, the notched portion 26A on the proximal end side of the right link 26 is pin-connected to the tube 21A of the hydraulic cylinder 21 by use of the pin 24; the distal end portion of the right link 26 is pin-connected to the right lower connecting pin 19 by use of the pin 25; and a longitudinally intermediate portion of the right link 26 is pin-connected to the floating link 22 by use of the pin 28.

[0054] Indicated at 32 is a tabular lower stopper which is provided on the lower boom 5A by being positioned between the left and right first brackets 12 and 13. This lower stopper 32 has a proximal end side secured to the lower end side of the lower boom 5A by using welding or other similar means and a distal end side extending to a position where it opposes the left and right lower connecting pins 18 and 19. As shown in Fig. 5, as the small diameter portions 18B and 19B of the left and right lower connecting pins 18 and 19 abut against this lower stopper 32, the lower stopper 32 sets the disengaging position of the left and right lower connecting pins 18 and 19.

[0055] In this case, when the small diameter portions 18B and 19B of the left and right lower connecting pins 18 and 19 have respectively abutted against this lower stopper 32, a state is kept in which the left lower connecting pin 18 is inserted only in the left lower first pin insertion hole 12D of the left inner first bracket 12A, and the right lower connecting pin 19 is inserted only in the right lower first pin insertion hole 13D of the right inner first bracket 13A. Accordingly, the arrangement provided is such that the lower pin inserting/withdrawing mechanism 31 is held in a cantilevered state between the left inner first bracket 12A and the right inner first bracket 13A through the left and right lower connecting pins 18 and 19.

[0056] Next, a description will be given of the upper centering members 33 for effecting the centering of the left and right upper connecting pins 16 and 17.

[0057] Namely, denoted at 33 are the left and right upper centering members which are provided on the extension boom 5B. These upper centering members 33 are for aligning the axis of the left and right upper connecting pins 16 and 17 with the axis 01 - 01 of the left and right upper first pin insertion holes 12C and 13C and the left and right upper second pin insertion holes 14A and 15A at the time of inserting the left and right upper connecting pins 16 and 17 into the upper first pin insertion holes 12C and 13C provided in the left and right first brackets 12 and 13 and into the upper second pin insertion holes 14A and 15A provided in the left and right second brackets 14 and 15.

[0058] The left upper centering member 33 is arranged at a position opposing the left second bracket 14 in such a manner as to sandwich the left inner first bracket 12A when the left second bracket 14 is disposed between the left inner first bracket 12A and the left outer first bracket 12B. Meanwhile, the right upper centering member 33 is arranged at a position opposing the right second bracket 15 in such a manner as to sandwich the right inner first bracket 13A when the right second bracket 15 is disposed between the right inner first bracket 13A and the right outer first bracket 13B

(see Fig. 12).

[0059] As shown in Figs. 8 to 10, the upper centering members 33 are formed in a substantially triangular shape as a whole by use of a thinner plate than the left and right second brackets 14 and 15, and extend from the upper corner portion 5B1 of the extension boom 5B to positions corresponding to the left and right upper second pin insertion holes 14A and 15A while opposing the left and right second brackets 14 and 15 in parallel thereto.

[0060] Here, the upper centering member 33 is largely constituted by a mounting portion 33A secured to the upper corner portion 5B1 of the extension boom 5B by using welding or other similar means, a projecting portion 33B projecting in a chevron shape from this mounting portion 33A, and an engaging groove portion 33C which is formed by downwardly recessing a distal end portion of the projecting portion 33B and is curved in a circular arc shape by surrounding the left and right upper second pin insertion holes 14A and 15A. In this case, the engaging groove portion 33C is formed with a circular arc shape having a substantially radius of curvature equal to that of the left and right upper second pin insertion holes 14A and 15A, and is adapted to engage the left and right upper connecting pins 16 and 17 from above. In addition, the lower side of the engaging groove portion 33C is formed as a tapered opening portion 33D which is more open than the diameter of the left and right upper second pin insertion holes 14A and 15A, and the left and right upper connecting pins 16 and 17 are each arranged to be guided into the engaging groove portion 33C along this opening portion 33D.

[0061] A description will be given of the case where the left and right upper connecting pins 16 and 17 are inserted into the first pin insertion holes 12C and 13C of the left and right first brackets 12 and 13 and the upper second pin insertion holes 14A and 15A of the left and right second brackets 14 and 15. First, as shown in Figs. 11 and 12, the engaging groove portions 33C of the left and right upper centering members 33 are respectively engaged from above with the large diameter portions 16A and 17A of the left and right upper connecting pins 16 and 17 projecting from the left and right inner first brackets 12A and 13A. In this case, since the engaging groove portions 33C have a radius of curvature substantially equal to that of the left and right upper second pin insertion holes 14A and 15A, as the engaging groove portions 33C of the left and right upper centering members 33 are engaged with the left and right upper connecting pins 16 and 17, the axis of the left and right upper connecting pins 16 and 17 can be aligned with the axis 01 - 01 of the left and right upper second pin insertion holes 14A and 15A.

[0062] Thus, the left and right upper centering members 33 cause the axis of the left and right upper connecting pins 16 and 17 to be aligned with the axis 01 - 01 of the left and right upper second pin insertion holes 14A and 15A. In consequence, the arrangement provided is such that the upper pin inserting/withdrawing mechanisms 20 make it possible to smoothly insert the left and right upper connecting pins 16 and 17 with respect to the upper first pin insertion holes 12C and 13C of the left and right first brackets 12 and 13 and the upper second pin insertion holes 14A and 15A of the left and right second brackets 14 and 15.

[0063] Further, a description will be given of the lower centering members 34 for effecting the centering of the left and right lower connecting pins 18 and 19.

[0064] Denoted at 34 are the left and right lower centering members which are provided on the extension boom 5B. These lower centering members 34 are for aligning the axis of the left and right lower connecting pins 18 and 19 with the axis 02 - 02 of the left and right lower first pin insertion holes 12D and 13D and the left and right lower second pin insertion holes 14A and 15A at the time of inserting the left and right lower connecting pins 18 and 19 into the lower first pin insertion holes 12D and 13D provided in the left and right first brackets 12 and 13 and into the lower second pin insertion holes 14B and 15B provided in the left and right second brackets 14 and 15.

[0065] The left lower centering member 34 is arranged at a position opposing the left second bracket 14 in such a manner as to sandwich the left inner first bracket 12A when the left second bracket 14 is disposed between the left inner first bracket 12A and the left outer first bracket 12B. Meanwhile, the right lower centering member 34 is arranged at a position opposing the right second bracket 15 in such a manner as to sandwich the right inner first bracket 13A when the right second bracket 15 is disposed between the right inner first bracket 13A and the right outer first bracket 13B.

[0066] As shown in Figs. 8 to 10, the lower centering members 34 are formed in a substantially triangular shape as a whole by use of a thinner plate than the left and right second brackets 14 and 15, and extend from the lower corner portion 5B2 of the extension boom 5B to positions corresponding to the left and right lower second pin insertion holes 14B and 15B while opposing the left and right second brackets 14 and 15 in parallel thereto.

[0067] The lower centering member 34 is largely constituted by a mounting portion 34A secured to the lower corner portion 5B2 of the extension boom 5B by using welding or other similar means, a projecting portion 34B projecting in a chevron shape from this mounting portion 34A, and an abutting groove portion 34C which is formed by recessing a distal end portion of the projecting portion 34B toward the extension boom 5B side and is curved in a circular arc shape along the left and right lower second pin insertion holes 14B and 15B. In this case, the abutting groove portion 34C is formed with a circular arc shape having a radius of curvature substantially equal to that of the left and right lower second pin insertion holes 14B and 15B, and is adapted to engage the left and right lower connecting pins 18 and 19 from the front-back direction (direction of arrow A in Fig. 11).

[0068] In this case, as shown in Figs. 11 and 12, the extension boom 5B rotates in the front-back direction (direction of arrow A) about the left and right upper connecting pins 16 and 17 inserted in the upper second pin insertion holes

14A and 15A of the left and right second brackets 14 and 15.

[0069] In consequence, as shown in Figs. 13 and 14, the abutting groove portions 34C of the left and right lower centering members 34 respectively abut against the large diameter portions 18A and 19A of the left and right lower connecting pins 18 and 19 projecting from the left and right inner first brackets 12A and 13A. In this case, since the abutting groove portions 34C have a radius of curvature substantially equal to that of the left and right lower second pin insertion holes 14B and 15B, as the abutting groove portions 34C of the left and right lower centering members 34 abut against the left and right lower connecting pins 18 and 19, the axis of the left and right lower connecting pins 18 and 19 can be aligned with the axis 02 - 02 of the left and right lower second pin insertion holes 14B and 15B.

[0070] Thus, the left and right lower centering members 34 cause the axis of the left and right lower connecting pins 18 and 19 to be aligned with the axis 02 - 02 of the left and right lower second pin insertion holes 14B and 15B. In consequence, the arrangement provided is such that the lower pin inserting/withdrawing mechanisms 31 make it possible to smoothly insert the left and right lower connecting pins 18 and 19 with respect to the lower first pin insertion holes 12D and 13D of the left and right first brackets 12 and 13 and the lower second pin insertion holes 14B and 15B of the left and right second brackets 14 and 15.

[0071] The two-member connecting device 11 in accordance with this embodiment has the above-described configuration, and a description will next be given of a case where the extension boom 5B is mounted to the distal end side of the lower boom 5A for constituting the boom 5 of the hydraulic excavator 1 by use of this two-member connecting device 11.

[0072] As shown in Fig. 2, the extension boom 5B is lifted by use of the hydraulic crane 9, and the proximal end side of this extension boom 5B is disposed on the distal end side of the lower boom 5A mounted on the upper revolving structure 3 of the hydraulic excavator 1.

[0073] At this time, as shown in Fig. 5, in the state in which the hydraulic cylinder 21 is extended, the upper pin inserting/withdrawing mechanism 20 causes the left upper connecting pin 16 to be inserted in the left upper first pin insertion hole 12C of the left inner first bracket 12A and the right upper connecting pin 17 to be inserted in the right upper first pin insertion hole 13C of the right inner first bracket 13A. In consequence, the upper pin inserting/withdrawing mechanism 20 is set in a disengaged position and is held between the left inner first bracket 12A and the right inner first bracket 13A, and portions of the large diameter portions 16A and 17A of the left and right upper connecting pins 16 and 17 project inwardly from the left and right inner first brackets 12A and 13A.

[0074] Meanwhile, in the state in which the hydraulic cylinder 21 is extended, the lower pin inserting/withdrawing mechanism 31 also causes the left lower connecting pin 18 to be inserted in the left lower first pin insertion hole 12D of the left inner first bracket 12A and the right lower connecting pin 19 to be inserted in the right lower first pin insertion hole 13D of the right inner first bracket 13A. In consequence, the lower pin inserting/withdrawing mechanism 31 is set in a disengaged position and is held between the left inner first bracket 12A and the right inner first bracket 13A, and portions of the large diameter portions 18A and 19A of the left and right lower connecting pins 18 and 19 project inwardly from the left and right inner first brackets 12A and 13A.

[0075] Next, as shown in Fig. 11, the extension boom 5B lifted by the hydraulic crane 9 is moved downward toward the lower boom 5A, and the engaging groove portions 33C of the left and right upper centering members 33 are engaged from above with the large diameter portions 16A and 17A of the left and right upper connecting pins 16 and 17 projecting from the left and right inner first brackets 12A and 13A. In consequence, the axis of the left and right upper connecting pins 16 and 17 can be aligned with the axis 01 - 01 of the left and right upper second pin insertion holes 14A and 15A.

[0076] In this state, as the hydraulic cylinder 21 of the upper pin inserting/withdrawing mechanism 20 is contracted, the left and right upper connecting pins 16 and 17 can be smoothly inserted into the upper first pin insertion holes 12C and 13C of the left and right first brackets 12 and 13 and the upper second pin insertion holes 14A and 15A of the left and right second brackets 14 and 15, as shown in Fig. 12.

[0077] Next, as the extension boom 5B is moved further downward, the left and right second brackets 14 and 15 are rotated in the front-back direction (direction of arrow A in Fig. 11) about the left and right upper connecting pins 16 and 17. In consequence, as shown in Fig. 13, the abutting groove portions 34C of the left and right lower centering members 34 are abutted against the large diameter portions 18A and 19A of the left and right lower connecting pins 18 and 19 projecting from the left and right inner first brackets 12A and 13A, thereby making it possible to align the axis of the left and right lower connecting pins 18 and 19 with the axis 02 - 02 of the left and right lower second pin insertion holes 14B and 15B.

[0078] In this state, as shown in Fig. 14, as the hydraulic cylinder 21 of the lower pin inserting/withdrawing mechanism 31 is contracted, the left and right lower connecting pins 18 and 19 can be smoothly inserted into the lower first pin insertion holes 12D and 13D of the left and right first brackets 12 and 13 and the lower second pin insertion holes 14B and 15B of the left and right second brackets 14 and 15.

[0079] Thus, the left and right first brackets 12 and 13 provided on the lower boom 5A and the left and right second brackets 14 and 15 provided on the extension boom 5B are connected by use of the left and right upper connecting pins 16 and 17 and the left and right lower connecting pins 18 and 19, thereby making it possible to mount the extension

boom 5B to the distal end side of the lower boom 5A.

[0080] In this case, as shown in Figs. 13 and 14, in the state in which the large diameter portions 16A and 17A of the left and right upper connecting pins 16 and 17 are inserted in the upper first pin insertion holes 12C and 13C of the left and right first brackets 12 and 13 and the upper second pin insertion holes 14A and 15A of the left and right second brackets 14 and 15, the engaging groove portions 33C of the left and right upper centering members 33 oppose the small diameter portions 16B and 17B of the upper connecting pins 16 and 17. In consequence, a clearance ΔD corresponding to the difference between the outside dimension D1 of the large diameter portion 16A and the outside dimension D2 of the small diameter portion 16B is formed between the engaging groove portions 33C of the left and right upper centering members 33 and the upper connecting pins 16 and 17 (see Fig. 14).

[0081] Likewise, in the state in which the large diameter portions 18A and 19A of the left and right lower connecting pins 18 and 19 are inserted in the lower first pin insertion holes 12D and 13D of the left and right first brackets 12 and 13 and the lower second pin insertion holes 14B and 15B of the left and right second brackets 14 and 15, the engaging groove portions 34C of the left and right lower centering members 34 oppose the small diameter portions 18B and 19B of the lower connecting pins 18 and 19. In consequence, the clearance ΔD corresponding to the difference between the outside dimension D1 of the large diameter portion 18A and the outside dimension D2 of the small diameter portion 18B is formed between the engaging groove portions 34C of the left and right lower centering members 34 and the lower connecting pins 18 and 19 (see Fig. 13).

[0082] For this reason, the load which is transmitted between the left and right first brackets 12 and 13 and the left and right second brackets 14 and 15 through the left and right upper connecting pins 16 and 17 can be suppressed from being transmitted to the left and right upper centering members 33. Also, the load which is transmitted between the left and right first brackets 12 and 13 and the left and right second brackets 14 and 15 through the left and right lower connecting pins 18 and 19 can be suppressed from being transmitted to the left and right lower centering members 34. As a result, the left and right upper centering members 33 and lower centering members 34 can be formed by using thin-walled plates, so that it is possible to attain a reduction in their weight.

[0083] As such, according to this embodiment, the configuration provided is such that the left and right upper centering members 33 and lower centering members 34 are provided at positions respectively opposing the left and right second brackets 14 and 15 in such a manner as to sandwich the left and right inner first brackets 12A and 13A in the extension boom 5B. For this reason, by engaging the engaging groove portions 33C of the upper centering members 33 with the left and right upper connecting pins 16 and 17, the axis of the left and right upper connecting pins 16 and 17 can be aligned with the axis 01 - 01 of the upper second pin insertion holes 14A and 15A provided in the left and right second brackets 14 and 15. Likewise, by abutting the abutting groove portions 34C of the lower centering members 34 with the left and right lower connecting pins 18 and 19, the axis of the left and right lower connecting pins 18 and 19 can be aligned with the axis 02 - 02 of the lower second pin insertion holes 14B and 15B provided in the left and right second brackets 14 and 15.

[0084] As a result, the left and right upper connecting pins 16 and 17 can be smoothly inserted into the left and right upper first pin insertion holes 12C and 13C and the left and right upper second pin insertion holes 14A and 15A, and the left and right lower connecting pins 18 and 19 can be smoothly inserted into the left and right lower first pin insertion holes 12D and 13D and the left and right lower second pin insertion holes 14B and 15B. Accordingly, the left and right first brackets 12 and 13 and the left and right second brackets 14 and 15 can be speedily connected by use of the left and right upper connecting pins 16 and 17 and the left and right lower connecting pins 18 and 19, making it possible to enhance workability at the time of connecting the extension boom 5B to the lower boom 5A.

[0085] It should be noted that, in the above-described embodiment, the case has been illustrated in which the upper and lower pin inserting/withdrawing mechanisms 20 and 31 are each constituted by the hydraulic cylinder 21 disposed in such a manner as to extend in the left-right direction, the floating link 22, and the left and right links 23 and 26. However, the present invention is not limited to the same, for example, the upper and lower pin inserting/withdrawing mechanisms 41 and 42 may be used as in a modification shown in Fig. 15.

[0086] Namely, the upper and lower pin inserting/withdrawing mechanisms 41 and 42 may be constituted by a hydraulic cylinder 43 disposed so as to be capable of extending and contracting in a direction (vertical direction) perpendicular to the axis of the left and right upper connecting pins 16 and 17, a floating link 44 which is pin-connected to one end side of the hydraulic cylinder 43, a left first link 45 connecting the left upper connecting pin 16 and the floating link 44, a right first link 46 connecting the right upper connecting pin 17 and the floating link 44, a left second link 47 connecting the other end side of the hydraulic cylinder 43 and the left first link 45, and a right second link 48 connecting the other end side of the hydraulic cylinder 43 and the right first link 46.

[0087] Further, a configuration may be provided such that a hydraulic cylinder having left and right two rods is disposed coaxially with the left and right upper connecting pins 16 and 17, and the left rod is connected to the left upper connecting pin 16, while the right rod is connected to the right upper connecting pin 17.

[0088] In addition, in the above-described embodiment, the case has been illustrated in which the left first bracket 12 is constituted by two plates including the left inner first bracket 12A and the left outer first bracket 12B, while the right

first bracket 13 is constituted by two plates including the right inner first bracket 13A and the right outer first bracket 13B. However, the present invention is not limited to the same, for example, the left first bracket may be constituted by the left inner first bracket 12A alone, and the right first bracket may be constituted by the right inner first bracket 13A alone.

[0089] Furthermore, in the above-described embodiment, the case has been illustrated in which the two-member connecting device 11 is used for the connecting portion between the lower boom 5A and the extension boom 5B among the lower boom 5A, the extension boom 5B, and the upper boom 5C constituting the boom 5 of the hydraulic excavator 1. However, the present invention is not limited to the same, for example, two-member connecting device 11 may also be used for such as the connecting portion between the extension boom 5B, the upper boom 5C, the connecting portion between the lower arm 7A and the upper arm 7B which constituting the arm 7, and the like.

Claims

1. A two-member structure with a two-member connecting device comprising:

a first member (5A) and a second member (5B);
left and right first brackets (12, 13) provided on the first member (5A) in such a manner as to oppose each other in a left-right direction;
upper and lower first pin insertion holes (12C, 12D, 13C, 13D) respectively provided in said left and right first brackets (12, 13) in such a manner as to be vertically spaced apart from each other;
left and right second brackets (14, 15) provided on the second member (5B) which is connected to said first member (5A), said left and right second brackets (14, 15) respectively opposing said first brackets (12, 13);
upper and lower second pin insertion holes (14A, 14B, 15A, 15B) respectively provided in said left and right second brackets (14, 15) in such a manner as to be vertically spaced apart from each other, said upper and lower second pin insertion holes (14A, 14B, 15A, 15B) being capable of being respectively arranged coaxially with said upper and lower first pin insertion holes (12C, 12D, 13C, 13D);
upper and lower connecting pins (16, 17, 18, 19) respectively inserted into said upper and lower first pin insertion holes (12C, 12D, 13C, 13D) and said upper and lower second pin insertion holes (14A, 14B, 15A, 15B); **characterised by**
upper and lower pin inserting/withdrawing mechanisms (20, 31, 41, 42) which are disposed between said left and right first brackets (12, 13) and are inserted and withdrawn with respect to said upper and lower second pin insertion holes (14A, 14B, 15A, 15B) in a state in which said upper and lower connecting pins (16, 17, 18, 19) are inserted in said upper and lower first pin insertion holes (12C, 12D, 13C, 13D),
wherein an upper centering member (33) for aligning an axis of said upper connecting pins (16, 17) with an axis of said upper second pin insertion holes (14A, 15A) when said upper connecting pins (16, 17) are inserted into said upper first pin insertion holes (12C, 13C) and said upper second pin insertion holes (14A, 15A), and a lower centering member (34) for aligning an axis of said lower connecting pins (18, 19) with an axis of said lower second pin insertion holes (14B, 15B) when said lower connecting pins (18, 19) are inserted into said lower first pin insertion holes (12D, 13D) and said lower second pin insertion holes (14B, 15B), are provided at positions respectively opposing said left and right second brackets (14, 15) in said second member (5B),
wherein said upper centering member (33) is formed by a plate extending from an upper corner portion (5B1) of said second member (5B) in parallel to said second bracket (14, 15) and having an engaging groove portion (33C) which is curved in a circular arc shape by surrounding said upper second pin insertion hole (14A, 15A) and is adapted to be engaged with said upper connecting pin (16, 17), and wherein
said lower centering member (34) is formed by a plate extending from a lower corner portion (5B2) of said second member (5B) in parallel to said second bracket (14, 15) and having an abutting groove portion (34C) which is curved in a circular arc shape along said lower second pin insertion hole (14B, 15B) and is adapted to abut against said lower connecting pin (18, 19).

Patentansprüche

1. Struktur aus zwei Elementen mit einer Vorrichtung zum Verbinden zweier Elemente, die Folgendes umfasst:

ein erstes Element (5A) und ein zweites Element (5B);
eine linke und eine rechte erste Halterung (12, 13), die auf dem ersten Element (5A) derart vorgesehen sind, dass sie einander in einer Rechts-Links-Richtung gegenüberliegen;
obere und untere erste Stifteinführöffnungen (12C, 12D, 13C, 13D), die jeweils in der linken und der rechten

ersten Halterung (12, 13) derart vorgesehen sind, dass sie vertikal voneinander beabstandet sind;
eine linke und eine rechte zweite Halterung (14, 15), die auf dem zweiten Element (5B) vorgesehen sind, das mit dem ersten Element (5A) verbunden ist, wobei die linke und die rechte zweite Halterung (14, 15) jeweils den ersten Halterungen (12, 13) gegenüberliegen;
obere und untere zweite Stifteinführöffnungen (14A, 14B, 15A, 15B), die jeweils in der linken und der rechten zweiten Halterung (14, 15) derart vorgesehen sind, dass sie vertikal voneinander beabstandet sind, wobei die oberen und die unteren zweiten Stifteinführöffnungen (14A, 14B, 15A, 15B) jeweils koaxial mit den oberen und unteren ersten Stifteinführöffnungen (12C, 12D, 13C, 13D) angeordnet werden können;
obere und untere Verbindungsstifte (16,17, 8, 19), die jeweils in die oberen und unteren ersten Stifteinführöffnungen (12C, 12D, 13C, 13D) und in die oberen und unteren zweiten Stifteinführöffnungen (14A, 14B, 15A, 15B) eingeführt werden; **gekennzeichnet durch**:

obere und untere Stifteinführ- bzw. Stiftherausziehmechanismen (20, 31, 41, 42), die zwischen der linken und der rechten ersten Halterung (12, 13) angeordnet sind und in einem Zustand, in dem obere und untere Verbindungsstifte (16, 7, 8, 19) in die oberen und unteren ersten Stifteinführöffnungen (12C, 12D, 13C, 13D) eingeführt sind, bezüglich der oberen und unteren zweiten Stifteinführöffnungen (14A, 14B, 15A, 15B) eingeführt und herausgezogen werden;
wobei ein oberes Zentrierelement (33) zum Ausrichten einer Achse der oberen Verbindungsstifte (16, 17) auf eine Achse der oberen zweiten Stifteinführöffnungen (14A, 15A), wenn die oberen Verbindungsstifte (16, 17) in die oberen ersten Stifteinführöffnungen (12C, 13C) und die oberen zweiten Stifteinführöffnungen (14A, 15A) eingeführt sind, und ein unteres zentrierelement (34) zum Ausrichten einer Achse der unteren Verbindungsstifte (18, 19) auf eine Achse der unteren zweiten Stifteinführöffnungen (14B, 15B), wenn die unteren Verbindungsstifte (18, 19) in die unteren ersten Stifteinführöffnungen (12D, 13D) und die unteren zweiten Stifteinführöffnungen (14B, 15B) eingeführt sind, an Positionen vorgesehen sind, die der linken bzw. rechten Halterung (14, 15) in dem zweiten Element (5B) gegenüberliegen,
wobei das obere Zentrierelement (33) durch eine Platte gebildet ist, die sich von einem oberen Kantenabschnitt (5B1) des zweiten Elements (5B) parallel zu der zweiten Halterung (14, 15) erstreckt und einen einrastenden Nutabschnitt (33C) aufweist, der in einer Kreisbogenform gebogen ist und die oberen zweiten Stifteinführöffnungen (14A, 15A) umgibt, und dafür ausgelegt ist, in den oberen Verbindungsstift (16, 17) einzurasten; und wobei
das untere Zentrierelement (34) durch eine Platte gebildet ist, die sich von einem unteren Kantenabschnitt (5B2) des zweiten Elements (5B) parallel zu der zweiten Halterung (14, 15) erstreckt und einen anliegenden Nutabschnitt (34C) aufweist, der in einer Kreisbogenform entlang der unteren zweiten Stifteinführöffnung (14B, 15B) gebogen ist, und dafür ausgelegt ist, an dem unteren Verbindungsstift (18, 19) anzuliegen.

Revendications

1. Structure en deux pièces avec un dispositif de connexion en deux éléments comprenant :

un premier élément (5A) et un second élément (5B) ;
des premières platines de gauche et de droite (12, 13) prévues sur le premier élément (5A) de manière à être opposées l'une à l'autre dans une direction gauche/droite ;
des premiers trous supérieurs et inférieurs d'insertion de broches (12C, 12D, 13C, 13D) prévus respectivement dans lesdites premières platines de gauche et de droite (12, 13) de manière à être verticalement espacés l'un de l'autre ;
des secondes platines de gauche et de droite (14, 15) prévues sur le second élément (5B) qui sont connectées audit premier élément (5A), lesdites secondes platines de gauche et de droite (14, 15) étant respectivement opposées auxdites premières platines (12, 13) ;
des seconds trous supérieurs et inférieurs d'insertion de broches (14A, 14B, 15A, 15B) prévus respectivement dans lesdites secondes platines de gauche et de droite (14, 15) de manière à être verticalement espacés l'un de l'autre, lesdits seconds trous supérieurs et inférieurs d'insertion de broches (14A, 14B, 15A, 15B) étant capables d'être respectivement agencés coaxialement avec lesdits premiers trous supérieurs et inférieurs d'insertion de broches (12C, 12D, 13C, 13D) ;
des broches de connexion supérieures et inférieures (16, 17, 18, 19) respectivement insérées dans lesdits premiers trous supérieurs et inférieurs d'insertion de broches (12C, 12D, 13C, 13D) et dans lesdits seconds trous supérieurs et inférieurs d'insertion de broche (14A, 14B, 15A, 15B) ;
caractérisé par

des mécanismes supérieurs et inférieurs d'insertion/extraction de broches (20, 31, 41, 42) qui sont disposés entre lesdites premières platines de gauche et de droite (12, 13) et qui sont insérés et extraits par rapport auxdits seconds trous supérieurs et inférieurs d'insertion de broche (14A, 14B, 15A, 15B) dans un état dans lequel lesdites brochent de connexion supérieures et inférieures (16, 17, 18, 19) sont insérées dans lesdits premiers trous supérieurs et inférieurs d'insertion de broche (12C, 12D, 13C, 13D),

dans laquelle un élément de centrage supérieur (33) destiné à aligner un axe desdites broches de connexion supérieures (16, 17) avec un axe desdits seconds trous supérieurs d'insertion de broche (14A, 15A) quand lesdites broches de connexion supérieures (16, 17) sont insérées dans lesdits premiers trous supérieurs d'insertion de broches (12C, 13C) et dans lesdits seconds trous supérieurs d'insertion de broches (14A, 15A), et un élément de centrage inférieur (34) pour aligner un axe desdites broches de connexion inférieures (18, 19) avec un axe desdits seconds trous inférieurs d'insertion de broches (14B, 15B) quand lesdites broches de connexion inférieures (18, 19) sont insérées dans lesdits premiers trous inférieurs d'insertion de broches (12D, 13D) et dans lesdits seconds trous inférieurs d'insertion de broches (14B, 15B), sont prévus à des positions respectivement opposées auxdites secondes platines de gauche et de droite (14, 15) dans ledit second élément (5B),

dans laquelle ledit élément de centrage supérieur (33) est formé par une plaque s'étendant depuis une portion de coin supérieure (5B) dudit second élément (5B) en parallèle à ladite seconde platine (14, 15) et ayant une portion formant gorge d'engagement (33C) qui est incurvée sous la forme d'un arc circulaire en entourant ledit second trou supérieur d'insertion de broche (14A, 15A) et qui est adaptée à être engagée avec ladite broche de connexion supérieure (16, 17), et

dans laquelle ledit élément de centrage inférieur (34) est formé par une plaque s'étendant depuis une portion de coin inférieure (5B2) dudit second élément (5B) en parallèle à ladite seconde platine (1415) et ayant une portion formant gorge de butée (34C) qui est incurvée sous la forme d'un arc circulaire le long dudit second trou inférieur d'insertion de broche (14B, 15B) et qui est adaptée à venir buter contre ladite broche de connexion inférieure (18, 19).

Fig.1

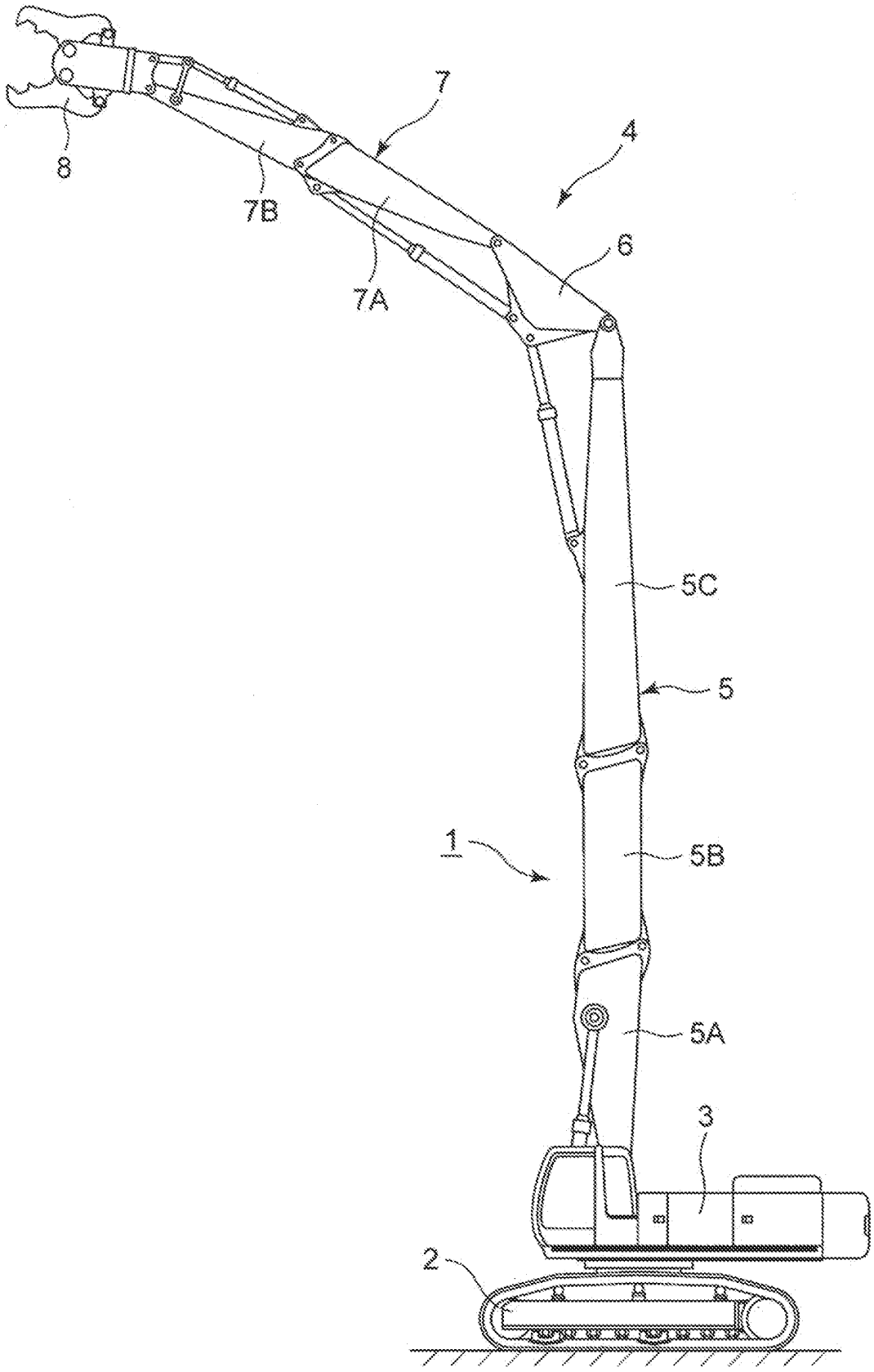


Fig. 2

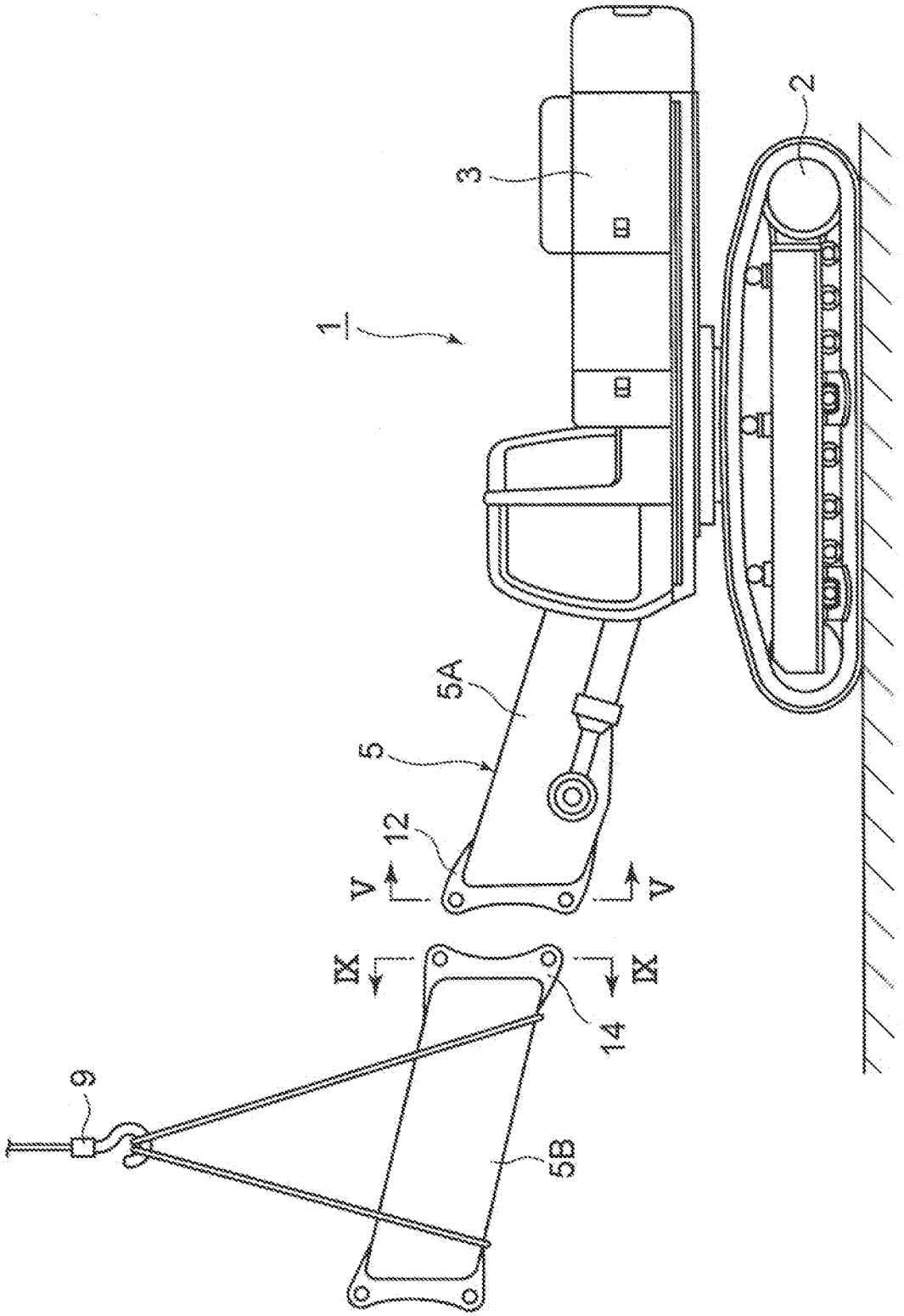


Fig.3

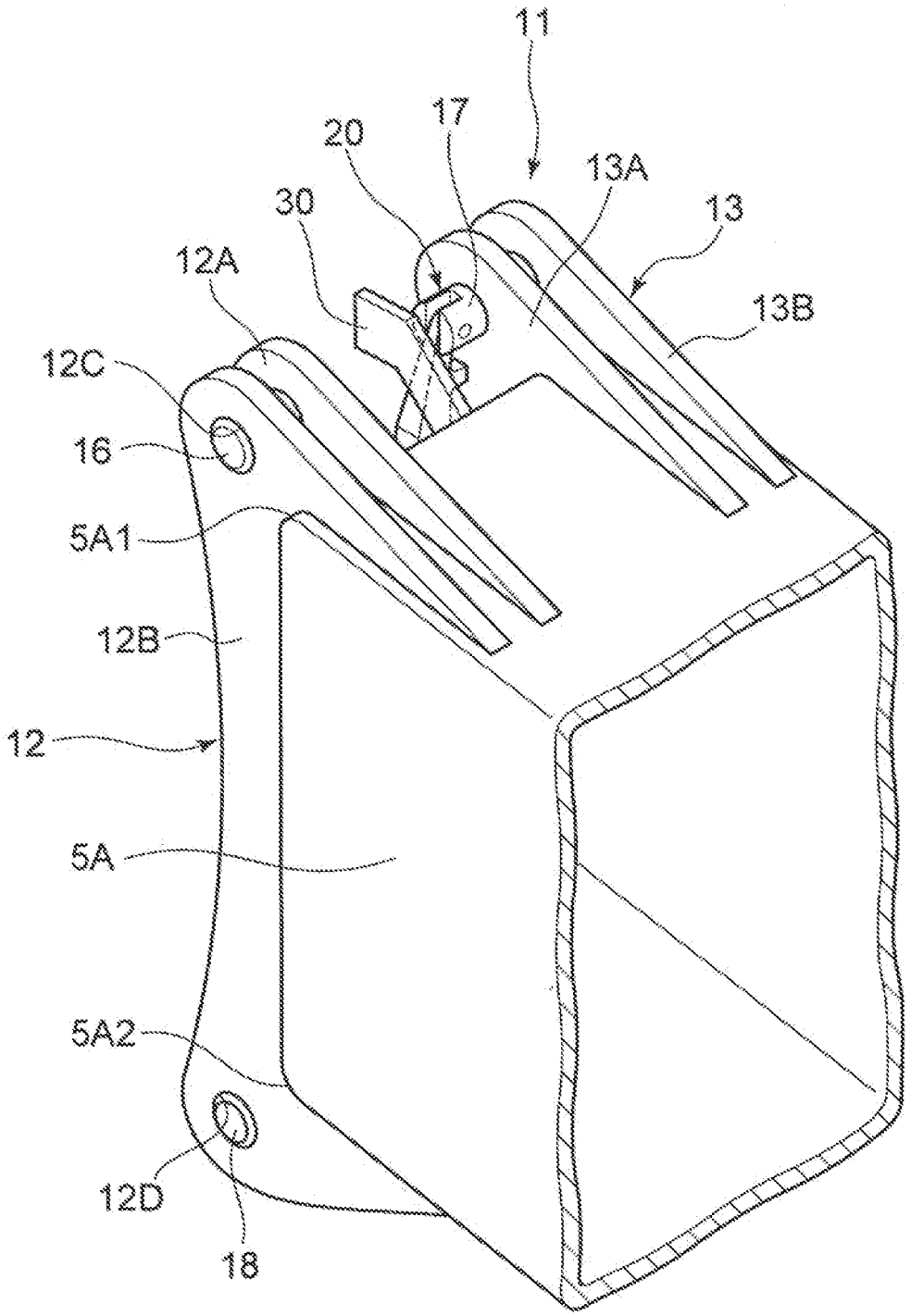


Fig. 4

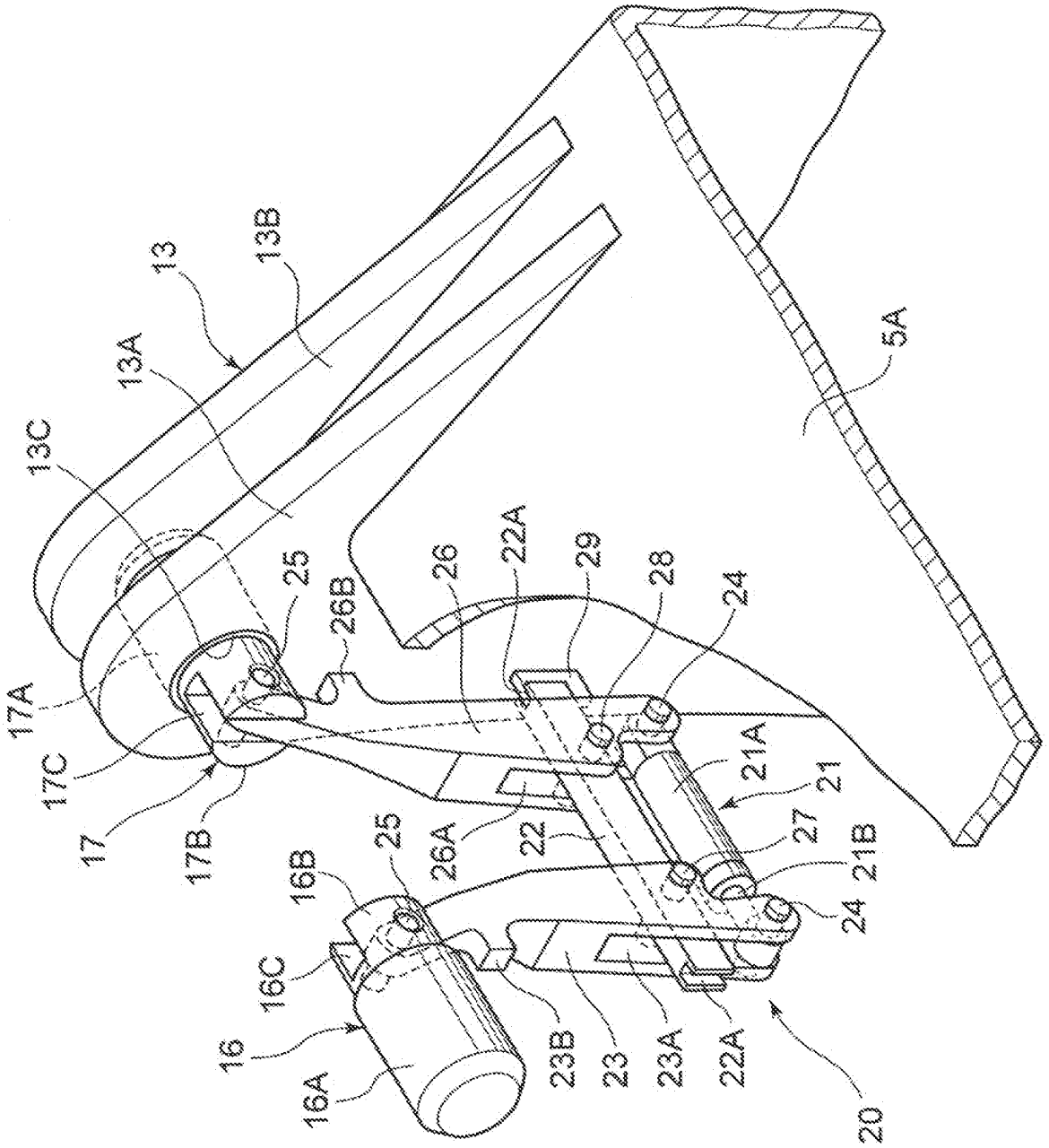

13
13B
13A
13C
5A
25
26B
26
22A
29
28
24
17A
17C
17
17B
21A
21
27
21B
25
26A
22
16B
16C
16
16A
23B
23
23A
22A
20

Fig.5

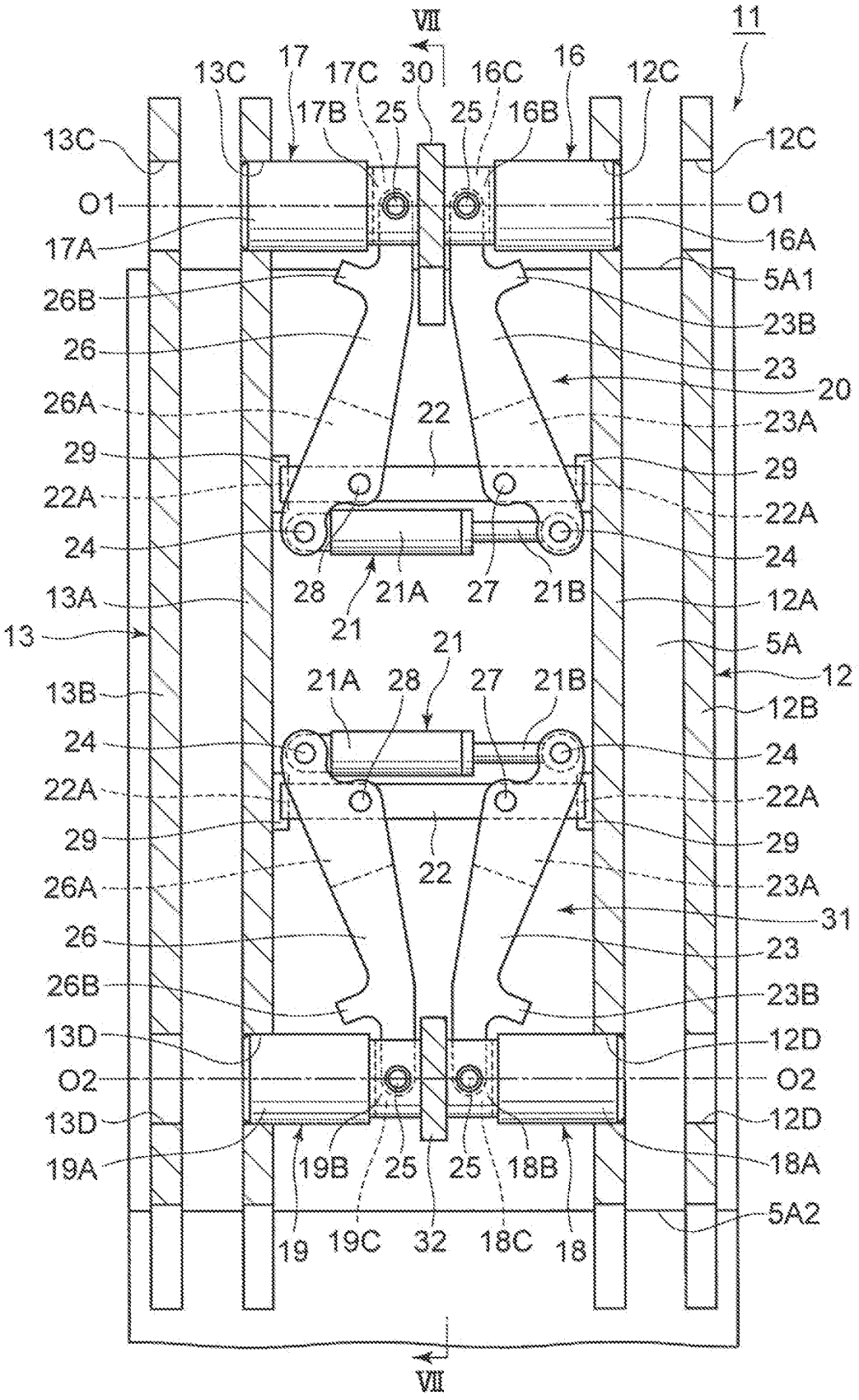

VII
11
13C
17
17C
30
16C
16
12C
17B
25
25
16B
O1
17A
26B
26
26A
22
29
22A
24
28
21A
27
21B
13A
13
21
12A
5A
12
13B
12B
22
31
19A
19B
25
25
18B
18A
19
19C
32
18C
18
5A2
VII

Fig.6

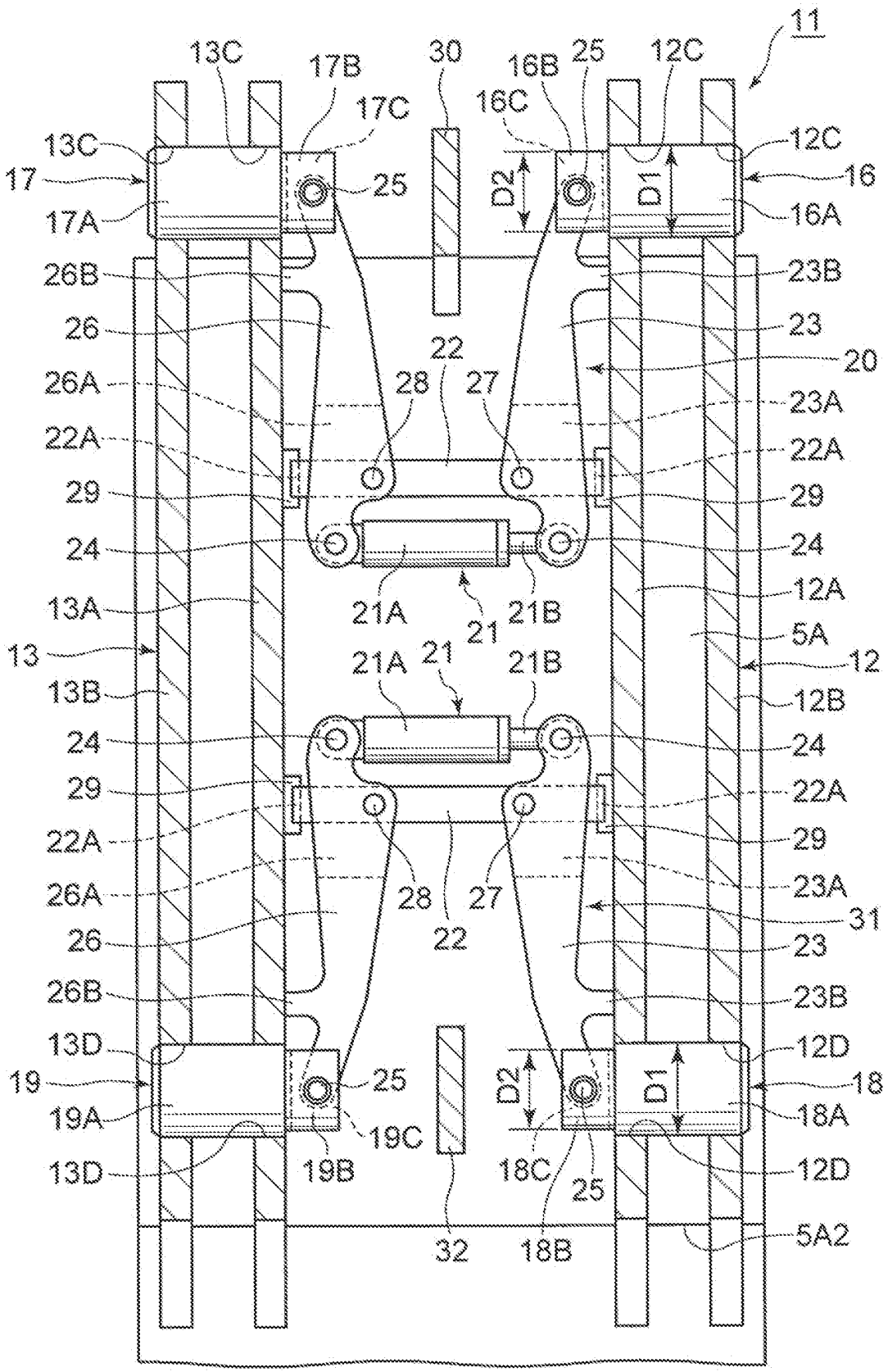

11
13C
17B
30
16B
25
12C
17C
16C
13C
12C
17
25
16
D2
D1
17A
16A
26B
23B
26
23
22
20
26A
28
27
23A
22A
22A
29
29
24
24
21A
21
21B
12A
13A
5A
13
21A
21
21B
12
13B
12B
24
24
29
22A
22A
29
26A
28
27
23A
31
22
26
23
26B
23B
13D
12D
19
25
D2
D1
18
19A
19C
18A
13D
19B
18C
25
12D
32
18B
5A2

Fig.7

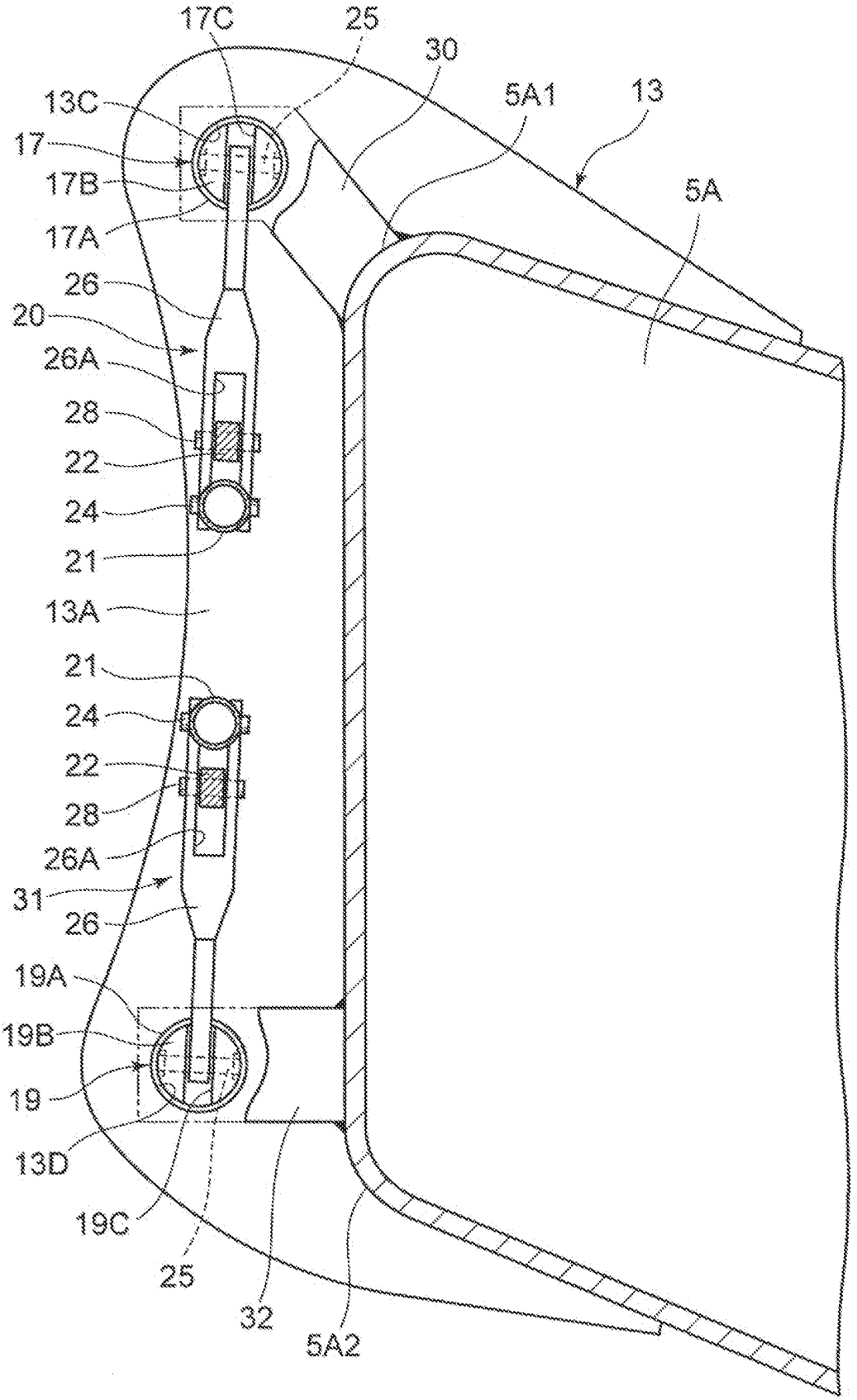

17C
25
30
5A1
13
13C
17
17B
17A
5A
26
20
26A
28
22
24
21
13A
21
24
22
28
26A
31
26
19A
19B
19
13D
19C
25
32
5A2

Fig.8

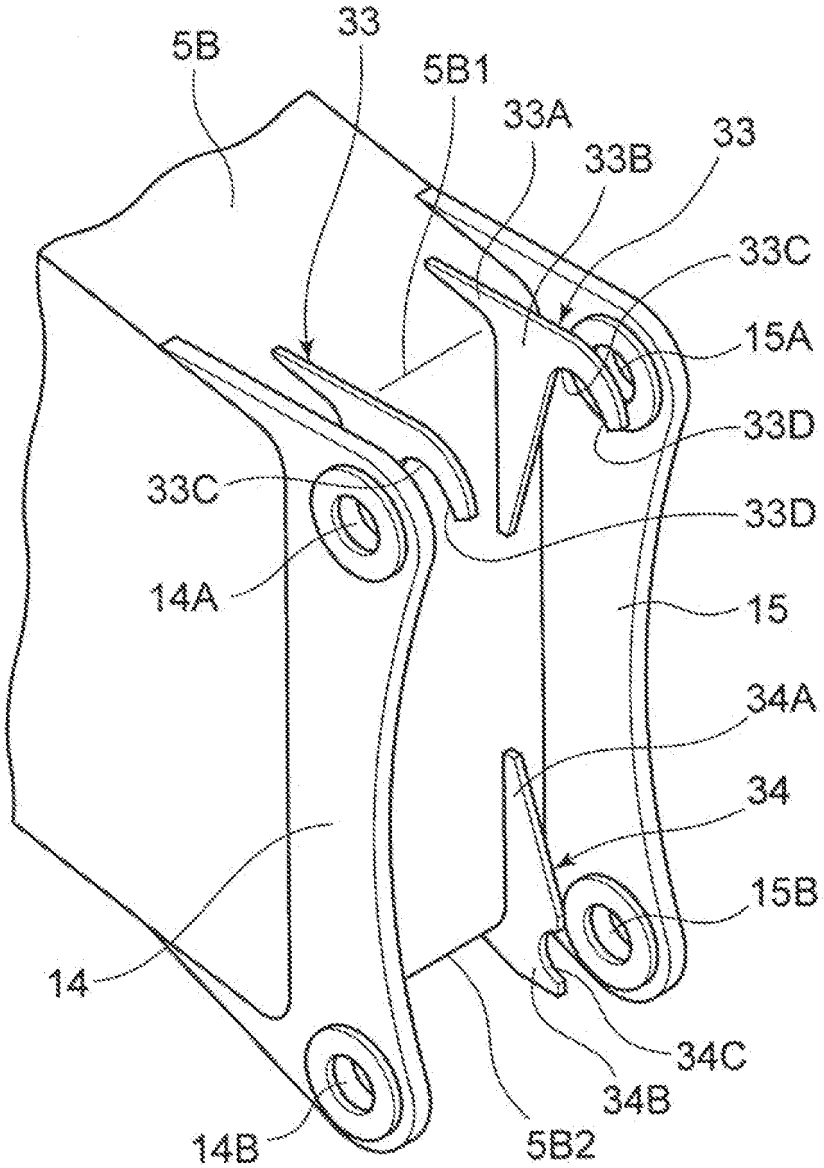

5B
33
5B1
33A
33B
33
33C
15A
33D
33C
33D
14A
15
34A
34
15B
14
34C
34B
14B
5B2

Fig.9

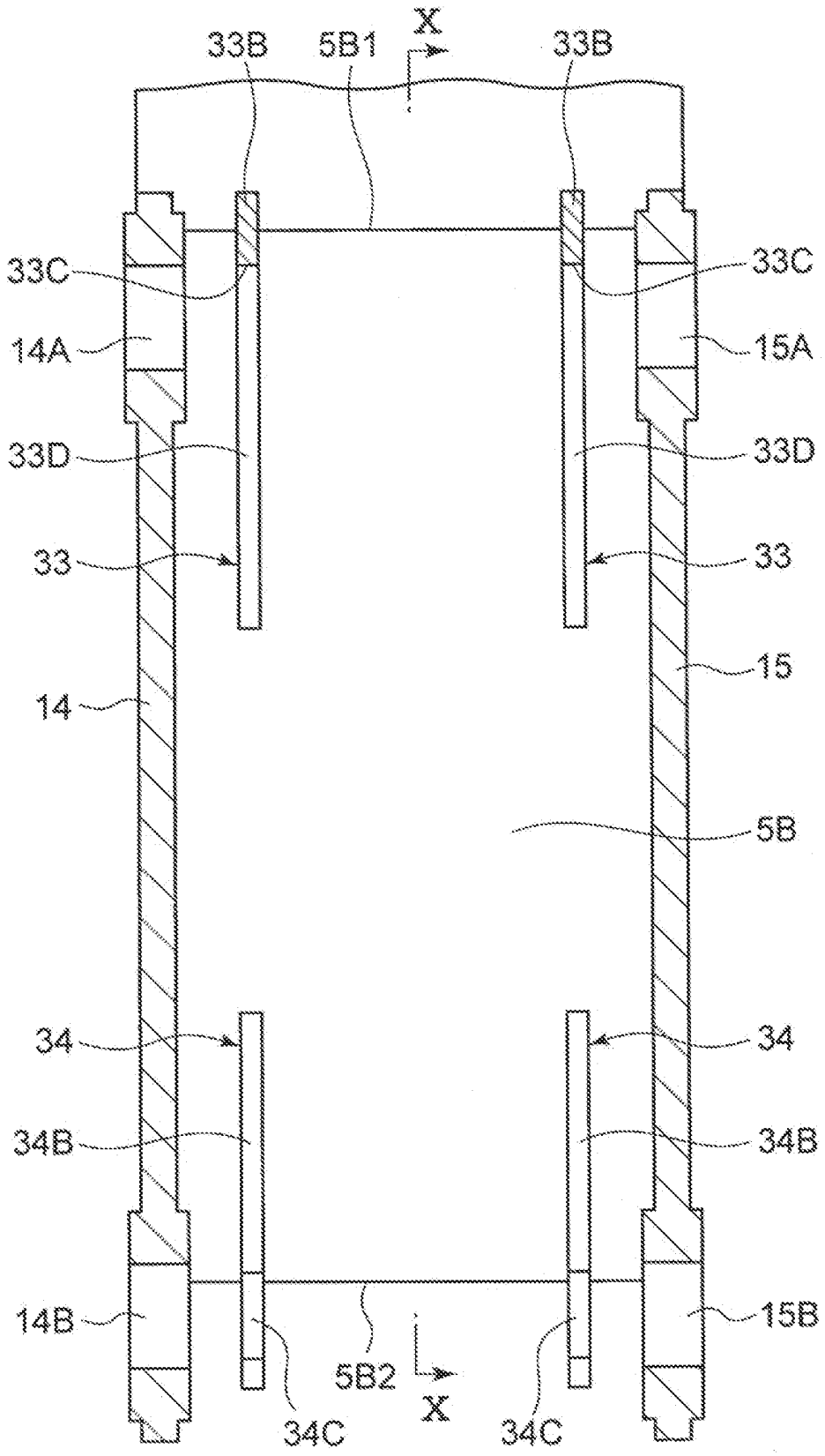

X
33B
5B1
33B
33C
33C
14A
15A
33D
33D
33
33
15
14
5B
34
34
34B
34B
14B
15B
5B2
X
34C
34C

Fig.10

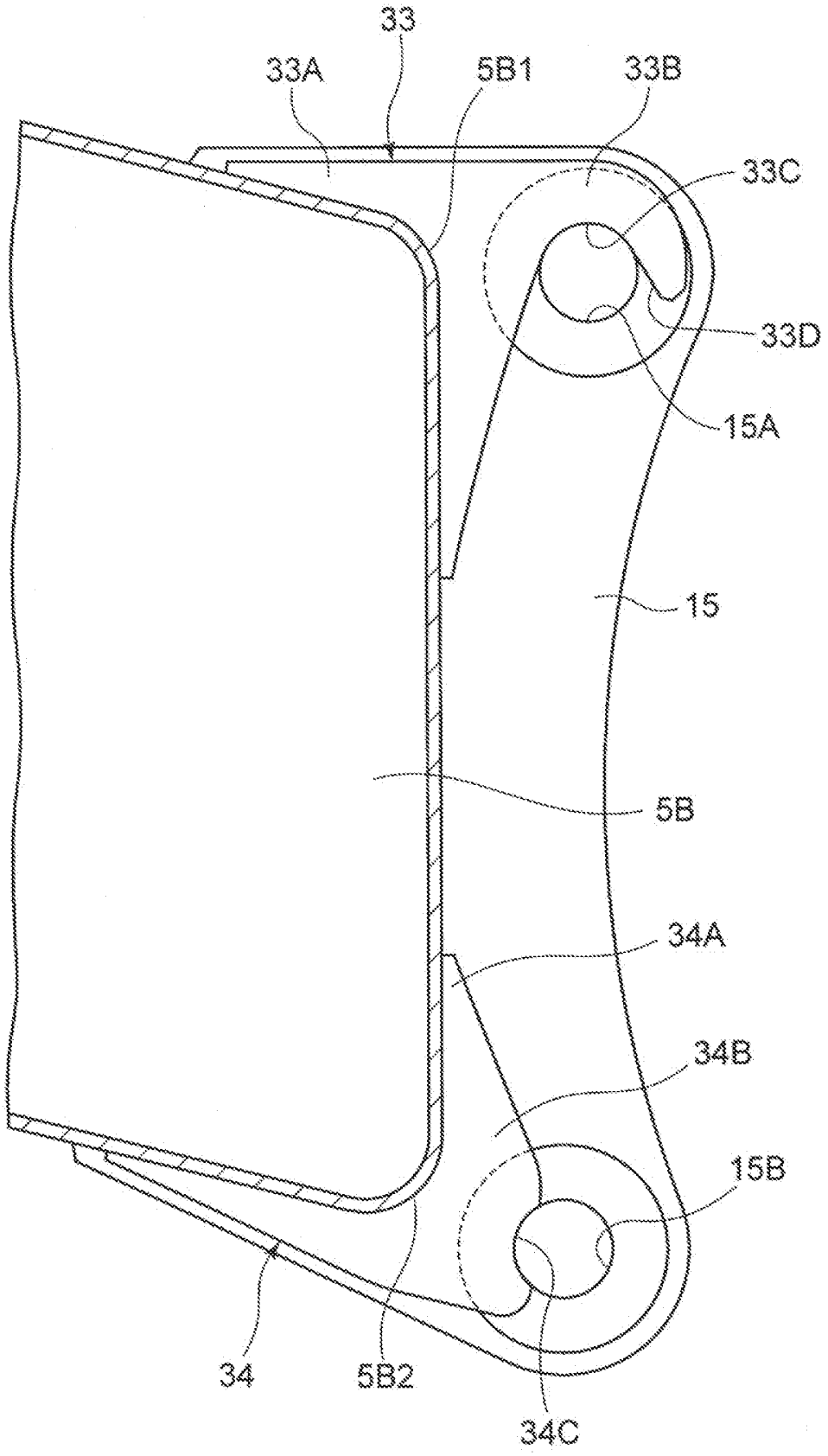


Fig.11

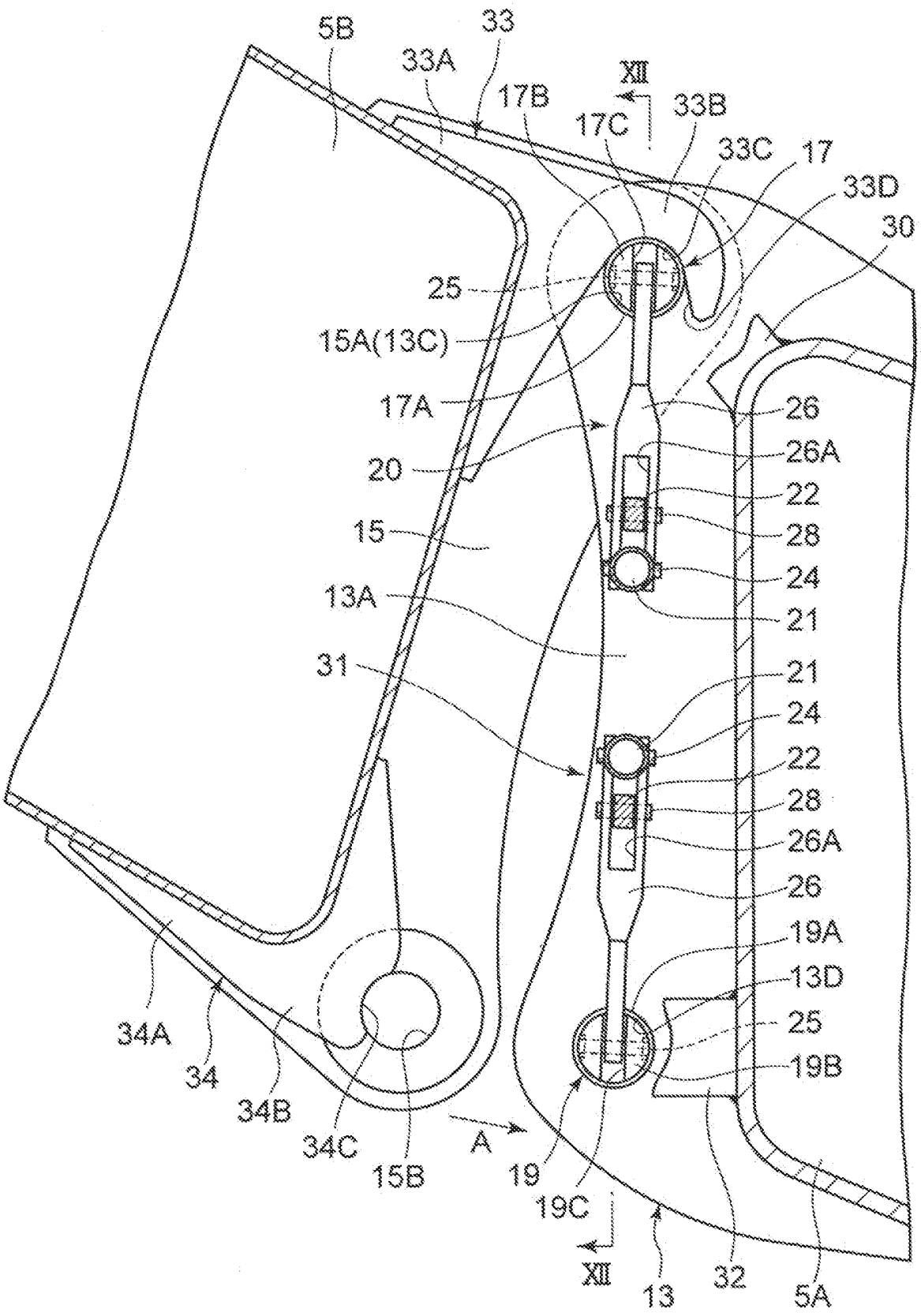

5B
33
33A
XII
17B
33B
17C
33C
17
33D
30
25
15A(13C)
17A
26
26A
20
22
15
28
24
13A
21
31
21
24
22
28
26A
26
19A
13D
25
19B
34A
34
34B
34C
15B
A
19
19C
XII
13
32
5A

Fig.12

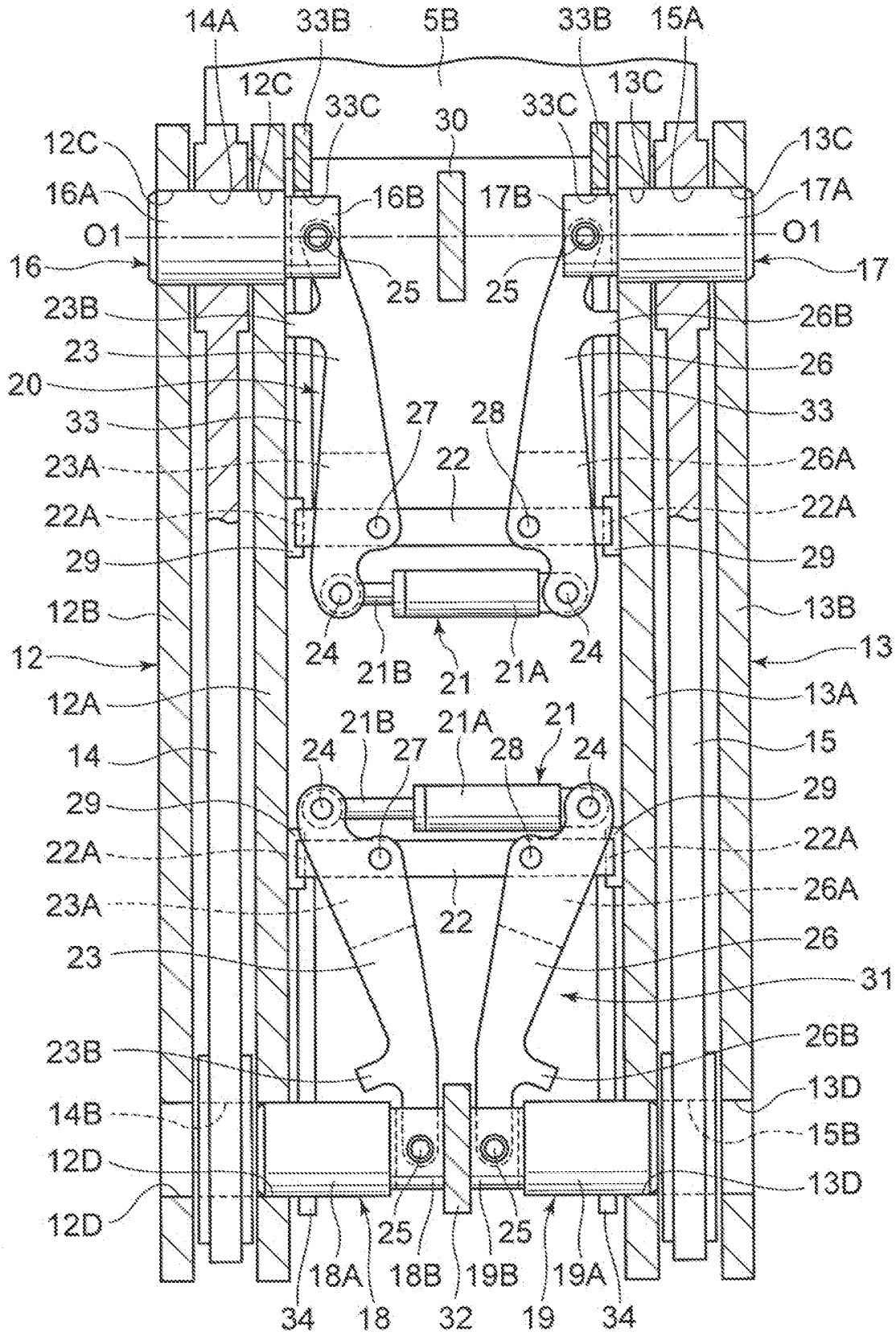

14A
33B
5B
33B
15A
12C
33C
30
33C
13C
12C
13C
16A
16B
17B
17A
O1
O1
16
25
25
17
23B
26B
23
26
20
33
27
28
33
23A
22
26A
22A
22A
29
29
12B
13B
24
21B
21
21A
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12
13
12A
13A
21B
21A
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14
24
27
28
24
15
29
29
22A
22A
23A
22
26A
23
22
26
31
23B
26B
14B
13D
15B
12D
13D
12D
25
25
18A
18B
19B
19A
34
18
32
19
34

Fig.13

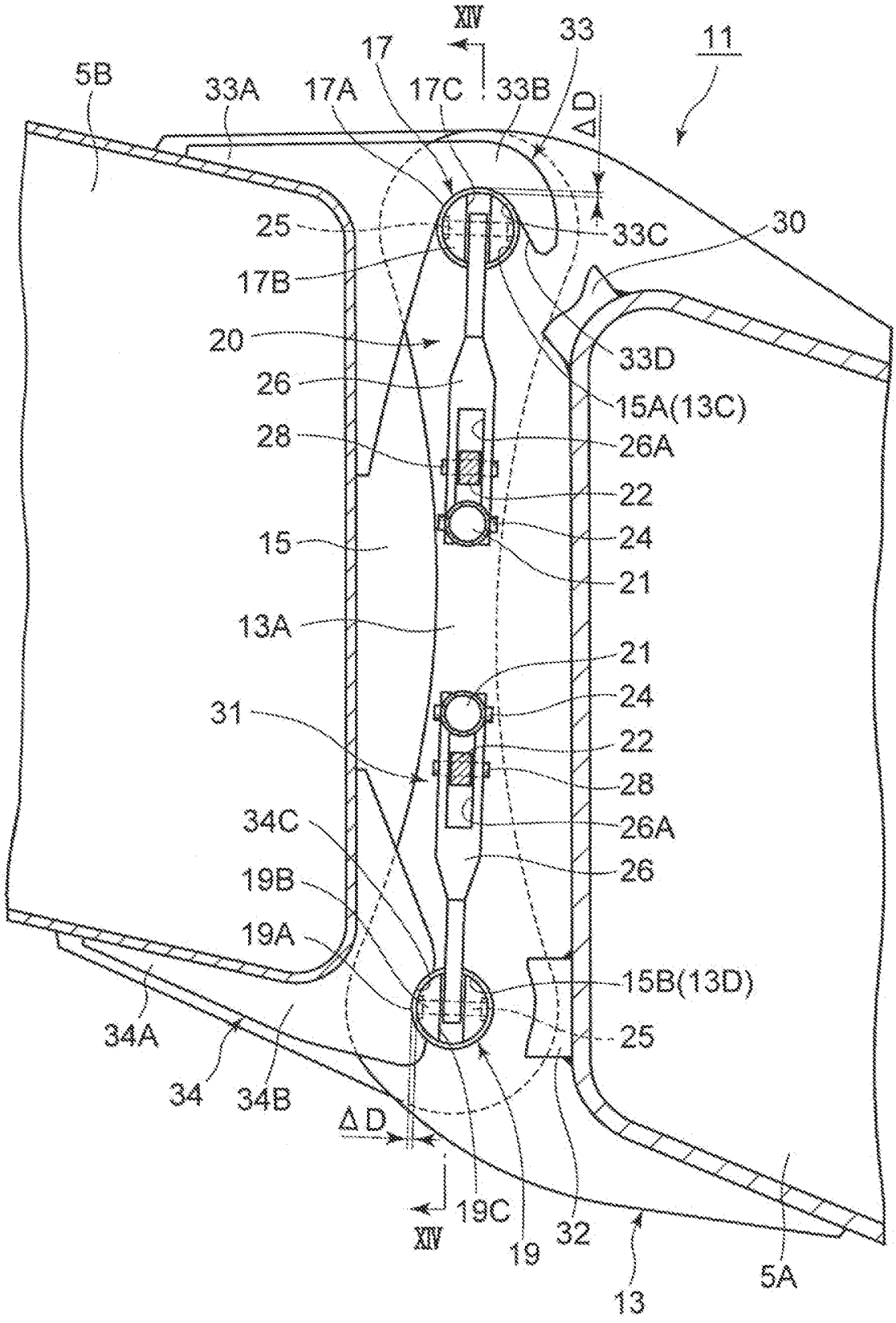

XIV
17
33
11
5B
33A
17A
17C
33B
ΔD
25
33C
30
17B
20
33D
26
15A(13C)
28
26A
22
15
24
21
13A
21
31
24
22
28
34C
26A
19B
26
19A
15B(13D)
34A
25
34
34B
ΔD
19C
XIV
19
32
13
5A

Fig.14

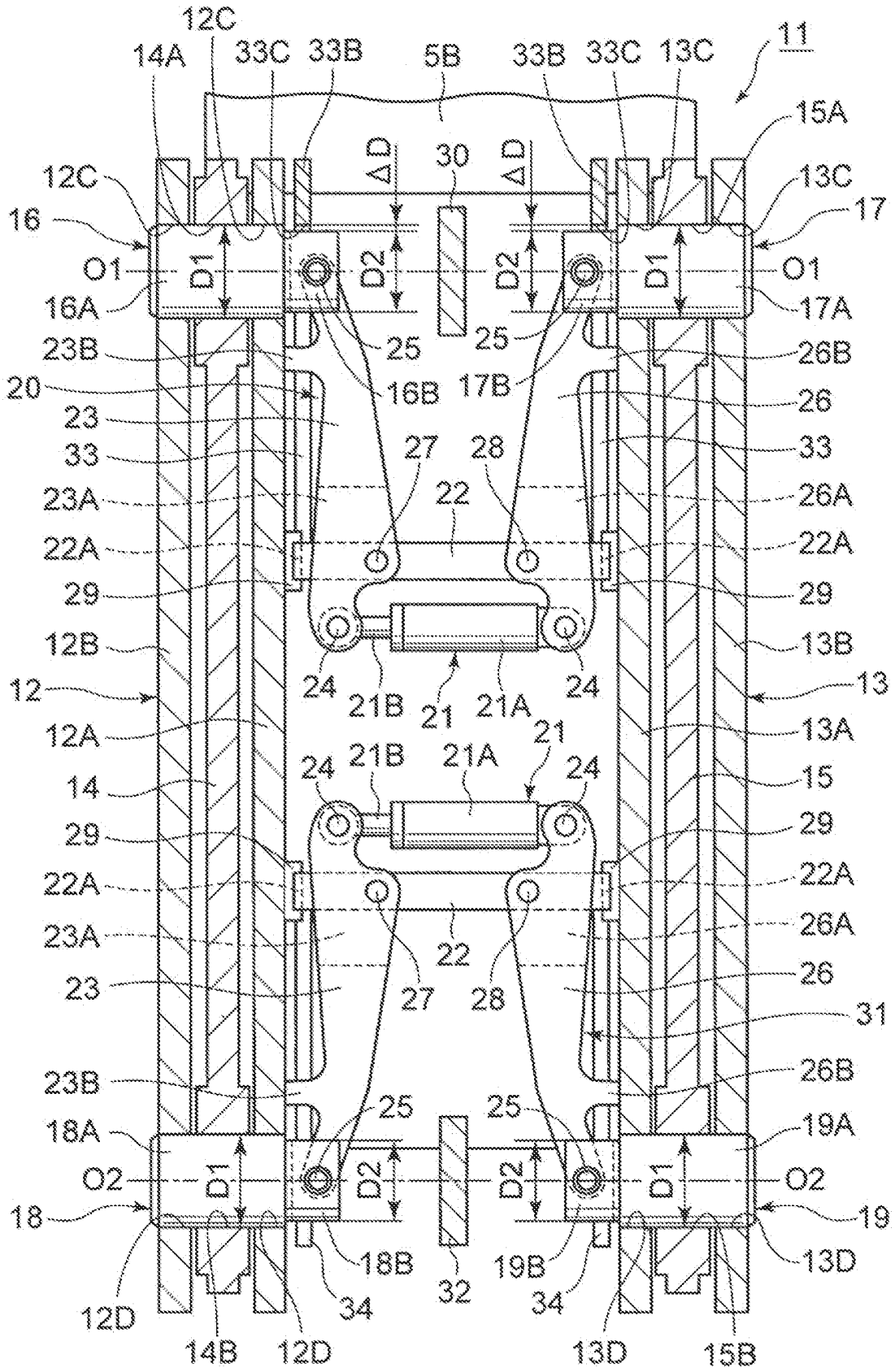
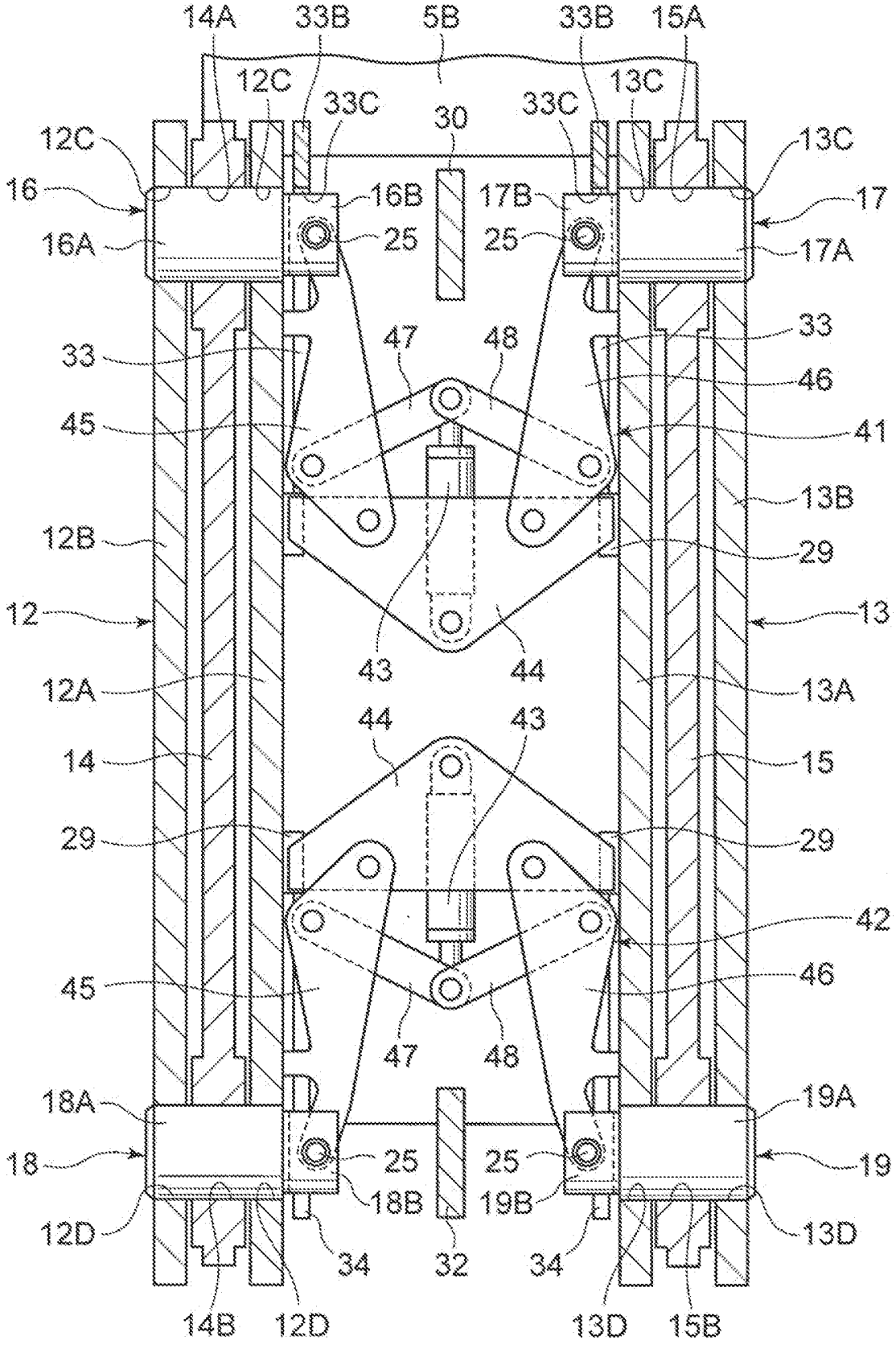

12C
14A
33C
33B
5B
33B
33C
13C
11
15A
12C
13C
16
17
ΔD
30
ΔD
O1
D1
D2
D2
D1
O1
16A
17A
25
25
23B
26B
16B
17B
20
26
23
33
27
28
33
23A
22
26A
22A
22A
29
29
12B
13B
24
21B
21
21A
24
12
13
12A
13A
21
24
21B
21A
24
14
15
29
29
22A
22A
23A
22
26A
23
27
28
26
31
23B
26B
25
25
18A
19A
O2
D1
D2
D2
D1
O2
18
19
18B
19B
13D
12D
32
34
34
14B
12D
13D
15B

Fig.15


14A
33B
5B
33B
15A
12C
33C
30
33C
13C
12C
13C
16
16B
17B
17
25
25
16A
17A
33
47
48
33
46
45
41
13B
12B
29
12
13
43
44
12A
13A
44
43
14
15
29
29
42
45
46
47
48
18A
19A
18
25
25
19
18B
19B
12D
13D
34
32
34
14B
12D
13D
15B

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- JP H4134566 B **[0005]**
- US 2006157605 A **[0006]**