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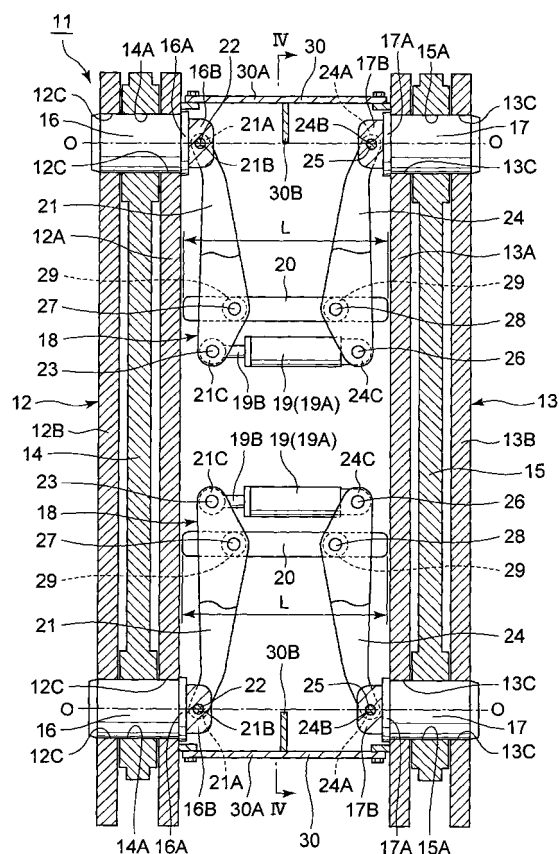
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(54) **Two-member connecting device**

(57) A pin inserting/withdrawing mechanism (18) which is provided between left and right first brackets (12), (13) is constituted by a hydraulic cylinder (19) disposed in such a manner as to be spaced apart from left and right connecting pins (16), (17) so as to be capable of extending and contracting in the same direction as the axis of the left and right connecting pins (16), (17); a floating link (20) disposed in a floating state between the left and right first brackets (12), (13); a left link (21) for connecting the left connecting pin (16) and the hydraulic cylinder (19) by means of the floating link (20); and a right link (24) for connecting the right connecting pin (17) and the hydraulic cylinder (19) by means of the floating link (20). In consequence, the left and right connecting pins (16), (17) respectively connected to one end sides (21A), (24A) of these left and right links (21), (24) move in the left-right direction in correspondence with the extension and contraction of the hydraulic cylinder (19). As a result, the left and right connecting pins (16), (17) can be smoothly inserted into or withdrawn from the left and right first brackets (12), (13) and the left and right second brackets (14), (15).

Fig. 3



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] The multi-boom for demolition work is configured into a desired length by connecting together the plurality of booms, and the configuration adopted is such that adjacent ones of the booms are connected by using a two-member connecting device.

[0004] In the two-member connecting device according to this prior art, left and right brackets provided on one of two booms which are connected to each other and left and right brackets provided on the other boom are connected together by left and right connecting pins.

[0005] In this case, one end sides of left and right links are respectively pin-connected rotatably to left and right connecting pins, and other end sides of these left and right links are respectively pin-connected rotatably to supporting members respectively provided projectingly on brackets, by using fulcrum pins. Further, both end portions of a hydraulic cylinder are respectively connected to longitudinally intermediate portions of the left and right links, and the configuration adopted is such that when this hydraulic cylinder is extended or contracted, the one end sides of the links respectively move in the left-right direction about the fulcrum pins to allow the connecting pins to be inserted or withdrawn with respect to the brackets (patent document 1: JP-A-2005-249185).

DISCLOSURE OF THE INVENTION

[0006] However, with the above-described prior art, the configuration adopted is such that the supporting members are fixedly provided on the left and right brackets, and the other end sides of the left and rights are rotatably supported by these supporting members. For this reason, there is a problem in that the operation of fixing the supporting members to the brackets by use of welding or other similar means is troublesome.

[0007] Further, in the case where the supporting member for supporting the other end side of the link is fixed

to the bracket by use of welding or other similar means, it is difficult to accurately position the supporting member with respect to a pin hole for a connecting pin provided in the bracket. Hence, there is a problem in that it is difficult to smoothly insert and withdraw the connecting pin connected to the one end side of the link with respect to the pin hole in the bracket in correspondence with the extension or contraction of the hydraulic cylinder.

[0008] Furthermore, the configuration adopted is such that an elongated hole for horizontally moving the connecting pin when that link is rotated about the fulcrum pin is formed in one end side of the link, and one end side of the link and the connecting pin are connected by means of a pin inserted in this elongated hole. Accordingly, troublesome processing such as end milling is required for forming the elongated holes in the one end sides of the links, so that there is a problem in that the overall manufacturing cost of the two-member connecting device including the links becomes high. In addition, in the case where the elongated hole is formed in the one end side of the link, there is a problem in that the pin inserted in the elongated hole becomes worn at an early period as the pin is constantly brought into sliding contact with an inner peripheral edge of that elongated hole.

SUMMARY OF THE INVENTION

[0009] In view of the above-discussed problems with the prior art, it is an object of the present invention to provide a two-member connecting device which is capable of smoothly effecting the inserting/withdrawing operation of the connecting pins with respect to the first and second members.

[0010] (1) To overcome the above-described problems, the present invention is applied to a two-member connecting device comprising: left and right first members opposing each other in a left-right direction; left and right first pin insertion holes which are respectively provided in the first members; left and right second members respectively opposing the left and right first members; left and right second pin insertion holes which are respectively provided in the second members and can be aligned with the first pin insertion holes as an identical axis; a left connecting pin which is inserted in the left first pin insertion hole and the left second pin insertion hole; a right connecting pin which is inserted in the right first pin insertion hole and the right second pin insertion hole; and a pin inserting/withdrawing mechanism which is disposed between the left and right first members, and which inserts or withdraws the left connecting pin with respect to the left first pin insertion hole and the left second pin insertion hole and inserts or withdraws the right connecting pin with respect to the right first pin insertion hole and the right second pin insertion hole.

[0011] The characteristic of the present invention lies in that the pin inserting/withdrawing mechanism includes: a hydraulic cylinder disposed so as to be capable of extending and contracting at a position spaced apart from

a position of an axis of the left and right 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 left and right 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 left and right connecting pins; a left link rotatably connecting the left connecting pin and the hydraulic cylinder, respectively, by means of the floating link; and/or a right link rotatably connecting the right connecting pin and the hydraulic cylinder, respectively, by means of the floating link, the left and right first members and the left and right second members being respectively connected or disconnected by the left and right connecting pins by means of the left and right links in correspondence with an extended state or a contracted state of the hydraulic cylinder.

[0012] With this arrangement, if the hydraulic cylinder is extended or contracted, the left and right links rotate in the left-right direction by using the floating link as a fulcrum, and the left and right connecting pins respectively connected to these left and right links move in the left-right direction, thereby making it possible to insert or withdraw the left and right connecting pins with respect to the first and second members. Thus, since the inserting/withdrawing operation of the connecting pins with respect to the first and second members can be effected easily by using the hydraulic cylinder, it is possible to enhance the workability at the time of connecting or disconnecting the first member and the second member. Further, since it is unnecessary to perform the inserting/withdrawing operation of the connecting pins with respect to the first and second members by a manual operation, this inserting/withdrawing operation of the connecting pins can be effected speedily and safely.

[0013] In this case, the floating link serving as the fulcrum when the left and right connecting pins rotate is set in a floating state with respect to the left and right first members. For this reason, as the links are moved in correspondence with the extending operation or contracting operation of the hydraulic cylinder, the left connecting pin connected to the left link can be moved horizontally along the axis of a left first pin insertion hole and a left second pin insertion hole. On the other hand, the right connecting pin connected to the right link can also be moved horizontally along the axis of a right first pin insertion hole and a right second pin insertion hole. As a result, the left connecting pin can be smoothly withdrawn from or inserted into the left first pin insertion hole and the left second pin insertion hole, and the right connecting pin can be smoothly withdrawn from or inserted into the right first pin insertion hole and the right second pin insertion hole.

[0014] Further, as the floating link serving as a fulcrum of the left and right links is set in the floating state with respect to the left and right first members, it is unnecessary to provide fulcrums of the left and right links fixedly on the left and right first members, respectively. As a result, it is possible to render unnecessary the operation of providing fulcrums of each links on the first members,

making it possible to enhance the workability at the time of mounting the pin inserting/withdrawing mechanism between the left and right first members.

[0015] Furthermore, as the floating link for connecting the left and right links is set in the floating state with respect to the left and right first members, elongated holes for horizontally moving the left and right connecting pins need not be provided in the connecting portion between the left link and the left connecting pin and the connecting portion between the right link and the right connecting pin. As a result, it is possible to lower the manufacturing cost of the left and right links, and it is possible to suppress the wear of such as the pins each rotatably connect the link and the connecting pin, thereby making it possible to prolong the service life of the left and right links.

[0016] (2) According to the invention, the left link and the right link may be respectively connected to the left and right connecting pins, the hydraulic cylinder and the floating link are preferably disposed between the first and second members on a left side and the first and second members on a right side at least in a state of being able to move in the direction perpendicular to the axis of the left and right connecting pins, and the pin inserting/withdrawing mechanism is preferably supported in cantilevered state by the left and right connecting pins.

[0017] With this arrangement, it is possible to cantilever the pin inserting/withdrawing mechanism by making use of the left and right connecting pins. In consequence, members for mounting the pin inserting/withdrawing mechanism between the left first and second members and the right first and second members can be made unnecessary, making it possible to enhance the workability at the time of mounting the pin inserting/withdrawing mechanism.

[0018] (3) According to the invention, a stopper against which the left connecting pin abuts at a position where the left connecting pin has been withdrawn from the left second pin insertion hole and/or against which the right connecting pin abuts at a position where the right connecting pin has been withdrawn from the right second pin insertion hole is preferably provided between the left first member and the right first member.

[0019] With this arrangement, the left connecting pin abuts against the stopper at a position where the left connecting pin has been withdrawn from the left second pin insertion hole, so that the left connecting pin can be prevented from being removed from the left first pin insertion hole. Meanwhile, the right connecting pin also abuts against the stopper at a position where the right connecting pin has been withdrawn from the right second pin insertion hole, so that the right connecting pin can be prevented from being removed from the right first pin insertion hole. In consequence, the pin inserting/withdrawing mechanism can be held between the left and right first members in a state in which the left connecting pin is inserted in the left first pin insertion hole and the right connecting pin is inserted in the right first pin insertion hole.

[0020] (4) According to the invention, rotation restricting members may be respectively provided on the left and right first members, preferably so as to restrict the floating link from rotating about each of the left and right connecting pins. As a result, it is possible to prevent the pin inserting/withdrawing mechanism from protruding to outside the left and right first members and interfering with an obstacle or the like, thereby making it possible to protect the pin inserting/withdrawing mechanism.

[0021] (5) According to the invention, the hydraulic cylinder is preferably disposed so as to be capable of extending and contracting in a same direction as the axis of the left and right connecting pins, and the left and right links are preferably each constituted by one link so as to connect the hydraulic cylinder and the floating link to the left and right connecting pins, respectively.

[0022] With this arrangement, if the hydraulic cylinder is extended or contracted in the same direction as the axis of the left and right connecting pins, the left and right links rotate in the left-right direction by using their connecting portions of the floating link, to thereby allow the left and right connecting pins to be inserted or withdrawn with respect to the left and right second pin insertion holes.

[0023] (6) According to the invention, the floating link may be disposed by being positioned between the left and right connecting pins and the hydraulic cylinder. In consequence, when the hydraulic cylinder is extended, the left and right connecting pins can be withdrawn from the left and right second pin insertion holes, whereas when the hydraulic cylinder is contracted, the left and right connecting pins can be inserted into the left and right second pin insertion holes.

[0024] (7) On the other hand, according to the invention, the floating link may be disposed by being positioned on an opposite side to the left and right connecting pins with the hydraulic cylinder located therebetween. In consequence, when the hydraulic cylinder is contracted, the left and right connecting pins can be withdrawn from the left and right second pin insertion holes, whereas when the hydraulic cylinder is extended, the left and right connecting pins can be inserted into the left and right second pin insertion holes.

[0025] (8) According to the invention, the hydraulic cylinder is preferably disposed so as to be capable of extending and contracting in the direction perpendicular to the axis of the left and right connecting pins, the floating link is preferably connected to one end of the hydraulic cylinder, and the left and right links are preferably constituted by left and right first links for connecting each of the connecting pins and the floating link and left and right second links for connecting other end of the hydraulic cylinder and an intermediate portion of each of the first links.

[0026] With this arrangement, as the hydraulic cylinder for constituting the 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 and right connecting pins, even in a case where the interval between the left and right first members is narrow, the pin inserting/withdrawing mechanism including the hydraulic cylinder can be easily disposed between these left and right first members.

[0027] (9) Further, according to the invention, the left and right second links and the other end of the hydraulic cylinder are preferably connected by using one common pin. With this arrangement, as three members including the left and right second links and the other end of the hydraulic cylinder are coaxially connected by means of one common pin, it is possible to reduce the number of parts of the pin inserting/withdrawing mechanism.

[0028] (10) Furthermore, according to the invention, either one of the left and right second links and the other end of the hydraulic cylinder are preferably connected by using one pin, and the left and right second links are preferably connected at a position different from a position of the one pin by using another pin. In consequence, it is possible to make short the length of one pin for connecting either one of the left and right second links and the other end of the hydraulic cylinder and the other pin for connecting the left and right second links, thereby making it possible to increase the strength of these two pins and prolong the service life of the pin inserting/withdrawing mechanism.

BRIEF DESCRIPTION OF THE DRAWINGS

[0029]

Fig. 1 is a front view illustrating a multi-boom type hydraulic excavator to which a two-member connecting device according to a first 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 fragmentary cross-sectional view, taken in the direction of arrows III - III in Fig. 2, of the two-member connecting device in accordance with a first embodiment;

Fig. 4 is a cross-sectional view, taken in the direction of arrows IV - IV in Fig. 3, of the two-member connecting device;

Fig. 5 is a cross-sectional view similar to Fig. 3 and illustrates a state in which left and right connecting pins have been withdrawn from left and right second brackets;

Fig. 6 is a cross-sectional view similar to Fig. 3 and illustrates a state in which the left connecting pin has abutted against a stopper;

Fig. 7 is a fragmentary perspective view illustrating a pin inserting/withdrawing mechanism and the like in accordance with the first embodiment;

Fig. 8 is a cross-sectional view similar to Fig. 3 and illustrates a two-member connecting device in accordance with a second embodiment;

Fig. 9 is a cross-sectional view similar to Fig. 8 and

illustrates a state in which the left and right connecting pins have been withdrawn from the left and right second brackets;

Fig. 10 is a cross-sectional view, taken in the direction of arrows X - X in Fig. 8, of a floating link, rotation restricting members, and the like;

Fig. 11 is a fragmentary perspective view illustrating the pin inserting/withdrawing mechanism and the like in accordance with the second embodiment;

Fig. 12 is a cross-sectional view similar to Fig. 3 and illustrates a two-member connecting device in accordance with a third embodiment;

Fig. 13 is a cross-sectional view similar to Fig. 12 and illustrates a state in which the left and right connecting pins have been withdrawn from the left and right second brackets;

Fig. 14 is a cross-sectional view, taken in the direction of arrows XIV - XIV in Fig. 12, of the floating link, the rotation restricting members, and the like;

Fig. 15 is a cross-sectional view illustrating a two-member connecting device in accordance with a fourth embodiment;

Fig. 16 is a cross-sectional view, taken in the direction of arrows XVI - XVI in Fig. 15, of the two-member connecting device;

Fig. 17 is a cross-sectional view illustrating a state in which the left and right connecting pins have been withdrawn from the left and right second brackets;

Fig. 18 is a cross-sectional view illustrating a state in which the left connecting pin has abutted against the stopper;

Fig. 19 is a fragmentary perspective view illustrating the pin inserting/withdrawing mechanism and the like in accordance with the fourth embodiment;

Fig. 20 is a cross-sectional view illustrating a two-member connecting device in accordance with a fifth embodiment;

Fig. 21 is a cross-sectional view illustrating a state in which the left and right connecting pins have been withdrawn from the left and right second brackets;

Fig. 22 is a cross-sectional view, taken in the direction of arrows XXII - XXII in Fig. 20, of the floating link, a first link, a second link, a hydraulic cylinder, one pin, another pin, and the like;

Fig. 23 is a cross-sectional view illustrating a two-member connecting device in accordance with a sixth embodiment;

Fig. 24 is a cross-sectional view illustrating a state in which the left and right connecting pins have been withdrawn from the left and right second brackets; and

Fig. 25 is a cross-sectional view illustrating modifications of the left and right first brackets.

DESCRIPTION OF REFERENCE NUMERALS

[0030]

11, 31, 41, 51, 71, 91: Two-member connecting device

12, 12': Left first bracket (left first member)

12C: Left first pin insertion hole

13, 13': Right first bracket (right first member)

13C: Right first pin insertion hole

14: Left second bracket (left second member)

14A: Left second pin insertion hole

15: Right second bracket (right second member)

15A: Right second pin insertion hole

16: Left connecting pin

17: Right connecting pin

18, 32, 42, 52, 72, 92: Pin inserting/withdrawing mechanism

19, 53, 73, 93: Hydraulic cylinder

20, 33, 43, 54, 74, 94: Floating link

21, 44: Left link

24, 45: Right link

30: Stopper

34, 47, 67, 88, 107: Rotation restricting member

56, 76, 96: Left first link (left link)

59, 79, 99: Left second link (left link)

62, 81, 102: Right first link (right link)

65, 84, 105: Right second link (right link)

86: One pin

87: Another pin

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

[0031] 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.

[0032] Figs. 1 to 10 show a first embodiment of the two-member connecting device in accordance with the invention.

[0033] 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.

[0034] The working mechanism 4 is largely constituted by a boom 5 consisting of a lower boom 5A mounted rotatably on a front portion 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.

[0035] Here, in a case where the extension boom 5B is mounted to the lower boom 5A of the boom 5, the configuration 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.

[0036] Next, a detailed description will be given of the two-member connecting device 11 in accordance with a first embodiment. Namely, denoted at 11 is the two-member connecting device disposed between the lower boom 5A and the extension boom 5B, and the two-member connecting device 11 connects a proximal end side of the extension boom 5B to a distal end side of the lower boom 5A. As shown in Figs. 3 to 7, the two-member connecting device 11 is comprised of the below-described left and right first brackets 12 and 13, left and right first pin insertion holes 12C and 13C, left and right second brackets 14 and 15, left and right second pin insertion holes 14A and 15A, two left connecting pins 16, two right connecting pins 17, two sets of pin inserting/withdrawing mechanisms 18 and the like.

[0037] Indicated at 12 is the left first bracket serving as a left first member provided on the left side of a distal end portion of the lower boom 5A. 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. Here, each of the left inner first bracket 12A and the left outer first bracket 12B is formed by using a thick-walled steel plate or the like, and is secured to the distal end portion of the lower boom 5A by welding or other similar means.

[0038] Further, 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. The left first pin insertion holes 12C are respectively bored in both end sides in the longitudinal direction (vertical direction in Figs. 3 and 4) of left inner first bracket 12A and the left outer first bracket 12B, and the below-described left connecting pin 16 is configured to be disposed in each of these left first pin insertion holes 12C in such a manner as to be capable of being inserted and withdrawn.

[0039] Indicated at 13 is the right first bracket serving as a right first member 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. Here, each of the right inner first bracket 13A and the right outer first bracket 13B is formed by using a thick-walled steel plate or the like, and is secured to the distal end portion of the lower boom 5A by welding or other similar means.

[0040] Further, 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. The right first pin insertion holes 13C are respectively bored in both end sides in the longitudinal direction (vertical direction in Figs. 3 and 4) of the right inner first bracket 13A and the right outer first bracket 13B, and the below-described right connecting pin 17 is configured to be disposed in these right first pin insertion holes 13C in such a manner as to be capable of being inserted and withdrawn.

[0041] In this case, the left 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 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 0 - 0 (see Fig. 5).

[0042] Denoted at 14 is the left second bracket serving as a left second member provided on the left side of a proximal end portion of the extension boom 5B. This left second bracket 14 is formed by a thick-walled steel plate or the like, and is secured to the proximal end portion of the extension boom 5B by welding or other similar means. The left second bracket 14 is disposed by being sandwiched between the left inner first bracket 12A and the left outer first bracket 12B of the left first bracket 12. In consequence, the left second bracket 14 opposes the left inner first bracket 12A and the left outer first bracket 12B in the left-right direction. Further, in the left second bracket 14, the left second pin insertion holes 14A are bored at positions corresponding to the left first pin insertion holes 12C of the left first bracket 12.

[0043] Indicated at 15 is the right second bracket serving as a right second member provided on the right side of a 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 is secured to the proximal end portion of the extension boom 5B by welding or other similar means. The right second bracket 15 is disposed by being sandwiched between the right inner first bracket 13A and the right outer first bracket 13B of the right first bracket 13. In consequence, the right second bracket 15 opposes the right inner first bracket 13A and the right outer first bracket 13B in the left-right direction. Further, in the right second bracket 15, the right second pin insertion holes 15A are bored at positions corresponding to the right first pin insertion holes 13C of the right first bracket 13.

[0044] In this case, as shown in Fig. 5, the arrangement provided is such that the left second pin insertion hole 14A of the left second bracket 14 and the right second pin insertion hole 15A of the right second bracket 15 is arranged to be aligned with the left first pin insertion holes 12C of the left first bracket 12 and the right first pin insertion holes 13C of the right first bracket 13 as the identical axis 0 - 0.

[0045] Denoted at 16 is the left connecting pin for connecting the left first bracket 12 and the left second bracket 14. The left connecting pin 16 is formed in a cylindrical shape extending in the left-right direction, and is inserted

in the left first pin insertion holes 12C of the left first bracket 12 and the left second pin insertion hole 14A of the left second bracket 14 in such a manner as to be capable of being inserted and withdrawn. Accordingly, the axis of the left connecting pin 16 is arranged to be aligned with the left first pin insertion holes 12C of the left first bracket 12 as the identical axis O - O. Here, a flange portion 16A having a larger diameter than the diameter of the left first pin insertion hole 12C and a link mounting portion 16B, to which a below-described left link 21 is rotatably mounted, are provided on a proximal end side of the left connecting pin 16.

[0046] Indicated at 17 is the right connecting pin for connecting the right first bracket 13 and the right second bracket 15. The right connecting pin 17 is formed in a cylindrical shape extending in the left-right direction, and is inserted in the right first pin insertion holes 13C of the right first bracket 13 and the right second pin insertion hole 15A of the right second bracket 15 in such a manner as to be capable of being inserted and withdrawn. Accordingly, the axis of the right connecting pin 17 is arranged to be aligned with the axis of the right first pin insertion holes 13C of the right first bracket 13 as the identical axis O - O. Here, a flange portion 17A having a larger diameter than the diameter of the right first pin insertion hole 13C and a link mounting portion 17B, to which a below-described right link 24 is rotatably mounted, are provided on a proximal end side of the right connecting pin 17.

[0047] Next, a description will be given of the two sets of pin inserting/withdrawing mechanisms 18 for inserting and withdrawing the two sets of the left and right connecting pins 16 and 17 arranged vertically.

[0048] Namely, designated at 18 are the two sets of pin inserting/withdrawing mechanisms arranged vertically between the left first bracket 12 and the right first bracket 13. These pin inserting/withdrawing mechanisms 18 are respectively adapted to insert and withdraw the left connecting pin 16 with respect to the left first pin insertion hole 12C of the left first bracket 12 and the left second pin insertion hole 14A of the left second bracket 14, and insert and withdraw the right connecting pin 17 with respect to the right first pin insertion holes 13C of the right first bracket 13 and the right second pin insertion hole 15A of the right second bracket 15. Further, the pin inserting/withdrawing mechanisms 18 are constituted by a hydraulic cylinder 19, a floating link 20, a left link 21, a right link 24 and the like, which will be described hereinafter.

[0049] Indicated at 19 is the hydraulic cylinder for constituting the pin inserting/withdrawing mechanisms 18. This hydraulic cylinder 19 is constituted by a tube 19A, a piston (not shown), and a rod 19B having a proximal end side fixed to the piston and a distal end side projecting from the tube 19A. Further, the hydraulic cylinder 19 is disposed in a state of being capable of extending and contracting in the same direction as the axis O - O of the left and right connecting pins 16 and 17 at a position

spaced apart from the position of the axis O - O of the left and right connecting pins 16 and 17, i.e., at a position vertically spaced apart from the axis O - O of the respective connecting pins 16 and 17.

[0050] Further, as pressure oil from a hydraulic source (not shown) is supplied to or discharged from the hydraulic cylinder 19, the hydraulic cylinder 19 extends or contracts the rod 19B to move the left and right connecting pins 16 and 17 in the left-right direction through the below-described left and right links 21 and 24 and the like.

[0051] Indicated at 20 is the floating link which is disposed at a position vertically spaced apart from the axis O - O of the left and right connecting pins 16 and 17. Namely, the floating link 20 is disposed adjacent to and parallel to the hydraulic cylinder 19. This floating link 20 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 20 constitutes a fulcrum for allowing the left and right connecting pins 16 and 17 respectively connected to the below-described left and right links 21 and 24 to move in the left-right direction in correspondence with the extension or contraction of the hydraulic cylinder 19.

[0052] In this case, the floating link 20 is formed in the shape of a rectangular rod extending in the left-right direction, and the lengthwise dimension L of the floating link 20 is set to be slightly smaller than the interval between the left inner first bracket 12A and the right inner first bracket 13A (see Fig. 3). Further, the floating link 20 is disposed between the left and right connecting pins 16 and 17, on the one hand, and the hydraulic cylinder 19, on the other hand. The arrangement provided is such that one side (left side) in the left-right direction of the floating link 20 is rotatably connected to a longitudinally intermediate position of the below-described left link 21, and the other side (right side) in the left-right direction of the floating link 20 is rotatably connected to a longitudinally intermediate position of the below-described right link 24.

[0053] Indicated at 21 is the left link for connecting the left connecting pin 16 and the hydraulic cylinder 19 through the floating link 20, and this left link 21 is formed by two plates extending in a direction (vertical direction) perpendicular to the axis O - O of the connecting pins 16 and 17 along the left and right first brackets 12 and 13 (see Fig. 7). Further, a pin hole 21B is bored in one end side 21A of the left link 21, and as a pin 22 is inserted into this pin hole 21B and the link mounting portion 16B of the left connecting pin 16, the one end side 21A of the left link 21 is rotatably connected to the left connecting pin 16, while the other end side 21C of the left link 21 is rotatably connected to the distal end side of the rod 19B for constituting the hydraulic cylinder 19 by using a pin 23.

[0054] Denoted at 24 is the right link for connecting the right connecting pin 17 and the hydraulic cylinder 19 through the floating link 20, and this right link 24 is also formed by two plates extending vertically along the left

and right first brackets 12 and 13 in the same way as the left link 21. Further, a pin hole 24B is bored in one end side 24A of the right link 24, and as a pin 25 is inserted into this pin hole 24B and the link mounting portion 17B of the right connecting pin 17, the one end side 24A of the right link 24 is rotatably connected to the right connecting pin 17, while the other end side 24C of the right link 24 is rotatably connected to the bottom end side of the tube 19A for constituting the hydraulic cylinder 19 by using a pin 26.

[0055] Further, one side (left side) in the left-right direction of the floating link 20 is rotatably connected to a longitudinally intermediate portion of the left link 21 by using a pin 27, while the other side (right side) in the left-right direction of the floating link 20 is rotatably connected to a longitudinally intermediate portion of the right link 24 by using a pin 28.

[0056] In this state, slight gaps are respectively formed between a left end portion of the floating link 20 and the left inner first bracket 12A and between a right end portion of the floating link 20 and the right inner first bracket 13A, and the floating link 20 is able to move between the left inner first bracket 12A and the right inner first bracket 13A in correspondence with the extension or contraction of the hydraulic cylinder 19. It should be noted that two spacers 29 are disposed between the floating link 20 and the left link 21 and between the floating link 20 and the right link 24, respectively, in such a manner as to sandwich the floating link 20.

[0057] Accordingly, if the hydraulic cylinder 19 is extended or contracted, the one end side 21A of the left link 21 rotates in the left-right direction by using as a fulcrum the connecting portion (pin 27) where the left link 21 is connected to the floating link 20, and the one end side 24A of the right link 24 rotates in the left-right direction by using as a fulcrum the connecting portion (pin 28) where the right link 24 is connected to the floating link 20.

[0058] In consequence, when the hydraulic cylinder 19 is contracted, the left connecting pin 16 is inserted into the left first pin insertion holes 12C of the left first bracket 12 and the left second pin insertion hole 14A of the left second bracket 14, as shown in Fig. 3. Likewise, the right connecting pin 17 is inserted into the right first pin insertion holes 13C of the right first bracket 13 and the right second pin insertion hole 15A of the right second bracket 15. As a result, the arrangement provided is such that the left and right first brackets 12 and 13 and the left and right second brackets 14 and 15 can be connected.

[0059] Meanwhile, when the hydraulic cylinder 19 is extended, as shown in Fig. 5, the left connecting pin 16 is withdrawn from the left second pin insertion hole 14A of the left second bracket 14, and the right connecting pin 17 is withdrawn from the right second pin insertion hole 15A of the right second bracket 15. In consequence, the arrangement provided is such that the left and right second brackets 14 and 15 can be disconnected from the left and right first brackets 12 and 13.

[0060] Denoted at 30 is a stopper which is provided

between the left first bracket 12 and the right first bracket 13 by being positioned in the vicinity of the left and right connecting pins 16 and 17. As shown in Fig. 5, the left connecting pin 16 abuts against the stopper 30 at a position where the left connecting pin 16 has been withdrawn from the left second pin insertion hole 14A, and the right connecting pin 17 abuts against the stopper 30 at a position where the right connecting pin 17 has been withdrawn from the right second pin insertion hole 15A. Here, the stopper 30 is constituted by a plate-like base plate 30A spanning between the left inner first bracket 12A and the right inner first bracket 13A, and an abutment plate 30B which is provided projectingly on a central portion in the left-right direction of that base plate 30A and against which the link mounting portion 16B of the left connecting pin 16 and the link mounting portion 17B of the right connecting pin 17 abut.

[0061] Further, the arrangement provided is such that when the hydraulic cylinder 19 has been extended and the left connecting pin 16 has been withdrawn from the left second pin insertion hole 14A, the link mounting portion 16B of the left connecting pin 16 abuts against the abutment plate 30B of the stopper 30 to thereby prevent the left connecting pin 16 from being removed from the left first pin insertion hole 12C of the left inner first bracket 12A. Meanwhile, the arrangement provided is such that when the hydraulic cylinder 19 has been extended and the right connecting pin 17 has been withdrawn from the right second pin insertion hole 15A, the link mounting portion 17B of the right connecting pin 17 abuts against the abutment plate 30B of the stopper 30 to thereby prevent the right connecting pin 17 from being removed from the right first pin insertion hole 13C of the right inner first bracket 13A.

[0062] Here, as shown in Fig. 5, when the link mounting portions 16B and 17B of the left and right connecting pins 16 and 17 are respectively abutted against the abutment plate 30B of the stopper 30, a state is kept in which the left connecting pin 16 is inserted only in the left first pin insertion hole 12C of the left inner first bracket 12A, and the right connecting pin 17 is inserted only in the right first pin insertion hole 13C of the right inner first bracket 13A. Accordingly, the arrangement provided is such that the pin inserting/withdrawing mechanism 18 is held between the left inner first bracket 12A and the right inner first bracket 13A by means of the left and right connecting pins 16 and 17.

[0063] The two-member connecting device 11 in accordance with the first 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 using this two-member connecting device 11.

[0064] First, as shown in Fig. 2, the extension boom 5B is lifted by using 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.

[0065] At this time, as shown in Fig. 5, in the state in which the hydraulic cylinder 19 is extended, the pin inserting/withdrawing mechanism 18 has the left connecting pin 16 inserted in the left first pin insertion hole 12C of the left inner first bracket 12A and the right connecting pin 17 inserted in the right first pin insertion hole 13C of the right inner first bracket 13A. In consequence, the pin inserting/withdrawing mechanism 18 is held between the left inner first bracket 12A and the right inner first bracket 13A by means of the left and right connecting pins 16 and 17.

[0066] Then, as shown in Fig. 5, the left second bracket 14 provided on the extension boom 5B is inserted between the left inner first bracket 12A and the left outer first bracket 12B provided on the lower boom 5A, and the right second bracket 15 provided on the extension boom 5B is inserted between the right inner first bracket 13A and the right outer first bracket 13B provided on the lower boom 5A. Further, the left second pin insertion hole 14A of the left second bracket 14 and the right second pin insertion hole 15A of the right second bracket 15 are aligned with the identical axis 0 - 0 to that of the left first pin insertion hole 12C of the left first bracket 12 and the right first pin insertion hole 13C of the right first bracket 13.

[0067] In this state, as shown in Fig. 3, as pressure oil from the hydraulic source (not shown) is supplied to or discharged from the hydraulic cylinder 19 of the pin inserting/withdrawing mechanism 18, the hydraulic cylinder 19 is contracted. In consequence, the left link 21 rotates counterclockwise by using as a fulcrum the connecting portion (pin 27) where the left link 21 is connected to the floating link 20, so that the left connecting pin 16 connected to the one end side 21A of this left link 21 can be inserted into the left first pin insertion hole 12C of the left first bracket 12 and the left second pin insertion hole 14A of the left second bracket 14. Meanwhile, since the right link 24 rotates clockwise by using as a fulcrum the connecting portion (pin 28) where the right link 24 is connected to the floating link 20, so that the right connecting pin 17 connected to the one end side 24A of this right link 24 can be inserted into the right first pin insertion hole 13C of the right first bracket 13 and the right second pin insertion hole 15A of the right second bracket 15.

[0068] In this case, the one end side 21A of the left link 21 moves about the pin 27 in a circular arc shape. However, the floating link 20 which is set in a floating state with respect to the left and right first brackets 12 and 13 is able to move in correspondence with the contacting operation of the hydraulic cylinder 19. In consequence, the left connecting pin 16 connected to the one end side 21A of the left link 21 by using the pin 22 is able to move horizontally along the axis 0 - 0 of the left first pin insertion hole 12C and the left second pin insertion hole 14A. In the same way, the one end side 24A of the right link 24 moves about the pin 28 in a circular arc shape. However, the floating link 20 which is set in the floating state is able to move in correspondence with the contacting operation

of the hydraulic cylinder 19. In consequence, the right connecting pin 17 connected to the one end side 24A of the right link 24 by using the pin 25 is able to move horizontally along the axis 0 - 0 of the right first pin insertion hole 13C and the right second pin insertion hole 15A.

[0069] Further, as the left connecting pin 16 is inserted into the left first pin insertion hole 12C and the left second pin insertion hole 14A, the left first bracket 12 and the left second bracket 14 can be connected by this left connecting pin 16. Likewise, as the right connecting pin 17 is inserted into the right first pin insertion hole 13C and the right second pin insertion hole 15A, the right first bracket 13 and the right second bracket 15 can be connected by this right connecting pin 17.

[0070] As a result, the left and right first brackets 12 and 13 provided on the distal end side of the lower boom 5A and the left and right second brackets 14 and 15 provided on the proximal end side of the extension boom 5B can be connected by the left and right connecting pins 16 and 17, thereby making it possible to mount the extension boom 5B to the distal end side of the lower boom 5A.

[0071] Next, a description will be given of a case where, to dismount the extension boom 5B from the distal end side of the lower boom 5A, the left and right connecting pins 16 and 17 are withdrawn from the left and right first brackets 12 and 13 provided on the distal end side of the lower boom 5A and the left and right second brackets 14 and 15 provided on the proximal end side of the extension boom 5B.

[0072] In this case, the hydraulic cylinder 19 of the pin inserting/withdrawing mechanism 18 is extended in the state in which the extension boom 5B mounted on the distal end side of the lower boom 5A is supported by the hydraulic crane 9, as shown in Fig. 2.

[0073] In consequence, as shown in Fig. 5, since the left link 21 rotates clockwise by using as a fulcrum the connecting portion (pin 27) where the left link 21 is connected to the floating link 20, the left connecting pin 16 connected to the one end side 21A of this left link 21 can be withdrawn from the left second pin insertion hole 14A of the left second bracket 14.

Meanwhile, since the right link 24 rotates counterclockwise by using as a fulcrum the connecting portion (pin 28) where the right link 24 is connected to the floating link 20, the right connecting pin 17 connected to the one end side 24A of this right link 24 can be withdrawn from the right second pin insertion hole 15A of the right second bracket 15.

[0074] In this case, for example, if the frictional force produced between the right connecting pin 17 and the right second pin insertion hole 15A is greater than the frictional force produced between the left connecting pin 16 and the left second pin insertion hole 14A, the left connecting pin 16 is withdrawn from the left second pin insertion hole 14A earlier than the right connecting pin 17, as shown in Fig. 6. At this time, as the link mounting portion 16B of the left connecting pin 16 abuts against

the abutment plate 30B of the stopper 30, the left connecting pin 16 is restricted from moving in the withdrawing direction any further than that, so that the distal end side of the left connecting pin 16 can be kept inserted in the left first pin insertion hole 12C of the left inner first bracket 12A.

[0075] Thus, when the link mounting portion 16B of the left connecting pin 16 abuts against the abutment plate 30B of the stopper 30, the force at the time when the hydraulic cylinder 19 is extended is concentrated on the right link 24, so that the right connecting pin 17 can be reliably withdrawn from the right second pin insertion hole 15A. Further, as the link mounting portion 17B of the right connecting pin 17 abuts against the abutment plate 30B of the stopper 30, the distal end side of the right connecting pin 17 can be kept inserted in the right first pin insertion hole 13C of the right inner first bracket 13A.

[0076] Accordingly, as shown in Fig. 5, the left connecting pin 16 can be withdrawn from the left second pin insertion hole 14A of the left second bracket 14, and the right connecting pin 17 can be withdrawn from the right second pin insertion hole 15A of the right second bracket 15. In consequence, the left and right second brackets 14 and 15 can be disconnected from the left and right first brackets 12 and 13, thereby making it possible to dismount the extension boom 5B from the lower boom 5A.

[0077] Further, after the extension boom 5B is dismounted from the lower boom 5A, the hydraulic cylinder 19 is kept extended. Namely, the left connecting pin 16 is kept inserted in the left first pin insertion hole 12C of the left inner first bracket 12A, and the right connecting pin 17 is kept inserted in the right first pin insertion hole 13C of the right inner first bracket 13A. In consequence, the pin inserting/withdrawing mechanism 18 is held in a state in which suspended between the left inner first bracket 12A and the right inner first bracket 13A by means of the left and right connecting pins 16 and 17.

[0078] As such, according to the first embodiment, the pin inserting/withdrawing mechanism 18 provided between the left and right first brackets 12 and 13 is constituted by the hydraulic cylinder 19 disposed in such a manner as to be spaced apart from the left and right connecting pins 16 and 17 so as to be capable of extending and contracting in the same direction as the axis 0 - 0 of the left and right connecting pins 16 and 17, the floating link 20 disposed in a floating state between the left and right first brackets 12 and 13, the left link 21 for connecting the left connecting pin 16 and the hydraulic cylinder 19 through the floating link 20, and the right link 24 for connecting the right connecting pin 17 and the hydraulic cylinder 19 through the floating link 20.

[0079] In consequence, if the hydraulic cylinder 19 is extended or contracted by supplying or discharging the pressure oil, the one end sides 21A and 24A of the left and right links 21 and 24 rotate by using the floating link 20 as a fulcrum, and the left and right connecting pins 16 and 17 respectively connected to the one end sides 21A

and 24A of these left and right links 21 and 24 move in the left-right direction. Thereby, the left and right connecting pins 16 and 17 can be inserted into or withdrawn from the left and right first brackets 12 and 13 and the left and right second brackets 14 and 15.

[0080] In this case, since the inserting/withdrawing operation of the left and right connecting pins 16 and 17 can be effected easily by using the hydraulic cylinder 19, it is possible to enhance the workability at the time of connecting or disconnecting the left and right first brackets 12 and 13 and the left and right second brackets 14 and 15. In addition, since it is unnecessary to perform the inserting/withdrawing operation of the left and right connecting pins 16 and 17 by a manual operation, this inserting/withdrawing operation can be effected speedily and safely.

[0081] Further, since the floating link 20 serving as the fulcrum when the left and right connecting pins 16 and 17 move is set in the floating state in which the floating link 20 is able to move with respect to the left and right first brackets 12 and 13, the floating link 20 is able to move freely in correspondence with the extending operation or contracting operation of the hydraulic cylinder 19. In consequence, the left connecting pin 16 can be moved horizontally along the axis 0 - 0 of the left first pin insertion hole 12C and the left second pin insertion hole 14A merely by the relative rotation of the left link 21 and the left connecting pin 16 about the pin 22. Likewise, the right connecting pin 17 can be moved horizontally along the axis 0 - 0 of the right first pin insertion hole 13C and the right second pin insertion hole 15A merely by the relative rotation of the right link 24 and the right connecting pin 17 about the pin 25. As a result, the left and right connecting pins 16 and 17 can be smoothly withdrawn from or inserted into the left and right first brackets 12 and 13 and the left and right second brackets 14 and 15.

[0082] On the other hand, as the floating link 20 is set in the floating state with respect to the left and right first brackets 12 and 13, the entire pin inserting/withdrawing mechanism 18 can be supported in cantilevered state by making use of the left and right connecting pins 16 and 17. In consequence, it is unnecessary to provide fulcrums of the left and right links 21 and 24 fixedly on the left and right first brackets 12 and 13. Therefore, it is possible to render unnecessary the troublesome operation of providing fulcrums of the left and right links 21 and 24 on the left and right first brackets 12 and 13 of the lower boom 5A which is a large structure, and it is possible to enhance the workability at the time of mounting the pin inserting/withdrawing mechanism 18 between the left and right first brackets 12 and 13.

[0083] Furthermore, as the floating link 20 is set in the floating state with respect to the left and right first brackets 12 and 13, the left connecting pin 16 can be inserted into the left first pin insertion hole 12C and the left second pin insertion hole 14A merely by the relative rotation of the left link 21 and the left connecting pin 16 about the pin 22, so that the pin hole 21B provided in the one end side

21A of the left link 21 need not be made an elongated hole.

Likewise, the right connecting pin 17 can be inserted into the right first pin insertion hole 13C and the right second pin insertion hole 15A merely by the relative rotation of the right link 24 and the right connecting pin 17 about the pin 25, so that the pin hole 24B provided in the one end side 24A of the right link 24 need not be made an elongated hole.

[0084] As a result, it is possible to prolong the service life of the left link 21 by suppressing the wear of such as the pin hole 21B bored in the left link 21 and the pin 22 inserted in that pin hole 21B, and it is possible to prolong the service life of the right link 24 by suppressing the wear of such as the pin hole 24B bored in the right link 24 and the pin 25 inserted in that pin hole 24B. Further, since it is unnecessary to form elongated holes in the one end sides 21A and 24A of the left and right links 21 and 24 by end milling or the like, it is possible to reduce the manufacturing cost of the left and right links 21 and 24.

[0085] Next, Figs. 8 to 11 show a second embodiment of the invention. The characteristic of this second embodiment lies in that rotation restricting members are provided for restricting the floating link from rotating about the left and right connecting pins. It should be noted that, in the following description of the second embodiment, the component elements identical to those of the foregoing first embodiment will be simply denoted by the same reference numerals to avoid repetitions of similar explanation.

[0086] In the drawings, designated at 31 is a two-member connecting device in accordance with the second embodiment. In substantially the same way as that of the above-described first embodiment, this two-member connecting device 31 is comprised of the left and right first brackets 12 and 13, the left and right first pin insertion holes 12C and 13C, the left and right second brackets 14 and 15, the left and right second pin insertion holes 14A and 15A, the two left connecting pins 16, the two right connecting pins 17, and two sets of pin inserting/withdrawing mechanisms 32 which will be described hereinafter. However, the configuration of the pin inserting/withdrawing mechanism 32 differs from that in accordance with the first embodiment.

[0087] Indicated at 32 is the pin inserting/withdrawing mechanism disposed between the left first bracket 12 and the right first bracket 13, and this pin inserting/withdrawing mechanism 32 is used in the second embodiment in substitution for the pin inserting/withdrawing mechanism 18 in accordance with the first embodiment. The pin inserting/withdrawing mechanism 32 is constituted by the hydraulic cylinder 19, the left link 21 and the right link 24, as well as a floating link 33 and a pair of rotation restricting members 34 which will be described below.

[0088] Indicated at 33 is the floating link which is disposed at a position vertically spaced apart from the left and right connecting pins 16 and 17. The floating link 33

is set in a floating state between these left and right first brackets 12 and 13, and extends in the left-right direction. Further, the floating link 33 constitutes a fulcrum for allowing the left and right connecting pins 16 and 17 respectively connected to the one end sides 21A and 24A of the left and right links 21 and 24 to move in the left-right direction in correspondence with the extension or contraction of the hydraulic cylinder 19.

[0089] The floating link 33 is formed in the shape of a rectangular rod extending in the left-right direction, and the lengthwise dimension of the floating link 33 is set to be slightly smaller than the interval between the left inner first bracket 12A and the right inner first bracket 13A. Further, the one side in the left-right direction of the floating link 33 is connected to a longitudinally intermediate portion of the left link 21 by using the pin 27, while the other side in the left-right direction is connected to a longitudinally intermediate portion of the right link 24 by using the pin 28. As shown in Fig. 10, a pair of recessed grooves 33A, which are each notched in a bifurcated shape, are respectively formed in both end portions in the left-right direction of the floating link 33. The arrangement provided is such that each of these recessed grooves 33A is engaged with the below-described rotation restricting member 34.

[0090] Denoted at 34 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 34 are for restricting the floating link 33 provided between the left and right first brackets 12 and 13 from rotating about the left and right connecting pins 16 and 17.

[0091] The rotation restricting members 34 are each formed by a rectangular body extending vertically along the respective one of the left and right first brackets 12 and 13. The rotation restricting members 34 are respectively secured at that portion of an inner side surface of the left inner first bracket 12A which opposes a left end portion of the floating link 33 and that portion of an inner side surface of the right inner second bracket 13A which opposes a right end portion of the floating link 33, by using welding or other similar means.

[0092] As a result, as shown in Fig. 10, the left and right recessed grooves 33A provided at the both end portions of the floating link 33 are respectively engaged with the left and right rotation restricting members 34, and the floating link 33 is freely movable in the vertical direction along the rotation restricting members 34. Namely, the floating link 33 is disposed in a floating state in which it is able to move in the direction perpendicular to the axis of the connecting pins 16 and 17 between the left and right first brackets 12 and 13 (vertical direction in Figs. 8 and 9).

[0093] Accordingly, as the hydraulic cylinder 19 of the pin inserting/withdrawing mechanism 32 is extended or contracted, the left and right links 21 and 24 rotate in the left-right direction by using the floating link 33 as a fulcrum, and the left and right connecting pins 16 and 17

respectively connected to these left and right links 21 and 24 move in the left-right direction.

At this time, the floating link 33 is arranged to move vertically between the left and right first brackets 12 and 13 in a state in which the recessed grooves 33A formed at its both end portions are engaged with the rotation restricting members 34.

[0094] The two-member connecting device 31 in accordance with the second embodiment has the above-described configuration, and as for its basic operation there is no special difference with the two-member connecting device 11 in accordance with the first embodiment.

[0095] As such, the two-member connecting device 31 in accordance with the second embodiment is configured such that the rotation restricting members 34 are respectively provided on the left and right first brackets 12 and 13, and the recessed grooves 33A provided at the both end portions of the floating link 33 for constituting the pin inserting/withdrawing mechanism 32 are respectively engaged with the rotation restricting members 34. In consequence, the floating link 33 is able to move freely in the vertical direction, but can be restricted from rotating in an arbitrary direction about the left and right connecting pins 16 and 17.

[0096] Next, Figs. 12 to 14 show a third embodiment of the invention. The characteristic of this third embodiment lies in that the floating link is disposed on an opposite side to the left and right connecting pins with the hydraulic cylinder located therebetween. It should be noted that, in the following description of the third embodiment, the component elements identical to those of the foregoing first embodiment will be simply denoted by the same reference numerals to avoid repetitions of similar explanation.

[0097] In the drawings, denoted at 41 is a two-member connecting device in accordance with the third embodiment. In substantially the same way as that of the above-described first embodiment, this two-member connecting device 41 is comprised of the left and right first brackets 12 and 13, the left and right first pin insertion holes 12C and 13C, the left and right second brackets 14 and 15, the left and right second pin insertion holes 14A and 15A, the two left connecting pins 16, the two right connecting pins 17, and pin inserting/withdrawing mechanism 42 which will be described hereinafter. However, the configuration of the pin inserting/withdrawing mechanism 42 differs from that in accordance with the first embodiment.

[0098] Indicated at 42 is the pin inserting/withdrawing mechanism disposed between the left first bracket 12 and the right first bracket 13, and this pin inserting/withdrawing mechanism 42 is used in the third embodiment in substitution for the pin inserting/withdrawing mechanism 18 in accordance with the first embodiment. The pin inserting/withdrawing mechanism 42 is constituted by the hydraulic cylinder 19, as well as a floating link 43, a left link 44, a right link 45 and a pair of rotation restricting members 47, which will be described below.

[0099] Indicated at 43 is the floating link which is disposed at a position vertically spaced apart from the left and right connecting pins 16 and 17. The floating link 43 is set in a floating state between these left and right first brackets 12 and 13, and extends in the left-right direction. Further, the floating link 43 constitutes a fulcrum for allowing the left and right connecting pins 16 and 17 respectively connected to the below-described left and right links 44 and 45 to move in the left-right direction in correspondence with the extension or contraction of the hydraulic cylinder 19.

[0100] Here, the floating link 43 is formed in the shape of a rectangular rod extending in the left-right direction, and the lengthwise dimension of the floating link 43 is set to be slightly smaller than the interval between the left inner first bracket 12A and the right inner first bracket 13A. Further, the floating link 43 is disposed on an opposite side to the left and right connecting pins 16 and 17 with the hydraulic cylinder 19 located therebetween.

[0101] Indicated at 44 is the left link for connecting the left connecting pin 16 and the hydraulic cylinder 19 through the floating link 43, and this left link 44 is formed by two plates extending vertically along the left and right first brackets 12 and 13. Further, a pin hole 44B is bored in one end side 44A of the left link 44, and as the pin 22 is inserted into this pin hole 44B and the link mounting portion 16B of the left connecting pin 16, the one end side 44A of the left link 44 is rotatably connected to the left connecting pin 16.

[0102] The other end side 44C of the left link 44 is rotatably connected to one side (left side) in the left-right direction of the floating link 43 by using the pin 27. Further, a longitudinally intermediate portion of the left link 44 is rotatably connected to the distal end side of the rod 19B for constituting the hydraulic cylinder 19 by using the pin 23.

[0103] Indicated at 45 is the right link for connecting the right connecting pin 17 and the hydraulic cylinder 19 through the floating link 43, and this right link 45 is also formed by two plates extending vertically along the left and right first brackets 12 and 13. Further, a pin hole 45B is bored in one end side 45A of the right link 45, and as the pin 25 is inserted into this pin hole 45B and the link mounting portion 17B of the right connecting pin 17, the one end side 45A of the right link 45 is rotatably connected to the right connecting pin 17.

[0104] The other end side 45C of the right link 45 is rotatably connected to the other side (right side) in the left-right direction of the floating link 43 by using the pin 28, and a longitudinally intermediate portion of the right link 45 is rotatably connected to the bottom side of the tube 19A for constituting the hydraulic cylinder 19 by using the pin 25. It should be noted that two spacers 46 are disposed between the floating link 43 and the left link 44 and between the floating link 43 and the right link 45, respectively, in such a manner as to sandwich the floating link 43.

[0105] Accordingly, when the hydraulic cylinder 19 is

extended, the left connecting pin 16 is inserted into the left first pin insertion holes 12C of the left first bracket 12 and the left second pin insertion hole 14A of the left second bracket 14, as shown in Fig. 12. Likewise, the right connecting pin 17 is inserted into the right first pin insertion holes 13C of the right first bracket 13 and the right second pin insertion hole 15A of the right second bracket 15. As a result, the left and right first brackets 12 and 13 and the left and right second brackets 14 and 15 can be connected.

[0106] Meanwhile, when the hydraulic cylinder 19 is contracted, as shown in Fig. 13, the left connecting pin 16 is withdrawn from the left second pin insertion hole 14A of the left second bracket 14, and the right connecting pin 17 is withdrawn from the right second pin insertion hole 15A of the right second bracket 15. In consequence, the arrangement provided is such that the left and right second brackets 14 and 15 can be disconnected from the left and right first brackets 12 and 13.

[0107] Indicated at 47 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 47 are for restricting the floating link 43 of the pin inserting/withdrawing mechanism 42 provided between the left and right first brackets 12 and 13 from rotating about the left and right connecting pins 16 and 17.

[0108] In this case, each of the rotation restricting members 47 has a recessed groove 47A having a U-shaped cross section, as shown in Fig. 14. Further, the rotation restricting members 47 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 using welding or other similar means, and extend vertically along the left and right first brackets 12 and 13. Further, the both end portions in the left-right direction of the floating link 43 are respectively engaged with the recessed grooves 47A of the left and right rotation restricting members 47, and the floating link 43 is freely movable in the vertical direction along the rotation restricting members 47.

[0109] The two-member connecting device 41 in accordance with the third embodiment has the above-described configuration, and as for its basic operation there is no special difference with the two-member connecting device 11 in accordance with the first embodiment.

[0110] As such, in the two-member connecting device 41 in accordance with the third embodiment, the floating link 43 is disposed on the opposite side to the left and right connecting pins 16 and 17 with the hydraulic cylinder 19 located therebetween. For this reason, by extending the hydraulic cylinder 19, the left and right connecting pins 16 and 17 can be inserted into the left and right first brackets 12 and 13 and the left and right second brackets 14 and 15, as shown in Fig. 12. Meanwhile, by contracting the hydraulic cylinder 19, the left and right connecting pins 16 and 17 can be withdrawn from the left and right second brackets 14 and 15, as shown in Fig. 13.

[0111] Thus, at the time of the extension of the hydraulic cylinder 19 when a greater force is applied to the left and right connecting pins 16 and 17, the left and right connecting pins 16 and 17 can be inserted into the left and right first brackets 12 and 13 and the left and right second brackets 14 and 15, so that the left and right first brackets 12 and 13 and the left and right second brackets 14 and 15 can be reliably connected by using the left and right connecting pins 16 and 17.

[0112] In addition, in the two-member connecting device 41 in accordance with the third embodiment, as the both end portions of the floating link 43 for constituting the pin inserting/withdrawing mechanism 42 are respectively engaged with the recessed grooves 47A of the rotation restricting members 47 provided on the left and right first brackets 12 and 13, the pin inserting/withdrawing mechanism 42 can be reliably restricted from rotating in an arbitrary direction about the left and right connecting pins 16 and 17.

[0113] Next, Figs. 15 to 19 show a fourth embodiment of the invention. The characteristic of the fourth embodiment lies in that the hydraulic cylinder is disposed so as to be capable of extending and contracting in the direction perpendicular to the axis of the left and right connecting pins. It should be noted that, in the following description of the fourth embodiment, the component elements identical to those of the foregoing first embodiment will be simply denoted by the same reference numerals to avoid repetitions of similar explanation.

[0114] In the drawings, indicated at 51 is a two-member connecting device in accordance with the fourth embodiment. In substantially the same way as that of the above-described first embodiment, this two-member connecting device 51 is comprised of the left and right first brackets 12 and 13, the left and right first pin insertion holes 12C and 13C, the left and right second brackets 14 and 15, the left and right second pin insertion holes 14A and 15A, the two left connecting pins 16, the two right connecting pins 17, and two sets of pin inserting/withdrawing mechanisms 52 which will be described hereinafter. In the fourth embodiment, however, the configuration of the pin inserting/withdrawing mechanism 52 differs from that in accordance with the first embodiment.

[0115] Designated at 52 is the pin inserting/withdrawing mechanism disposed between the left first bracket 12 and the right first bracket 13. This pin inserting/withdrawing mechanism 52 is used in the fourth embodiment in substitution for the pin inserting/withdrawing mechanism 18 in accordance with the first embodiment. The pin inserting/withdrawing mechanism 52 is constituted by a hydraulic cylinder 53, a floating link 54, left and right first links 56 and 62, and left and right second links 59 and 65, which will be described hereinafter.

[0116] Indicated at 53 is the hydraulic cylinder, and this hydraulic cylinder 53 is disposed at a position spaced apart vertically from the position of the axis 0 - 0 of the left and right connecting pins 16 and 17. The hydraulic cylinder 53 is constituted by a tube 53A, a piston (not

shown), and a rod 53B, and is extended or contracted in the direction perpendicular to the axis 0 - 0 of the connecting pins 16 and 17 as pressure oil from the hydraulic source (not shown) is supplied to or discharged from the hydraulic cylinder 53.

[0117] Indicated at 54 is the floating link disposed at a position spaced apart vertically from the position of the left and right connecting pins 16 and 17, and this floating link 54 is mounted to neither of the left and right first brackets 12 and 13, and is set in a floating state with respect to these left and right first brackets 12 and 13.

[0118] Here, the floating link 54 is formed by two triangular plates opposing each other in a state in which spacers (not shown) having a larger width than the outside diameter of the hydraulic cylinder 53 (tube 53A) are sandwiched therebetween. The lengthwise dimension L in the left-right direction of the floating link 54 is set to be slightly smaller than the interval between the left inner first bracket 12A and the right inner first bracket 13A, and slight gaps are respectively formed between a left end portion of the floating link 54 and the left inner first bracket 12A and between a right end portion of the floating link 54 and the right inner first bracket 13A (see Fig. 15). Consequently, the arrangement provided is such that the floating link 54 is able to move between the left inner first bracket 12A and the right inner first bracket 13A in correspondence with the extension or contraction of the hydraulic cylinder 53.

[0119] Further, the bottom side of the tube 53A, i.e., one end of the hydraulic cylinder 53, is rotatably connected to an intermediate portion in the left-right direction of the floating link 54 by means of the pin 55. The other end sides 56B and 62B of the below-described left and right first links 56 and 62 are respectively connected rotatably to both end sides in the left-right direction of the floating link 54, and the floating link 54 constitutes a fulcrum of these left and right first links 56 and 62.

[0120] Indicated at 56 is the left first link for connecting the left connecting pin 16 and the floating link 54, and this left first link 56 together with the below-described left second link 59 constitutes the left link in accordance with the invention. The left first link 56 is formed by two plates extending vertically along the left and right first brackets 12 and 13 (see Fig. 19). Further, one longitudinal end side 56A of the left first link 56 is connected to the link mounting portion 16B of the left connecting pin 16 by means of a pin 57, and the other longitudinal end side 56B of the left first link 56 is connected to the floating link 54 by means of a pin 58.

[0121] Indicated at 59 is the left second link connecting a longitudinally intermediate portion 56C of the left first link 56 and the distal end of the rod 53B of the hydraulic cylinder 53, and the left second link 59 transmits the extending/contacting force of the hydraulic cylinder 53 to the left first link 56, and is formed by two plates extending in the left-right direction while opposing each other at a fixed interval (see Fig. 19).

[0122] Here, one longitudinal end side 59A of the left

second link 59 is connected to the intermediate portion 56C of the left first link 56 by means of a pin 60, and the other longitudinal end side 59B of the left second link 59 is connected to the distal end of the rod 53B, i.e., the other end of the hydraulic cylinder 53, by means of a pin 61.

[0123] Indicated at 62 is the right first link for connecting the right connecting pin 17 and the floating link 54, and this right first link 62 together with the below-described right second link 65 constitutes the right link. The right first link 62 is formed by two plates extending in the longitudinal direction of the left and right first brackets 12 and 13. Further, one longitudinal end side 62A of the right first link 62 is connected to the link mounting portion 17B of the right connecting pin 17 by means of a pin 63, and the other longitudinal end side 62B of the right first link 62 is connected to the floating link 54 by means of a pin 64.

[0124] Indicated at 65 is the right second link connecting a longitudinally intermediate portion 62C of the right first link 62 and the distal end of the rod 53B of the hydraulic cylinder 53. Further, this right second link 65 transmits the extending/contacting force of the hydraulic cylinder 53 to the right first link 62, and is formed by two plates extending in the left-right direction while opposing each other at a fixed interval in the same way as the left second link 59.

[0125] In this case, one longitudinal end side 65A of the right second link 65 is connected to the intermediate portion 62C of the right first link 62 by means of a pin 66, and the other longitudinal end side 65B of the right second link 65 is connected to the distal end of the rod 53B, i.e., the other end of the hydraulic cylinder 53, by means of the pin 61.

[0126] Further, in the fourth embodiment, the arrangement provided is such that three members including the other end side 59B of the left second link 59, the other end side 65B of the right second link 65, and the distal end of the rod 53B of the hydraulic cylinder 53 are rotatably connected by means of the one common pin 61.

[0127] Accordingly, if the hydraulic cylinder 53 is extended or contracted, the extending/contracting force of this hydraulic cylinder 53 is transmitted to the left first link 56 through the left second link 59 and is transmitted to the right first link 62 through the right second link 65. For this reason, the left first link 56 rotates in the left-right direction by using as a fulcrum the connecting portion (pin 58) connected to the floating link 54, and the right first link 62 rotates in the left-right direction by using as a fulcrum the connecting portion (pin 64) connected to the floating link 54.

[0128] In consequence, as shown in Fig. 15, when the hydraulic cylinder 53 is contracted, the left connecting pin 16 connected to the one end side 56A of the left first link 56 is inserted into the left first pin insertion holes 12C of the left first bracket 12 and the left second pin insertion hole 14A of the left second bracket 14. Likewise, the right connecting pin 17 connected to the one end side 62A of

the right first link 62 is inserted into the right first pin insertion holes 13C of the right first bracket 13 and the right second pin insertion hole 15A of the right second bracket 15. As a result, the arrangement provided is such that the left and right first brackets 12 and 13 and the left and right second brackets 14 and 15 can be connected.

[0129] On the other hand, as shown in Fig. 17, when the hydraulic cylinder 53 is extended, the left connecting pin 16 is withdrawn from the left second pin insertion hole 14A of the left second bracket 14, and the right connecting pin 17 is withdrawn from the right second pin insertion hole 15A of the right second bracket 15. In consequence, the arrangement provided is such that the left and right second brackets 14 and 15 can be disconnected from the left and right first brackets 12 and 13.

[0130] Further, when the hydraulic cylinder 53 has been extended and the left connecting pin 16 has been withdrawn from the left second pin insertion hole 14A, the link mounting portion 16B of the left connecting pin 16 abuts against the abutment plate 30B of the stopper 30. In consequence, the left connecting pin 16 holds the state of being inserted in only the left first pin insertion hole 12C of the left inner first bracket 12A. Likewise, when the hydraulic cylinder 53 has been extended and the right connecting pin 17 has been withdrawn from the right second pin insertion hole 15A, the link mounting portion 17B of the right connecting pin 17 abuts against the abutment plate 30B of the stopper 30. In consequence, the right connecting pin 17 holds the state of being inserted in only the right first pin insertion hole 13C of the right inner first bracket 13A. Accordingly, the arrangement provided is such that the pin inserting/withdrawing mechanism 52 is held between the left inner first bracket 12A and the right inner bracket 13A in a state in which the pin inserting/withdrawing mechanism 52 is supported in cantilevered state by the left and right connecting pins 16 and 17.

[0131] Indicated at 67 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 67 are for restricting the floating link 54 of the pin inserting/withdrawing mechanism 52 from rotating about the left and right connecting pins 16 and 17.

[0132] Here, the rotation restricting members 67 are each formed by a rectangular body extending vertically along the respective one of the left and right first brackets 12 and 13. The rotation restricting members 67 are respectively secured to the inner side surface of the left inner first bracket 12A and the inner side surface of the right inner second bracket 13A by using welding or other similar means. Further, the arrangement provided is such that the two plates constituting the floating link 54 respectively sandwich the left and right rotation restricting members 67, and the floating link 54 moves vertically along these rotation restricting members 67 in the state in which the floating link 54 is engaged with the rotation restricting members 67.

[0133] The two-member connecting device 51 in accordance with the fourth embodiment has the above-de-

scribed configuration, and as for its basic operation there is no special difference with the two-member connecting device 11 in accordance with the first embodiment.

[0134] As such, the two-member connecting device 51 in accordance with the fourth embodiment is configured such that the hydraulic cylinder 53 of the pin inserting/withdrawing mechanism 52 is disposed so as to be capable of extending and contracting in the direction perpendicular to the axis 0-0 of the left and right connecting pins 16 and 17 (vertical direction in Figs. 15 and 16). In consequence, even in a case where the interval between the left and right first brackets 12 and 13 is narrow, the pin inserting/withdrawing mechanism 52 including the hydraulic cylinder 53 can be easily disposed between these left and right first brackets 12 and 13.

[0135] Further, since three members including the other end side 59B of the left second link 59, the other end side 65B of the right second link 65, and the distal end of the rod 53B of the hydraulic cylinder 53 are coaxially connected by means of the one common pin 61, it is possible to reduce the number of parts of the pin inserting/withdrawing mechanism 52.

[0136] Next, Figs. 20 to 22 show a fifth embodiment of the invention. The characteristic of the fifth embodiment lies in that either one of the left and right second links and the other end of the hydraulic cylinder are connected by using one pin, and the left and right second links are connected by another pin. It should be noted that, in the following description of the fifth embodiment, the component elements identical to those of the foregoing first embodiment will be simply denoted by the same reference numerals to avoid repetitions as similar explanation.

[0137] In the drawings, indicated at 71 is a two-member connecting device in accordance with the fifth embodiment. This two-member connecting device 71 is comprised of the left and right first brackets 12 and 13, the left and right first pin insertion holes 12C and 13C, the left and right second brackets 14 and 15, the left and right second pin insertion holes 14A and 15A, the two left connecting pins 16, the two right connecting pins 17, and two sets of pin inserting/withdrawing mechanisms 72 which will be described hereinafter.

[0138] Designated at 72 is the pin inserting/withdrawing mechanism in accordance with the fifth embodiment, and this pin inserting/withdrawing mechanism 72 is constituted by a hydraulic cylinder 73, a floating link 74, left and right first links 76 and 81, and left and right second links 79 and 84, which will be described hereinafter.

[0139] Indicated at 73 is the hydraulic cylinder, and this hydraulic cylinder 73 is constituted by a tube 73A, a piston (not shown), and a rod 73B, and is extended or contracted in the direction perpendicular to the axis of the left and right connecting pins 16 and 17 as pressure oil from the hydraulic source (not shown) is supplied to or discharged from the hydraulic cylinder 73.

[0140] Indicated at 74 is the floating link disposed at a position spaced apart vertically from the position of the left and right connecting pins 16 and 17, and this floating

link 74 is set in a floating state with respect to these left and right first brackets 12 and 13. Here, in the same way as in the fourth embodiment, the floating link 74 is formed by two triangular plates opposing each other in such a manner as to sandwich the hydraulic cylinder 73, and the bottom side of the tube 73A of the hydraulic cylinder 73 is connected to an intermediate portion in the left-right direction of the floating link 74 by means of a pin 75.

[0141] Indicated at 76 is the left first link for connecting the left connecting pin 16 and the floating link 74, and this left first link 76 together with the below-described left second link 79 constitutes the left link. Here, one longitudinal end side 76A of the left first link 76 is connected to the link mounting portion 16B of the left connecting pin 16 by means of a pin 77, and the other longitudinal end side 76B of the left first link 76 is connected to the floating link 74 by use of a pin 78.

[0142] Indicated at 79 is the left second link for connecting the left first link 76 and the rod 73B of the hydraulic cylinder 73, and one longitudinal end side 79A of the left second link 79 is connected to an intermediate portion 76C of the left first link 76 by means of a pin 80. Meanwhile, the other longitudinal end side 79B of the left second link 79 is connected to the below-described right second link 84 by use of another pin 87.

[0143] Indicated at 81 is the right first link for connecting the right connecting pin 17 and the floating link 74, and the right first link 81 together with the below-described right second link 84 constitutes the right link. Here, one longitudinal end side 81A of the right first link 81 is connected to the link mounting portion 17B of the right connecting pin 17 by use of a pin 82, and the other longitudinal end side 81B of the right first link 81 is connected to the floating link 74 by use of a pin 83.

[0144] Indicated at 84 is the right second link for connecting the right first link 81 and the rod 73B of the hydraulic cylinder 73. One longitudinal end side 84A of this right second link 84 is connected to an intermediate portion 81C of the right first link 81 by use of a pin 85. Further, a longitudinally intermediate portion 84B of the right second link 84 is connected to the distal end of the rod 73B of the hydraulic cylinder 73 by use of a pin 86, and the other longitudinal end side 84C of the right second link 84 is connected to the other end side 79B of the left second link 79 by use of another pin 87.

[0145] Namely, in the fifth embodiment, two members including the rod 73B of the hydraulic cylinder 73 and the right second link 84 are connected by the one pin 86, and two members including the left second link 79 and the right second link 84 are connected by another pin 87 at a position different from that of the one pin 86. In consequence, the arrangement provided is such that the lengthwise dimension S of the pins 86 and 87 can be made short, as shown in Fig. 22.

[0146] Indicated at 88 are the left and right rotation restricting members which are respectively provided on the left and right first brackets 12 and 13, and these rotation restricting members 88 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. Further, the arrangement provided is such that the respective rotation restricting members 88 guide the floating link 74 vertically movably.

[0147] The two-member connecting device 71 in accordance with the fifth embodiment has the above-described configuration, and as for its basic operation there is no special difference with the two-member connecting device 11 in accordance with the first embodiment.

[0148] As such, in the pin inserting/withdrawing mechanism 72 of the two-member connecting device 71 in accordance with the fifth embodiment, two members including the rod 73B of the hydraulic cylinder 73 and the right second link 84 are connected through the one pin 86, and two members including the left second link 79 and the right second link 84 are connected through the other pin 87. For this reason, as compared with a case where, for instance, three members including the distal end of the rod 73B of the hydraulic cylinder 73, the left second link 79, and the right second link 84 are superposed and are connected by one elongated pin, the lengthwise dimension S of the pins 86 and 87 can be made short. As a result, it is possible to increase the strength of the pins 86 and 87 and prolong the service life of the pin inserting/withdrawing mechanism 72.

[0149] Further, Figs. 23 to 24 show a sixth embodiment of the invention. The characteristic of the sixth embodiment lies in that conversely to the above-described fourth and fifth embodiments, the left and right connecting pins are inserted into the left and right second pin insertion holes when the hydraulic cylinder is extended, and the left and right connecting pins are withdrawn from the left and right second pin insertion holes when the hydraulic cylinder is contracted. It should be noted that, in the following description of the sixth embodiment, the component elements identical to those of the foregoing first embodiment will be simply denoted by the same reference numerals to avoid repetitions as similar explanation.

[0150] In the drawings, indicated at 91 is a two-member connecting device in accordance with the sixth embodiment. This two-member connecting device 91 is comprised of the left and right first brackets 12 and 13, the left and right first pin insertion holes 12C and 13C, the left and right second brackets 14 and 15, the left and right second pin insertion holes 14A and 15A, the two left connecting pins 16, the two right connecting pins 17, and two sets of pin inserting/withdrawing mechanisms 92 which will be described hereinafter.

[0151] Denoted at 92 is the pin inserting/withdrawing mechanism in accordance with the sixth embodiment, and this pin inserting/withdrawing mechanism 92 is constituted by a hydraulic cylinder 93, a floating link 94, left and right first links 96 and 102, and left and right second links 99 and 105 which will be described hereinafter.

[0152] Indicated at 93 is the hydraulic cylinder, and the hydraulic cylinder 93 is constituted by a tube 93A, a piston (not shown), and a rod 93B, and is extended or contracted

in the direction perpendicular to the axis of the left and right connecting pins 16 and 17 as pressure oil from the hydraulic source is supplied to or discharged from the hydraulic cylinder 93.

[0153] Indicated at 94 is the floating link disposed at a position spaced apart vertically from the position of the left and right connecting pins 16 and 17. This floating link 94 is formed by two triangular plates opposing each other in such a manner as to sandwich the hydraulic cylinder 93, and is set in a floating state with respect to the left and right first brackets 12 and 13. Further, the bottom side of the tube 93A of the hydraulic cylinder 93 is connected to an intermediate portion in the left-right direction of the floating link 94 by means of a pin 95.

[0154] Indicated at 96 is the left first link for connecting the left connecting pin 16 and the floating link 94, and the left first link 96 together with the below-described left second link 99 constitutes the left link. Here, one end side 96A of the left first link 96 is connected to the link mounting portion 16B of the left connecting pin 16 by means of a pin 97, and the other end side 96B of the left first link 96 is connected to the floating link 94 by means of a pin 98.

[0155] Indicated at 99 is the left second link for connecting the left first link 96 and the rod 93B of the hydraulic cylinder 93. One end side 99A of this left second link 99 is connected to an intermediate portion 96C of the left first link 96 by means of a pin 100, and the other end side 99B thereof is connected to the distal end of the rod 93B of the hydraulic cylinder 93 by means of a pin 101.

[0156] Indicated at 102 is the right first link for connecting the right connecting pin 17 and the floating link 94, and this right first link 102 together with the below-described right second link 105 constitutes the right link. One end side 102A of the right first link 102 is connected to the link mounting portion 17B of the right connecting pin 17 by means of a pin 103, and the other end side 102B of the right first link 102 is connected to the floating link 94 by means of a pin 104.

[0157] Indicated at 105 is the right second link for connecting the right first link 102 and the rod 93B of the hydraulic cylinder 93. One end side 105A of this right second link 105 is connected to an intermediate portion 102C of the right first link 102 by means of a pin 106, and the other end side 105B is connected to the distal end of the rod 93B of the hydraulic cylinder 93 by means of the pin 101.

[0158] Accordingly, when the hydraulic cylinder 93 is extended, the left connecting pin 16 is inserted into the left first pin insertion holes 12C of the left first bracket 12 and the left second pin insertion hole 14A of the left second bracket 14, as shown in Fig. 23. Likewise, the right connecting pin 17 is adapted to be inserted into the right first pin insertion holes 13C of the right first bracket 13 and the right second pin insertion hole 15A of the right second bracket 15.

[0159] Meanwhile, when the hydraulic cylinder 93 is contracted, as shown in Fig. 24, the left connecting pin

16 is adapted to be withdrawn from the left second pin insertion hole 14A of the left second bracket 14, and the right connecting pin 17 is adapted to be withdrawn from the right second pin insertion hole 15A of the right second bracket 15.

[0160] It should be noted that indicated at 107 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 107 are for restricting the floating link 94 from rotating about the left and right connecting pins 16 and 17.

[0161] The two-member connecting device 91 in accordance with the sixth embodiment has the above-described configuration, and as for its basic operation there is no special difference with the two-member connecting device 11 in accordance with the first embodiment.

[0162] As such, in the pin inserting/withdrawing mechanism 92 of the two-member connecting device 91 in accordance with the sixth embodiment, conversely to the above-described fourth and fifth embodiments, when the hydraulic cylinder 93 is extended, the left and right connecting pins 16 and 17 can be inserted into the first pin insertion holes 12C and 13C of the left and right first brackets 12 and 13 and the second pin insertion holes 14A and 15A of the left and right second brackets 14 and 15.

[0163] It should be noted that, in the above-described first embodiment, the case is 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, and the right first bracket 13 is constituted by the 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, and a left first bracket 12' and a right first bracket 13' each constituted by a single plate may be used as in a modification shown in Fig. 25. This also applies to the second to sixth embodiments.

[0164] Further, in the above-described first embodiment, the case is illustrated in which the two-member connecting device 11 is used in 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 two-member connecting device 11 in accordance with the present invention is not limited to the same, and the two-member connecting device 11 may be used in, for instance, a connecting portion between the extension boom 5B and the upper boom 5C, a connecting portion between the lower arm 7A and the upper arm 7B constituting the arm 7, or the like. This also applies to the second to sixth embodiments.

[0165] In addition, in the above-described embodiments, the case is illustrated in which the left and right first brackets 12 and 13 are provided on the lower boom 5A for constituting the boom 5 of the hydraulic excavator 1, and the left and right second brackets 14 and 15 are

provided on the extension boom 5B. However, the present invention is not limited to the same, and a configuration may be adopted in which, for example, the left and right first brackets 12 and 13 are provided on the extension boom 5B, and the left and right second brackets 14 and 15 are provided on the lower boom 5A.

[0166] Furthermore, in the above-described first, second and third embodiments, the case is illustrated in which the hydraulic cylinder 19 which is extended or contracted in the same direction as the axis 0 - 0 of the left and right connecting pins 16 and 17 is used, and, in the above-described fourth, fifth and sixth embodiments, the hydraulic cylinders 53, 73 and 93 which are extended or contracted in the direction perpendicular to the axis 0 - 0 of the left and right connecting pins 16 and 17 are used. However, the present invention is not limited to the same, and, for example, may be configured to use a hydraulic cylinder which is extended or contracted in a diagonal direction to the axis 0 - 0 of the left and right connecting pins 16 and 17.

Features, components and specific details of the structures of the above-described embodiments may be exchanged or combined to form further embodiments optimized for the respective application. As far as those modifications are readily apparent for an expert skilled in the art they shall be disclosed implicitly by the above description without specifying explicitly every possible combination, for the sake of conciseness of the present description.

Claims

1. A two-member connecting device comprising:

left and right first members (12, 13; 12', 13') opposing each other in a left-right direction;
 left and right first pin insertion holes (12C, 13C) which are respectively provided in said first members (12, 13; 12', 13');
 left and right second members (14, 15) respectively opposing said left and right first members (12, 13; 12', 13');
 left and right second pin insertion holes (14A, 15A) which are respectively provided in said second members (14, 15) and can be aligned with said first pin insertion holes (12C, 13C) as an identical axis;
 a left connecting pin (16) which is inserted in said left first pin insertion hole (12C) and said left second pin insertion hole (14A);
 a right connecting pin (17) which is inserted in said right first pin insertion hole (13C) and said right second pin insertion hole (15A); and
 a pin inserting/withdrawing mechanism (18; 32; 42; 52; 72; 92) which is disposed between said left and right first members (12, 13; 12', 13'), and which inserts or withdraws said left connecting

pin (16) with respect to said left first pin insertion hole (12C) and said left second pin insertion hole (14A) and inserts or withdraws said right connecting pin (17) with respect to said right first pin insertion hole (13C) and said right second pin insertion hole (15A),

characterized in that

said pin inserting/withdrawing mechanism includes:

a hydraulic cylinder (19; 53; 73; 93) disposed so as to be capable of extending and contracting at a position spaced apart from a position of an axis of said left and right connecting pins (16, 17);

a floating link (20; 33; 43; 54; 74; 94) disposed at a position spaced apart in a same direction as said hydraulic cylinder from the position of the axis of said left and right connecting pins (16, 17), in a floating state in which said floating link is capable of moving in at least a direction perpendicular to the axis of said left and right connecting pins (16, 17);

a left link (21; 44) rotatably connecting said left connecting pin (16) and said hydraulic cylinder, respectively, by means of said floating link; and

a right link (24; 45) rotatably connecting said right connecting pin (17) and said hydraulic cylinder, respectively, by means of said floating link,

said left and right first members (12, 13; 12', 13') and said left and right second members (14, 15) being respectively connected or disconnected by said left and right connecting pins (16, 17) by means of said left and right links (21, 24; 44, 45) in correspondence with an extended state or a contracted state of said hydraulic cylinder.

2. The two-member connecting device according to claim 1, wherein said left link (21; 44) and said right link (24; 45) are respectively connected to said left and right connecting pins (16, 17), said hydraulic cylinder and said floating link are disposed between said first and second members (12, 14) on a left side and said first and second members (13, 15) on a right side at least in a state of being able to move in the direction perpendicular to the axis of said left and right connecting pins (16, 17), and said pin inserting/withdrawing mechanism is supported in cantilevered state by said left and right connecting pins (16, 17).

3. The two-member connecting device according to claim 1 or 2, wherein a stopper (30) against which said left connecting pin (16) abuts at a position where said left connecting pin has been withdrawn from

said left second pin insertion hole (14A) and against which said right connecting pin (17) abuts at a position where said right connecting pin has been withdrawn from said right second pin insertion hole (15A) is provided between said left first member (12; 12') and said right first member (13; 13').

4. The two-member connecting device according to at least one of claims 1- 3, wherein rotation restricting members (34; 47; 67; 88; 107) are respectively provided on said left and right first members (12, 13; 12', 13') so as to restrict said floating link from rotating about each of said left and right connecting pins (16, 17). 5 10 15
5. The two-member connecting device according to at least one of claims 1 - 4, wherein said hydraulic cylinder is disposed so as to be capable of extending and contracting in a same direction as the axis of said left and right connecting pins (16, 17), and said left and right links (21, 24; 44, 45) are each constituted by one link so as to connect said hydraulic cylinder and said floating link to said left and right connecting pins (16, 17), respectively. 20 25
6. The two-member connecting device according to claim 5, wherein said floating link is disposed by being positioned between said left and right connecting pins (16, 17) and said hydraulic cylinder. 30
7. The two-member connecting device according to claim 5, wherein said floating link is disposed by being positioned on an opposite side to said left and right connecting pins (16, 17) with said hydraulic cylinder located therebetween. 35
8. The two-member connecting device according to at least one of claims 1 - 7, wherein said hydraulic cylinder is disposed so as to be capable of extending and contracting in the direction perpendicular to the axis of said left and right connecting pins (16, 17), said floating link is connected to one end of said hydraulic cylinder, and said left and right links are constituted by left and right first links (56, 62; 76, 81; 96, 102) for connecting each of said connecting pins and said floating link and left and right second links (59, 65; 79, 84; 99, 105) for connecting other end of said hydraulic cylinder and an intermediate portion of each of said first links. 40 45 50
9. The two-member connecting device according to claim 8, wherein said left and right second links and the other end of said hydraulic cylinder are connected by using one common pin (86). 55
10. The two-member connecting device according to claim 8, wherein either one of said left and right second links and the other end of said hydraulic cylinder

are connected by using one pin (86), and said left and right second links are connected at a position different from a position of said one pin (86) by using another pin (87).

Fig. 1

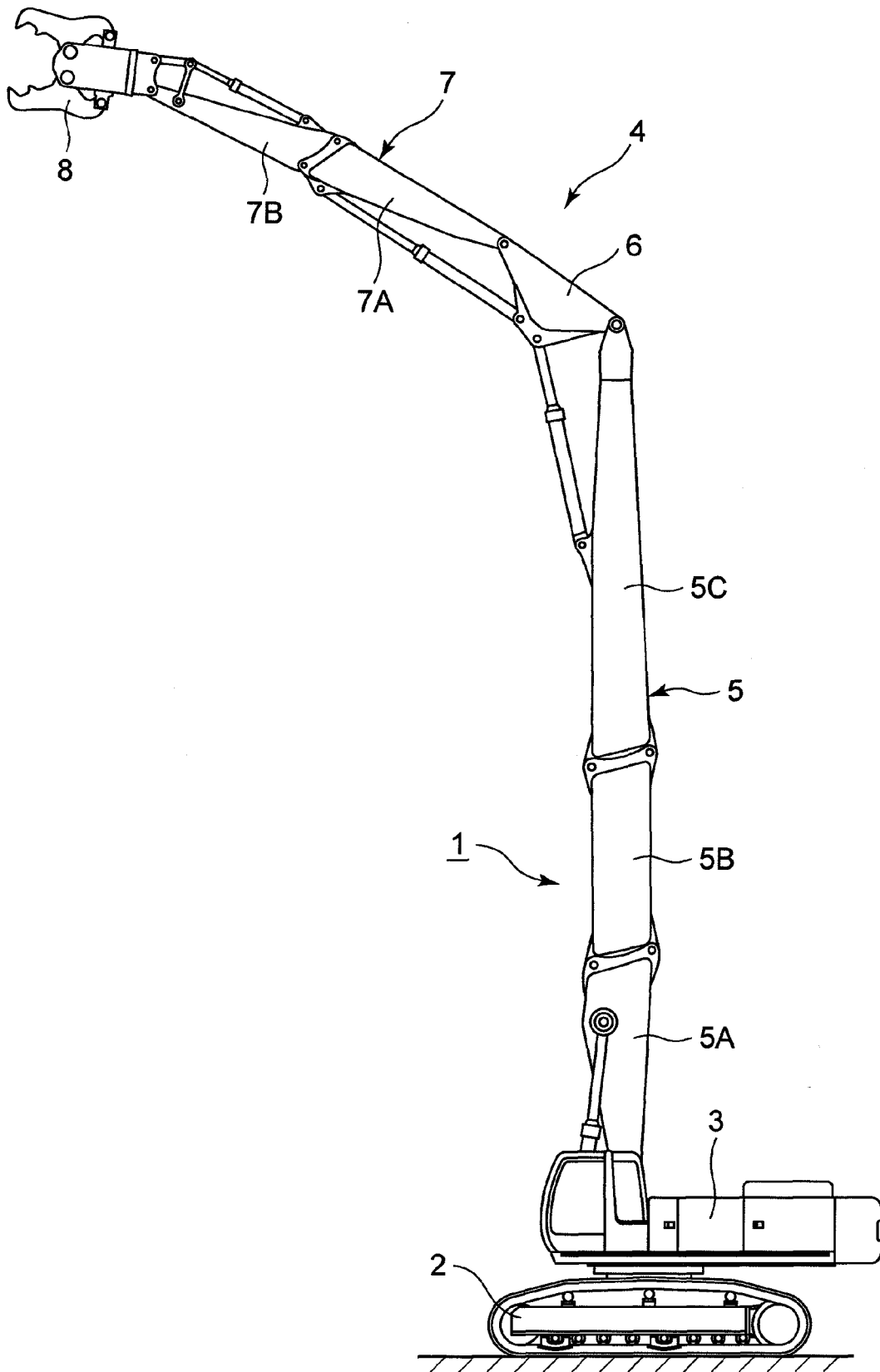


Fig. 2

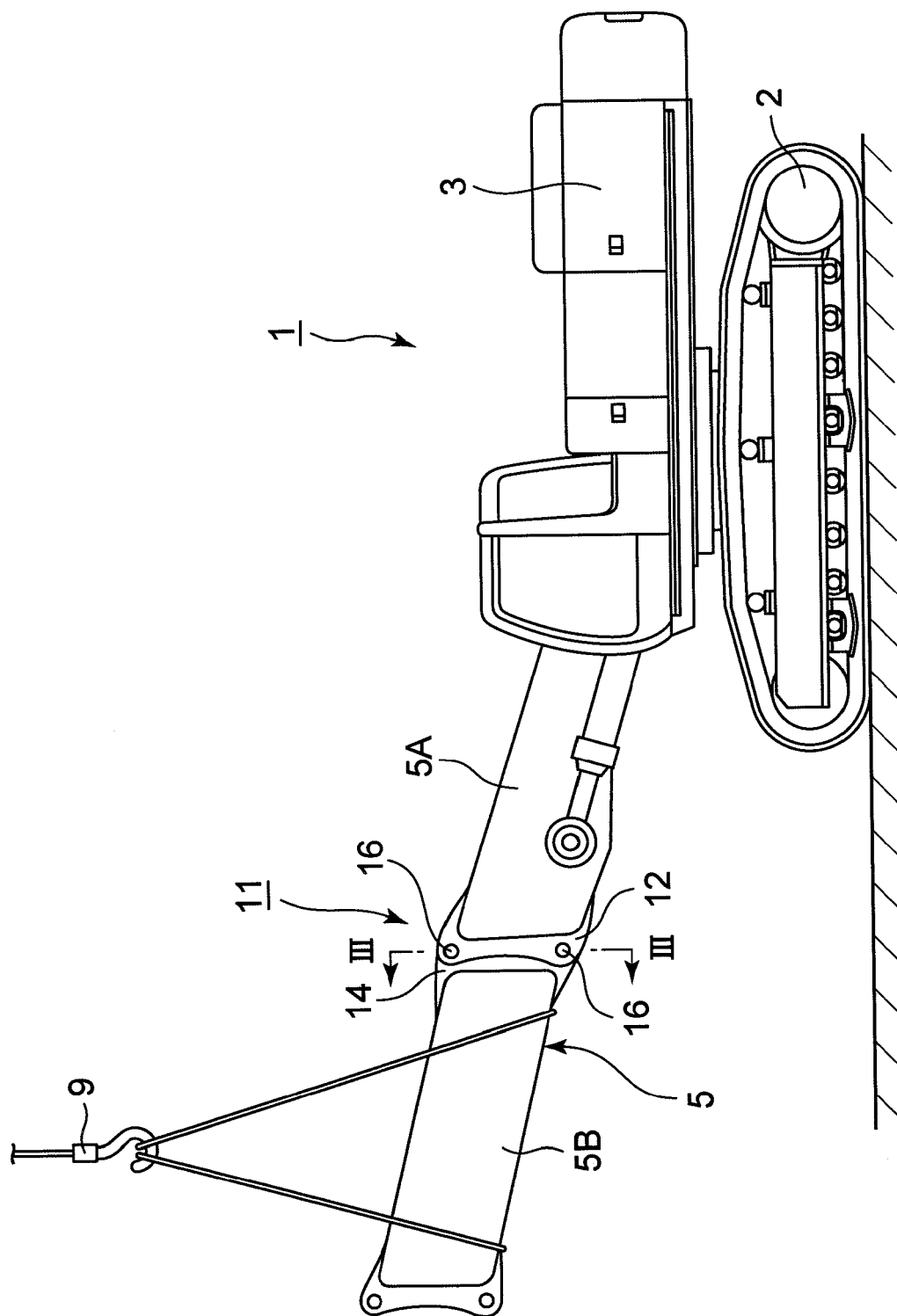


Fig. 3

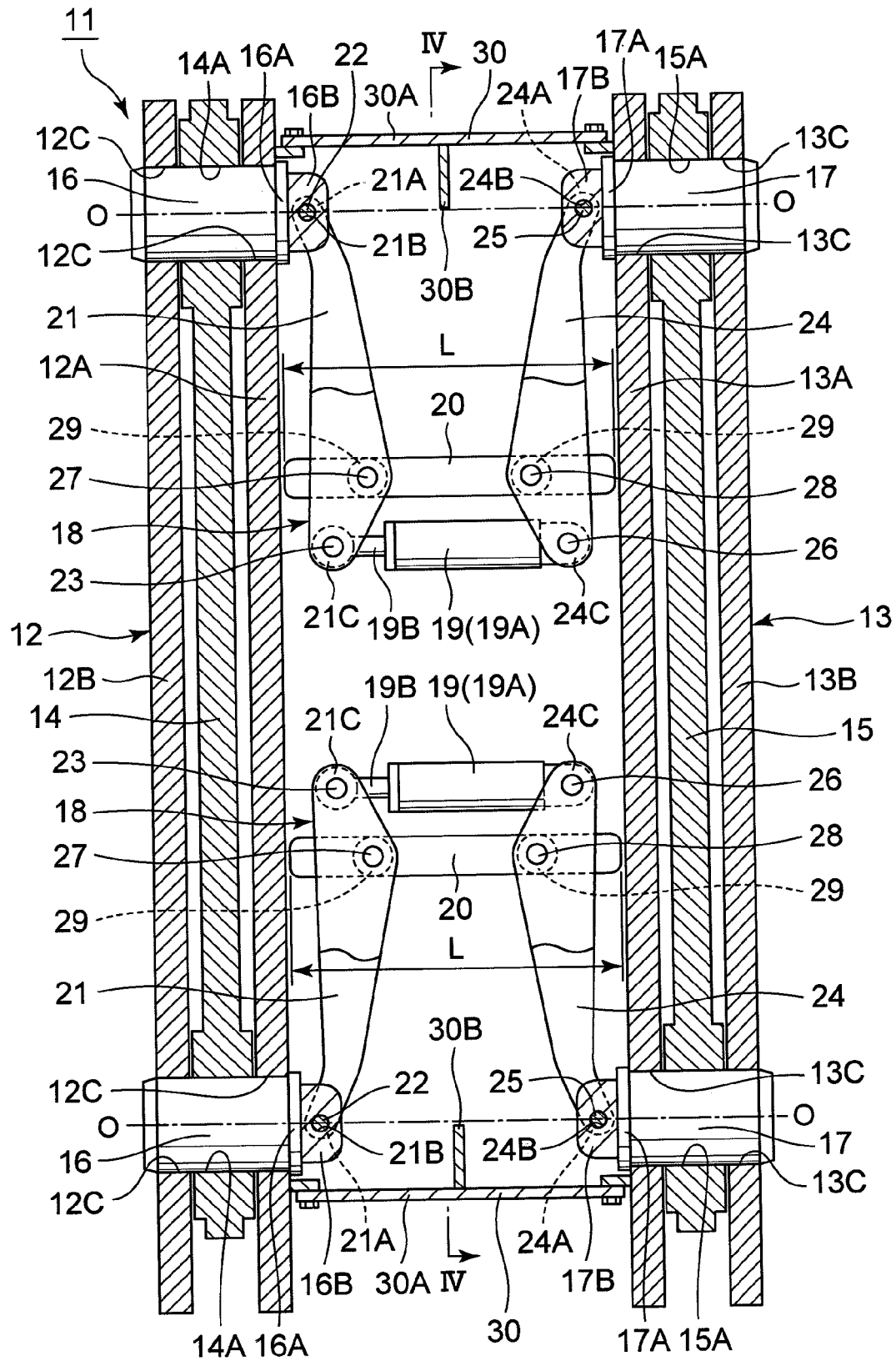


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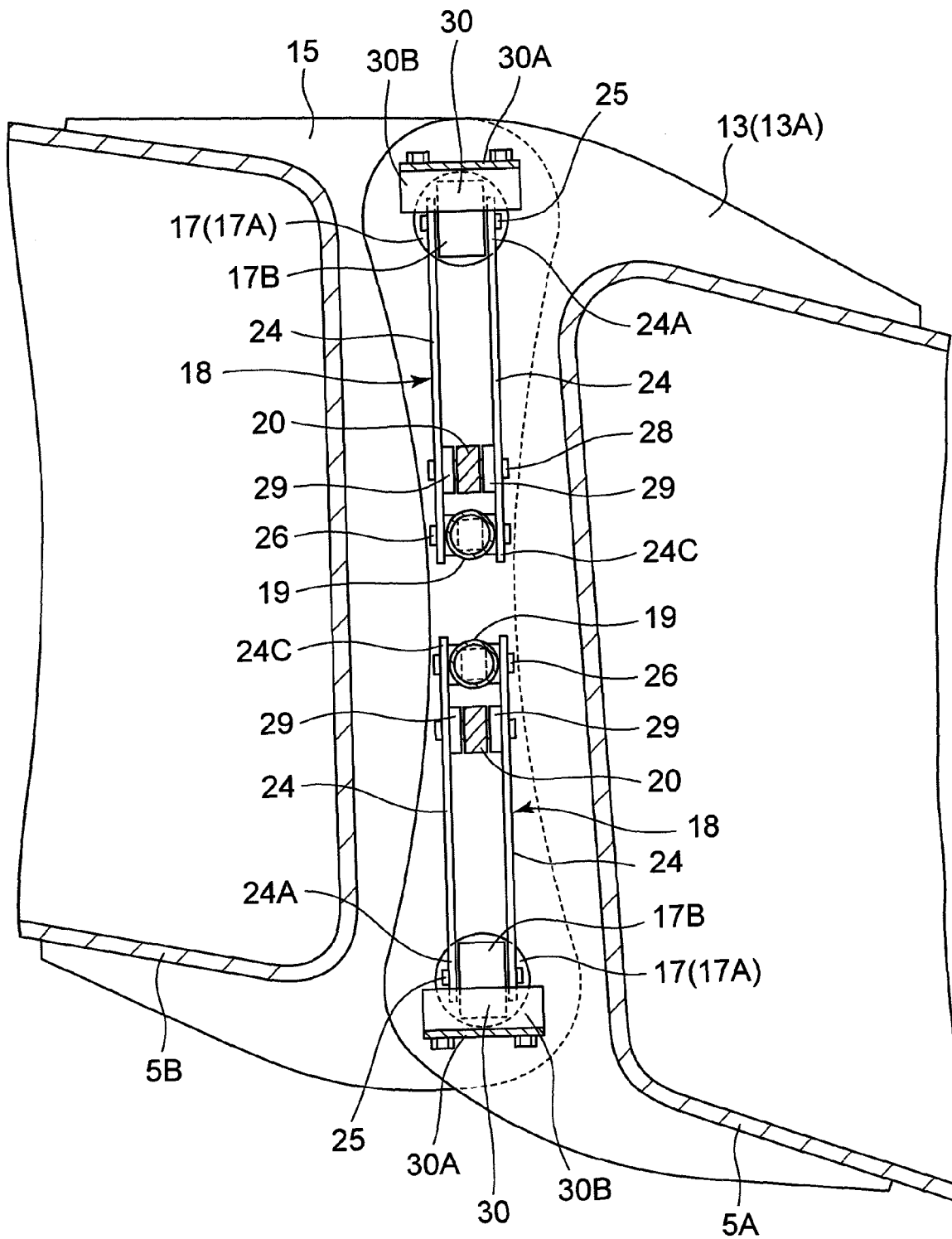


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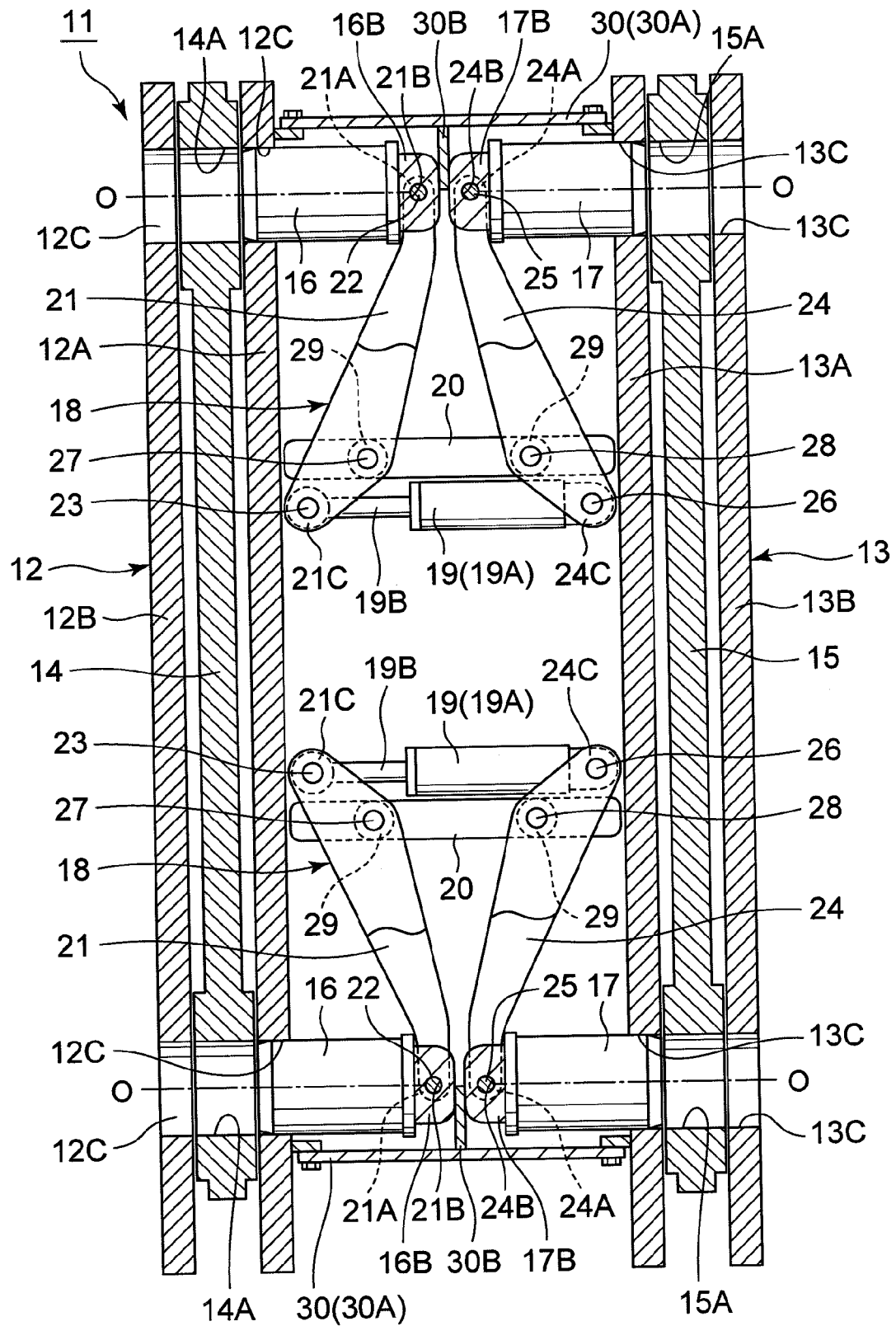


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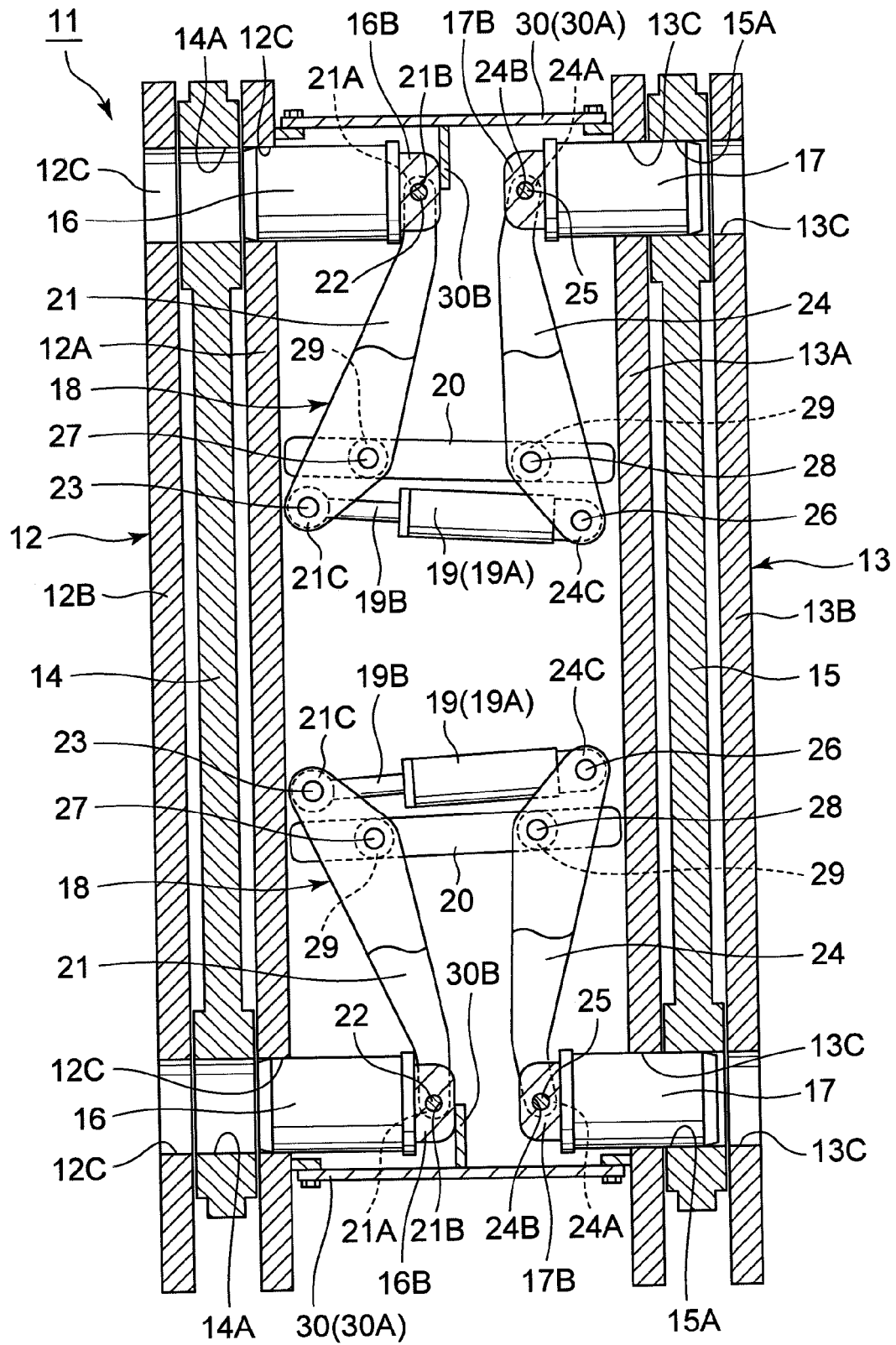


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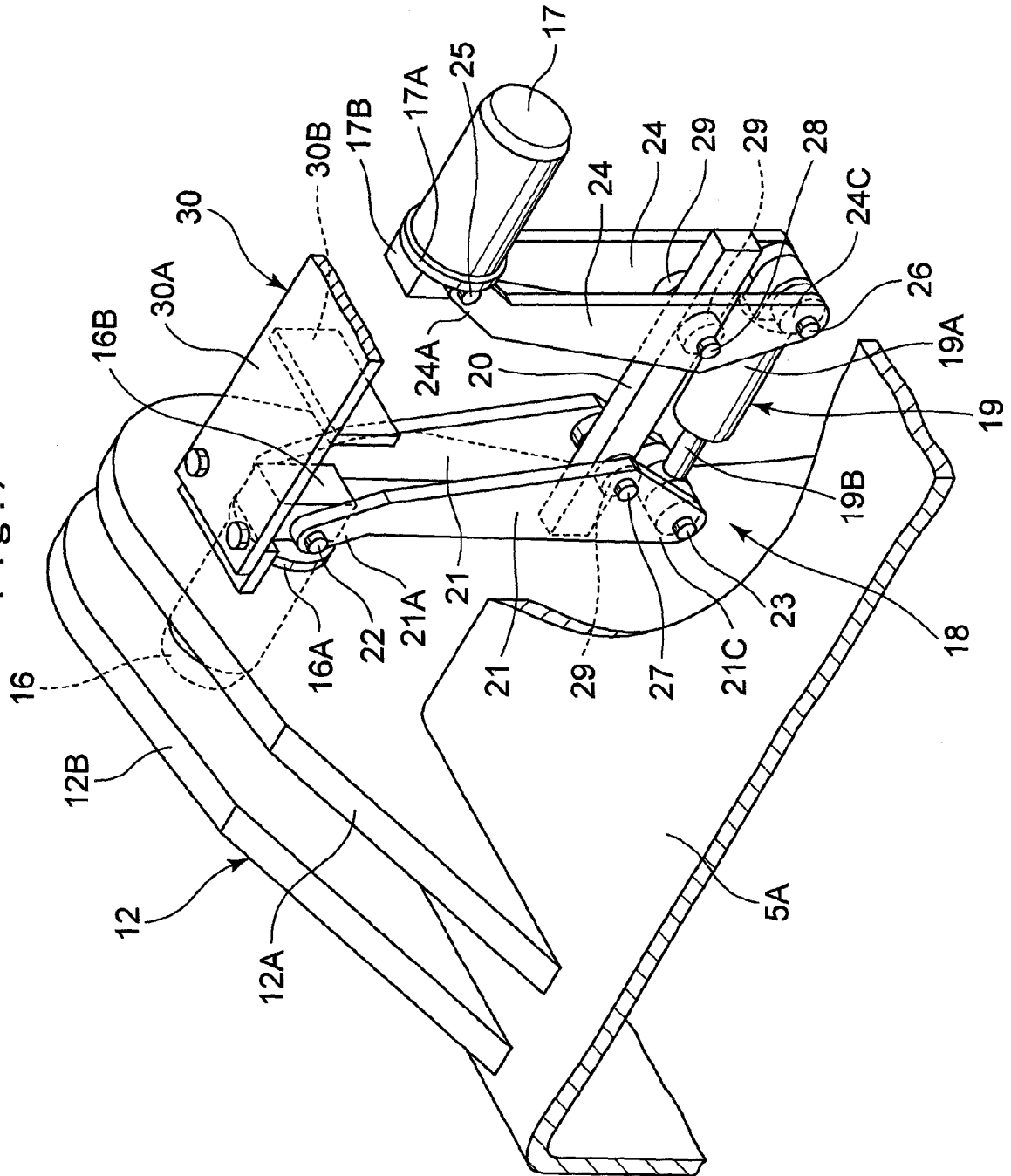


Fig. 8

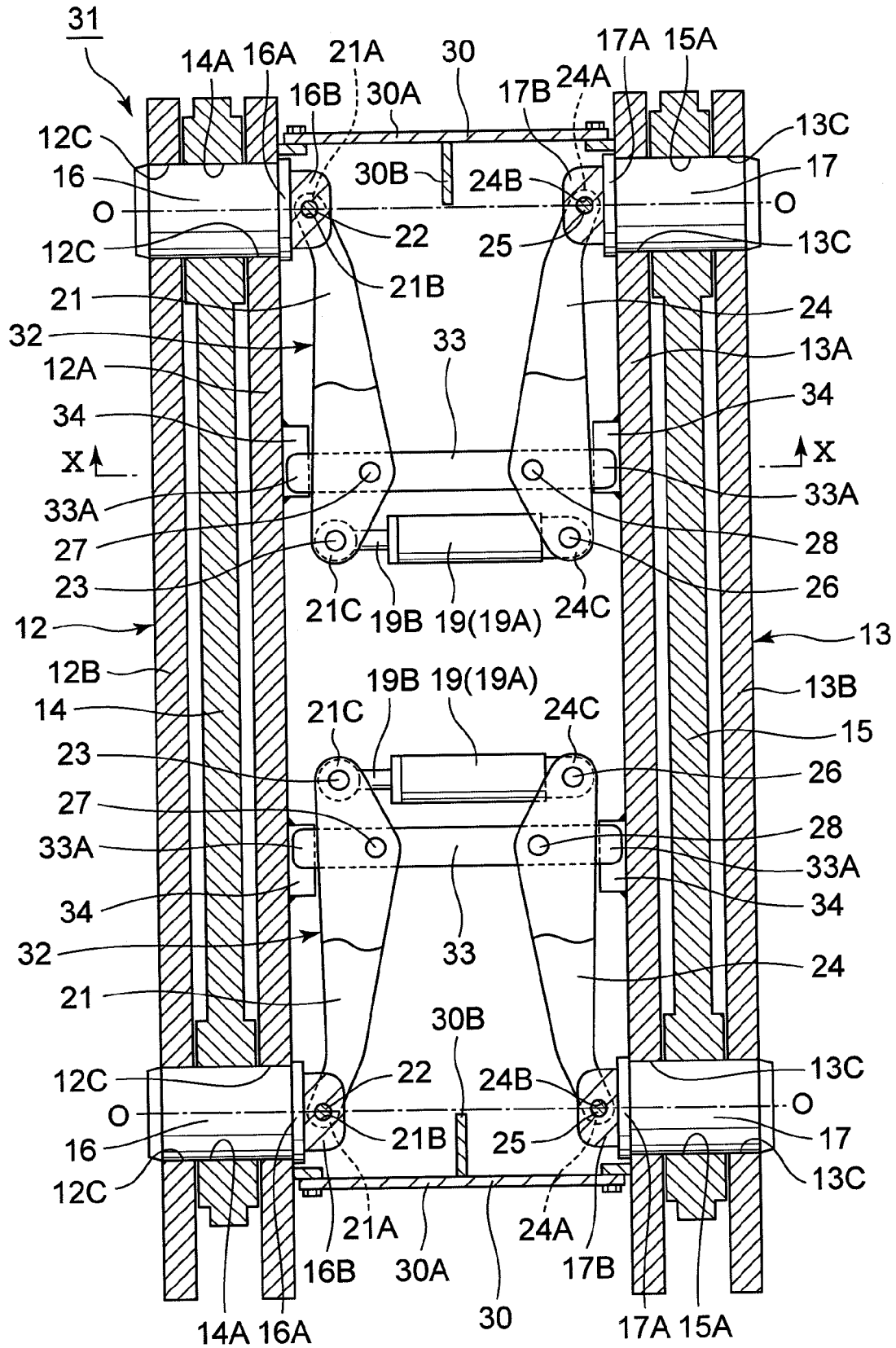


Fig. 9

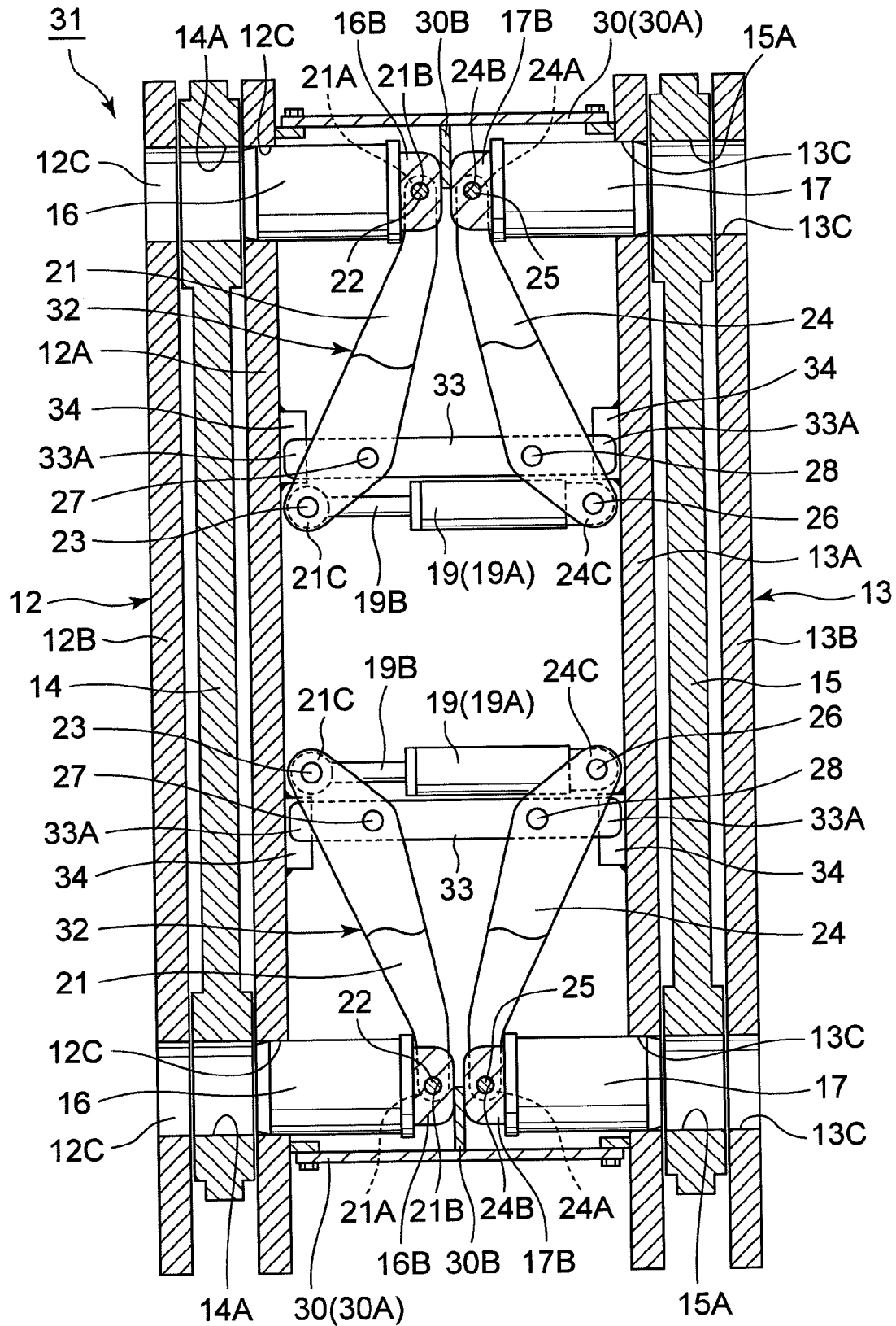


Fig.10

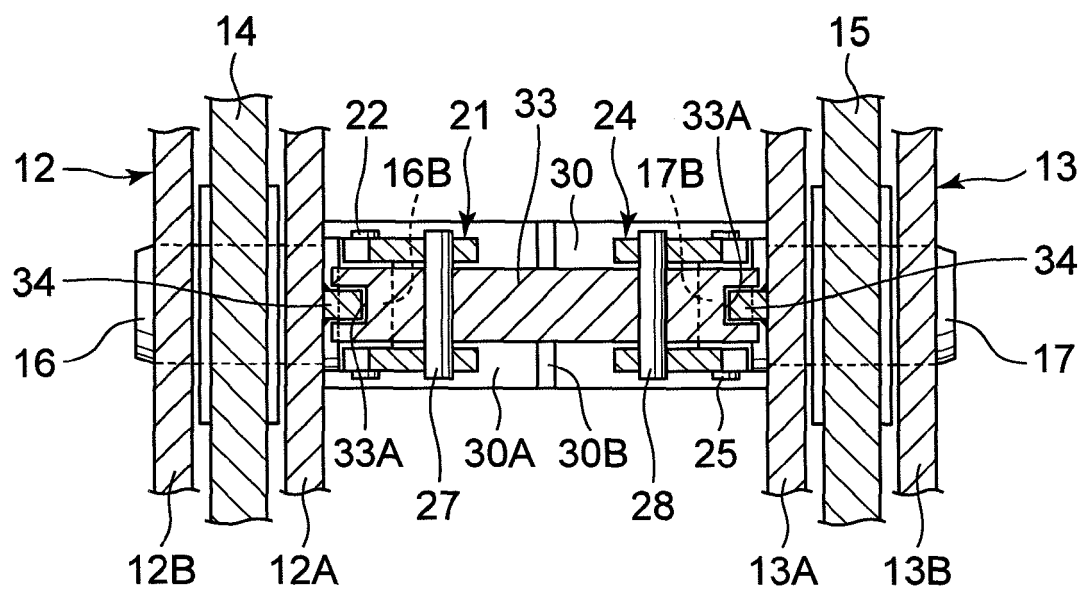


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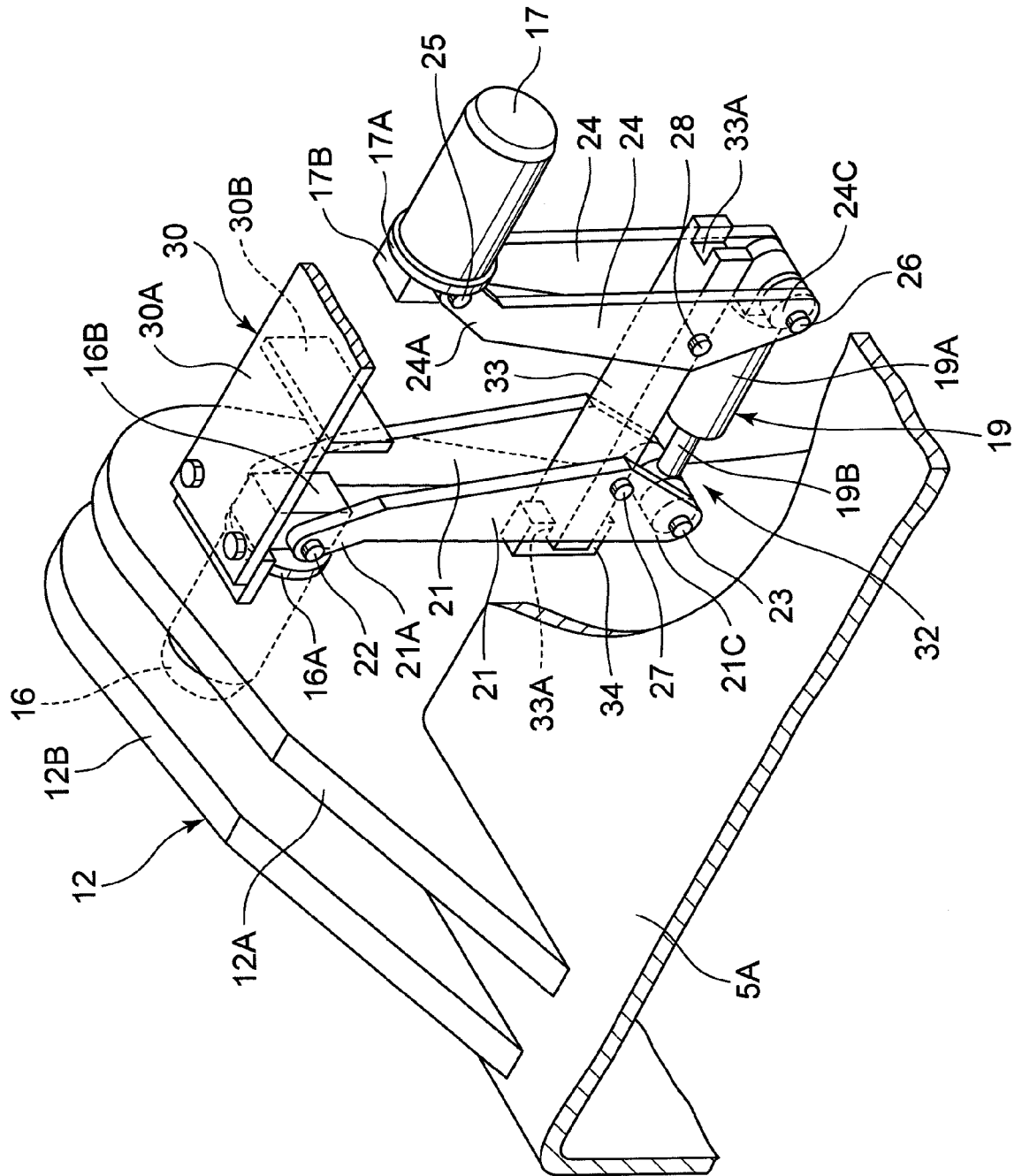


Fig. 12

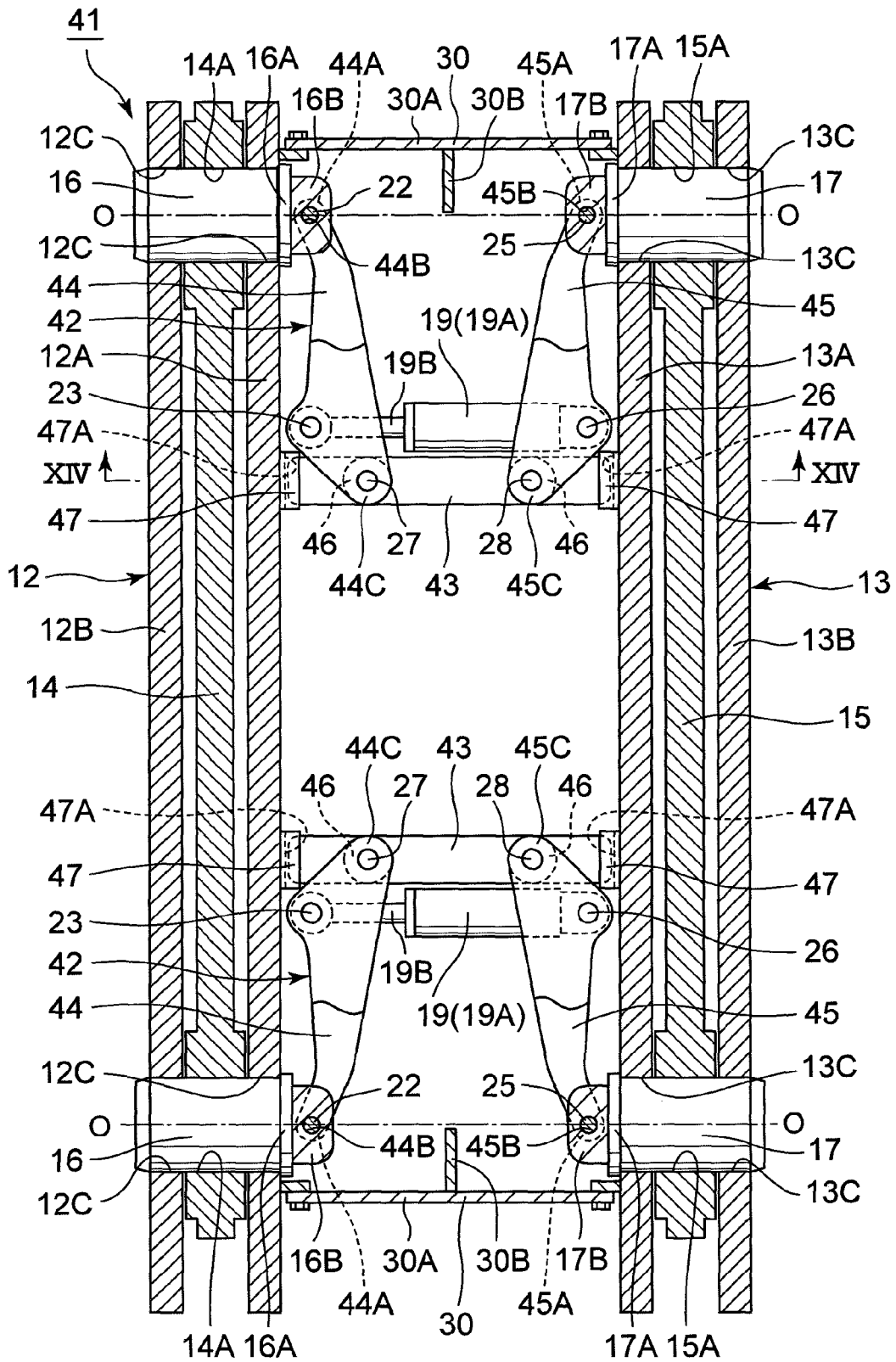


Fig. 13

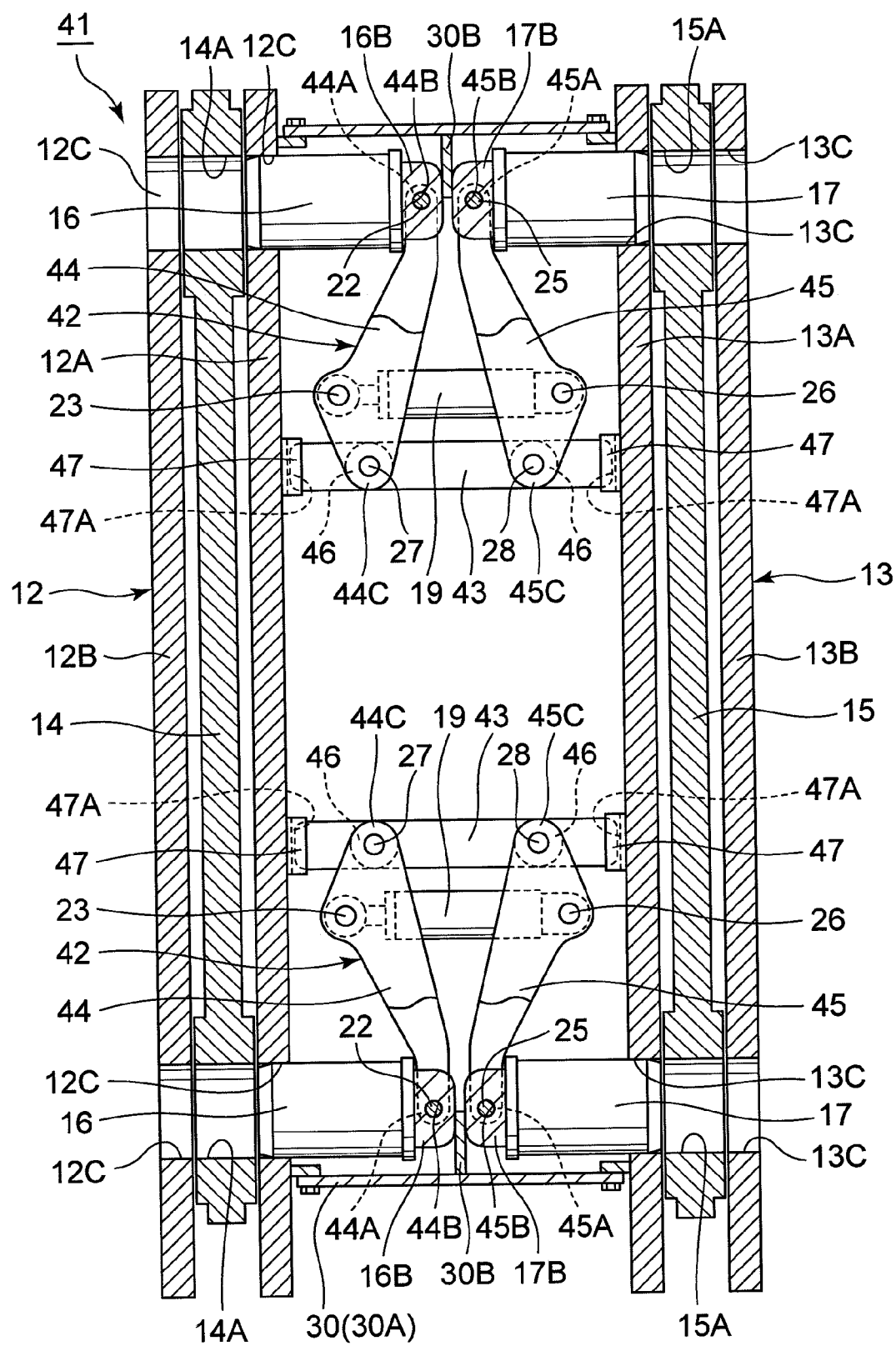


Fig. 14

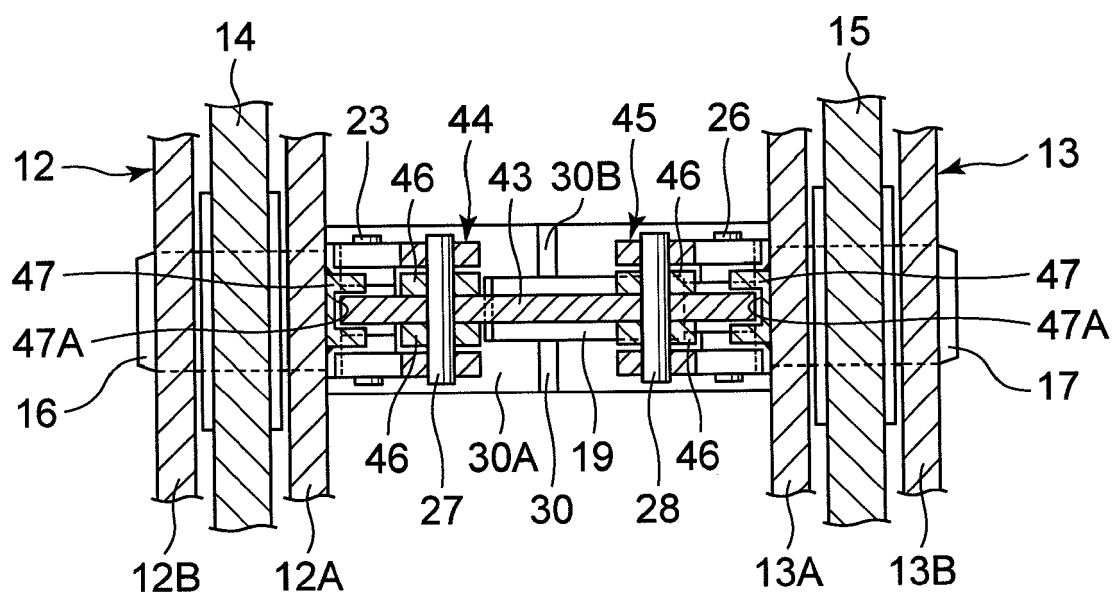


Fig. 15

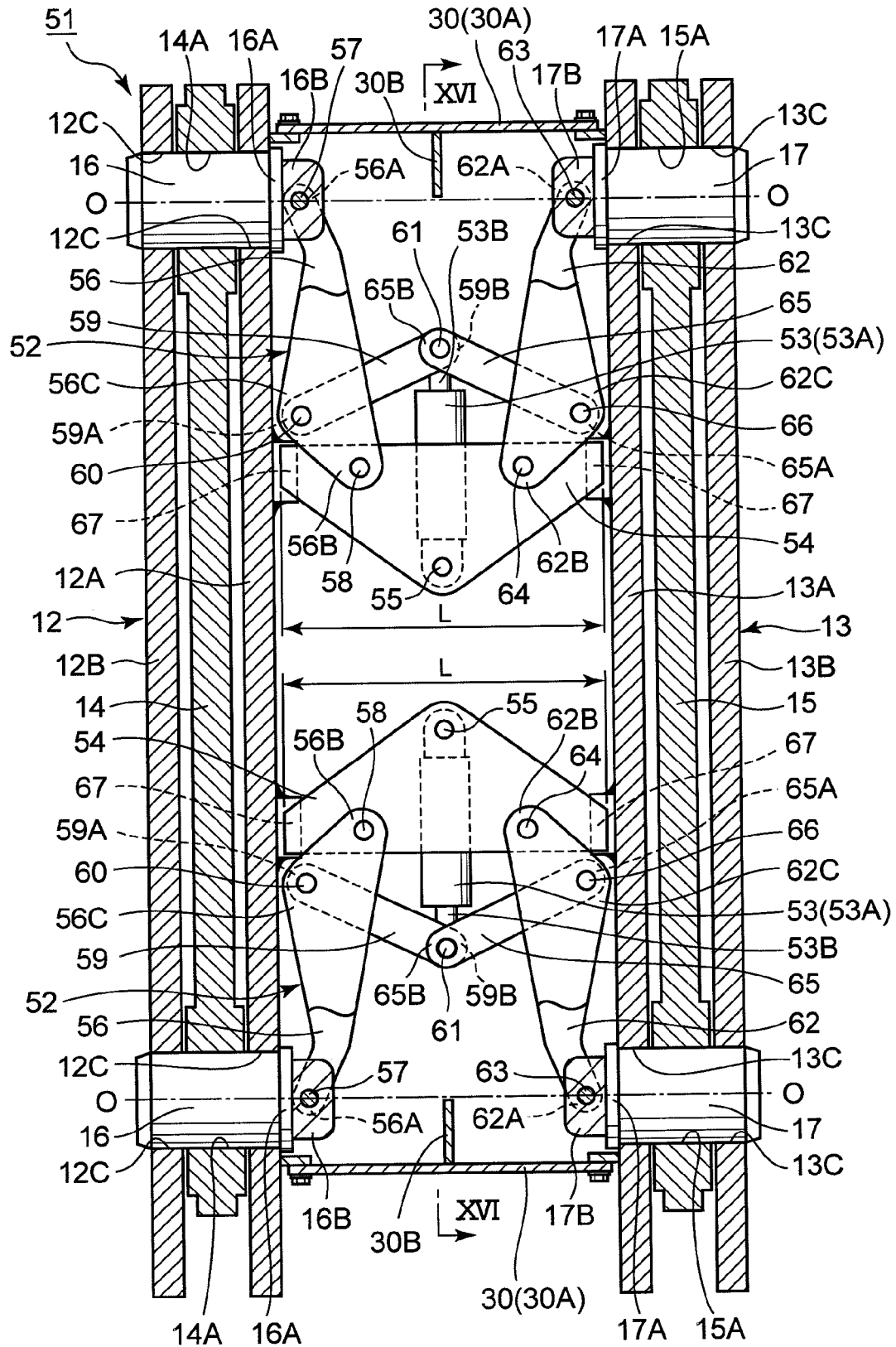


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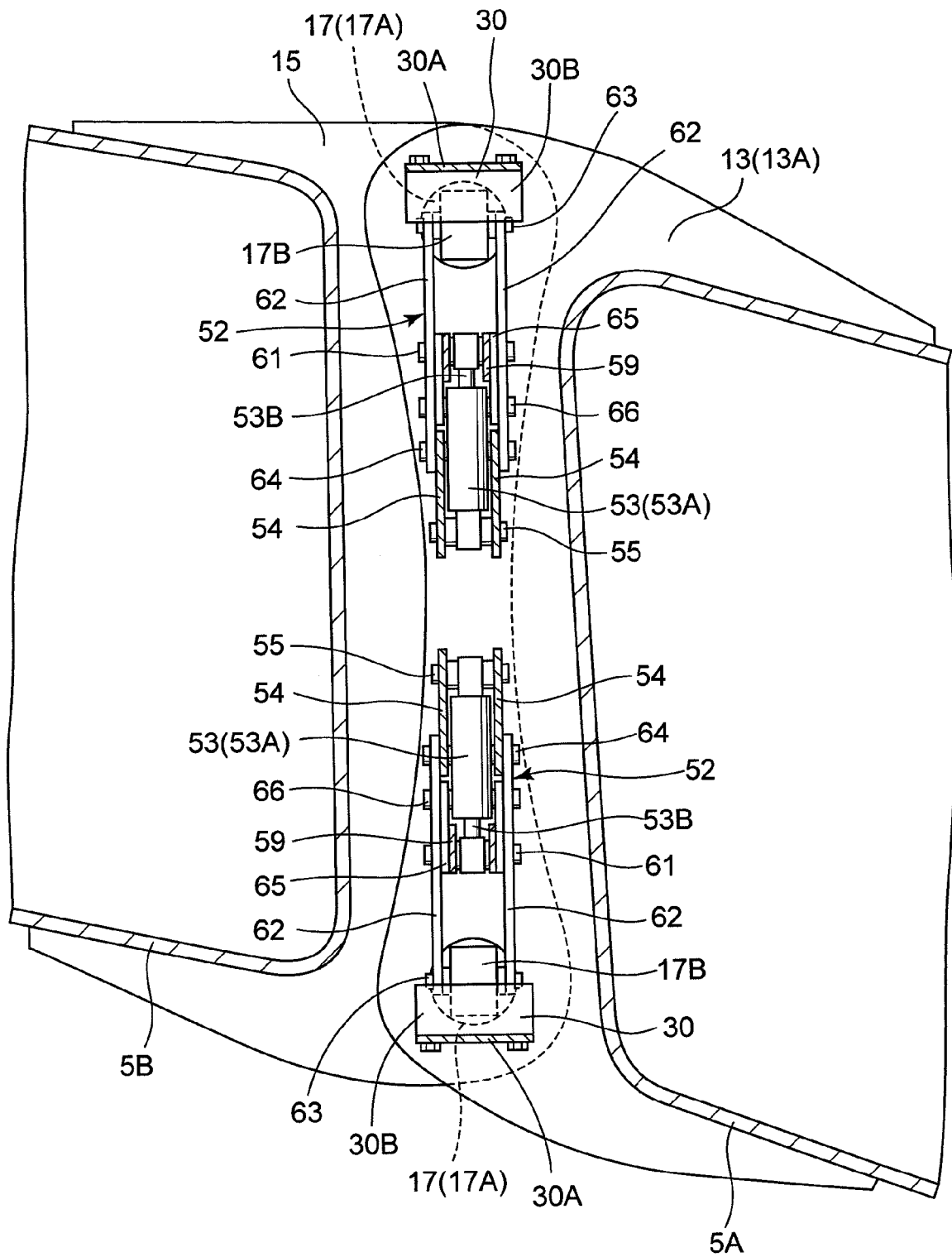


Fig. 17

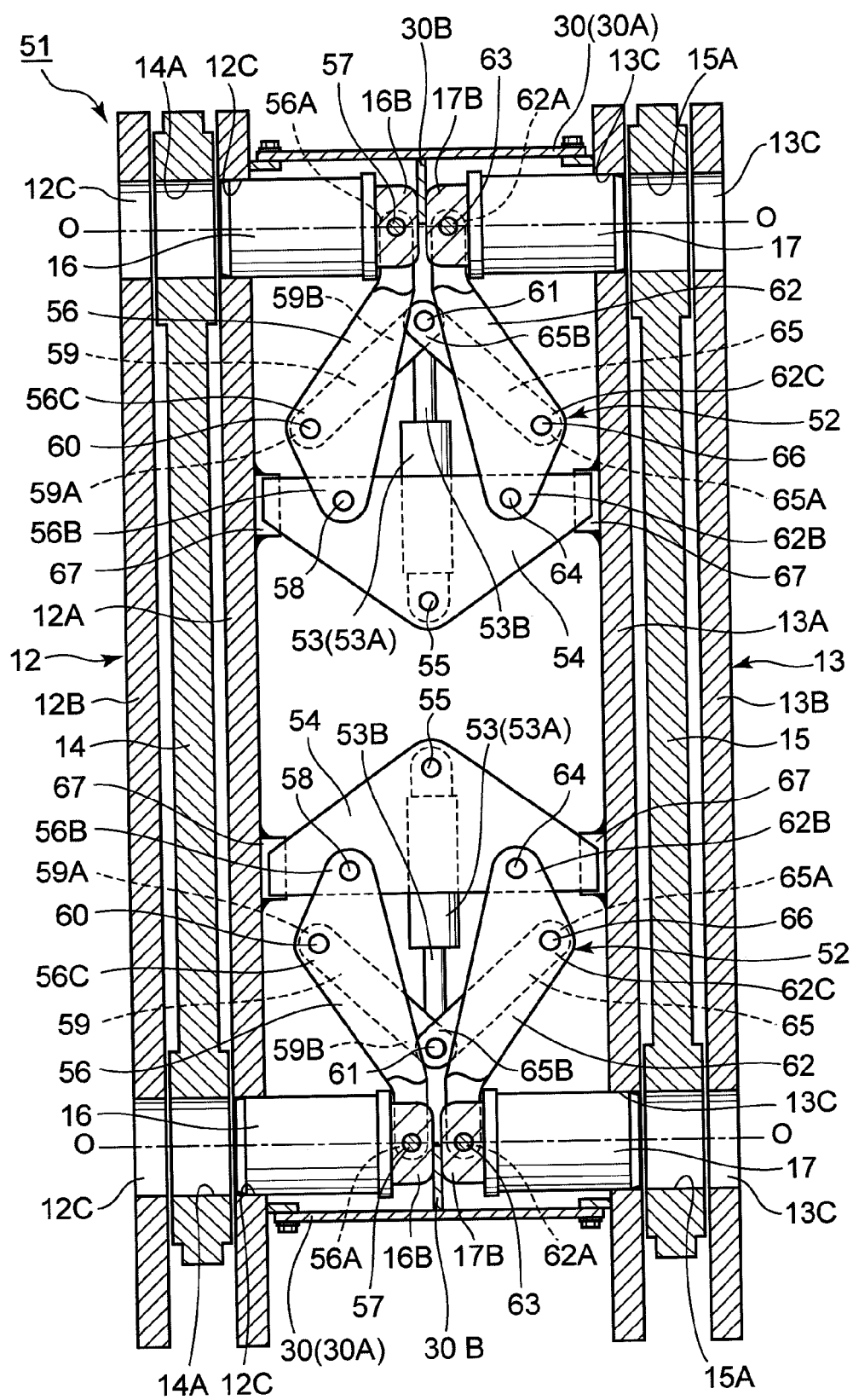


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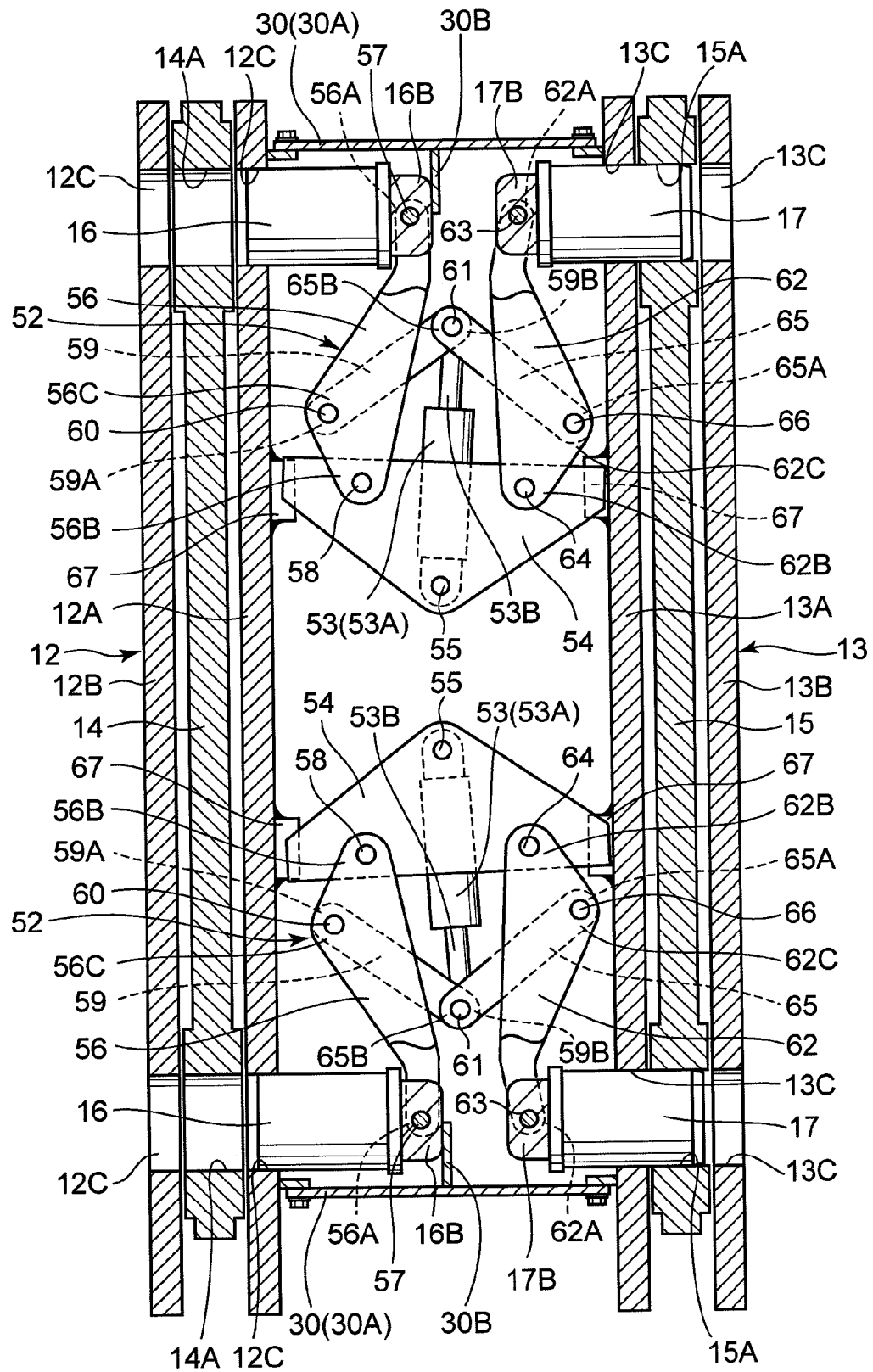


Fig. 19

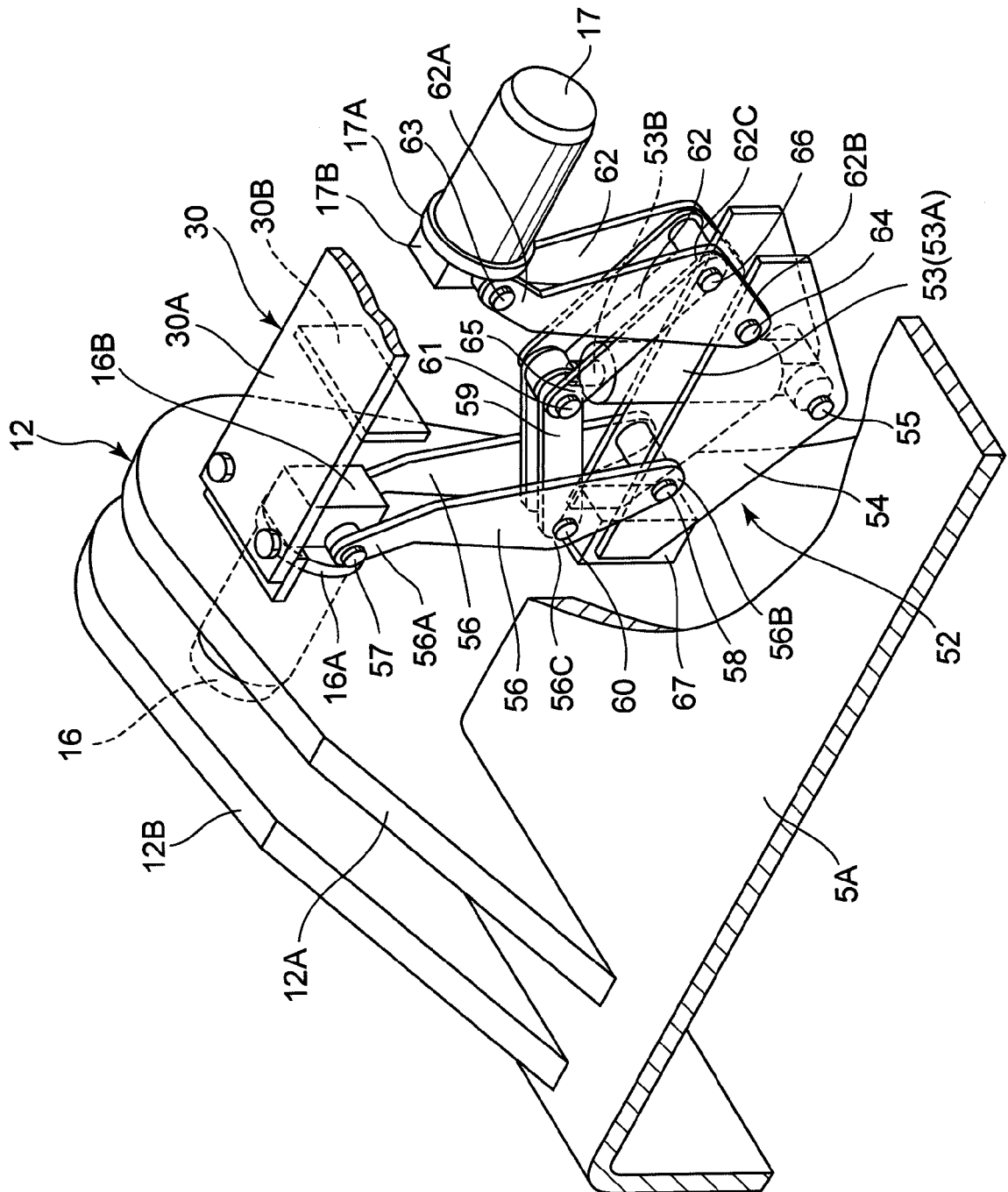


Fig. 20

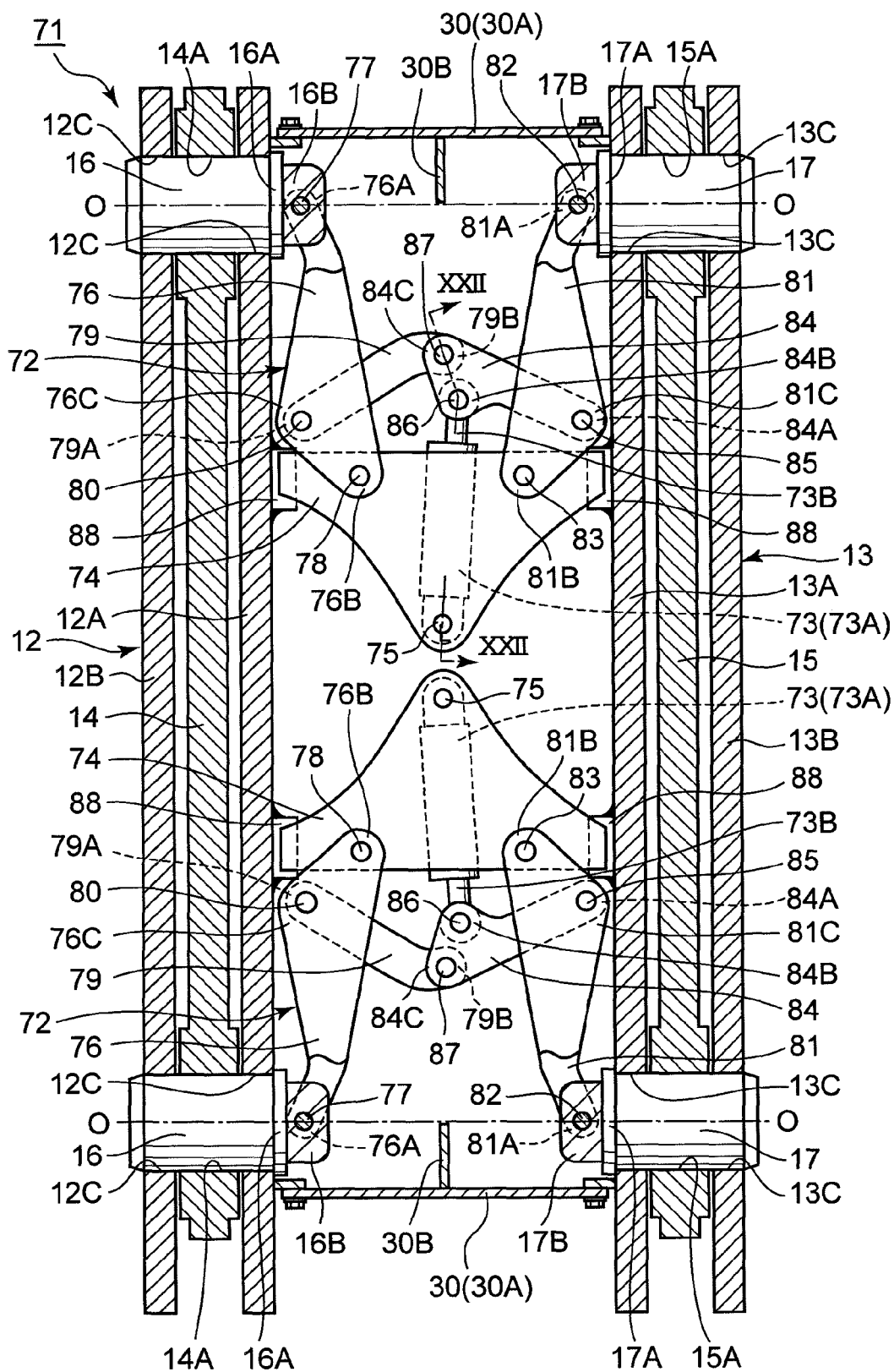


Fig. 21

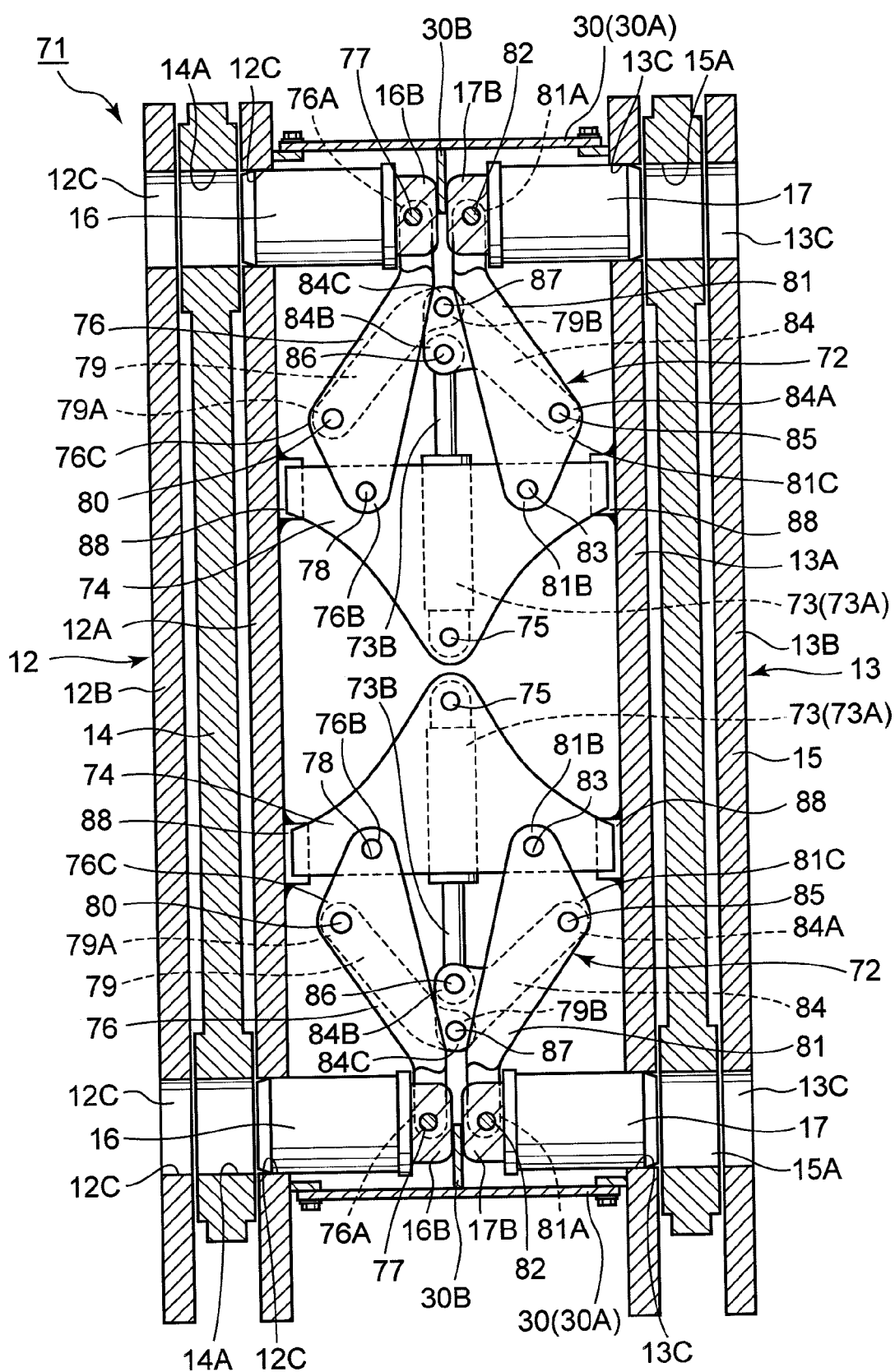


Fig. 22

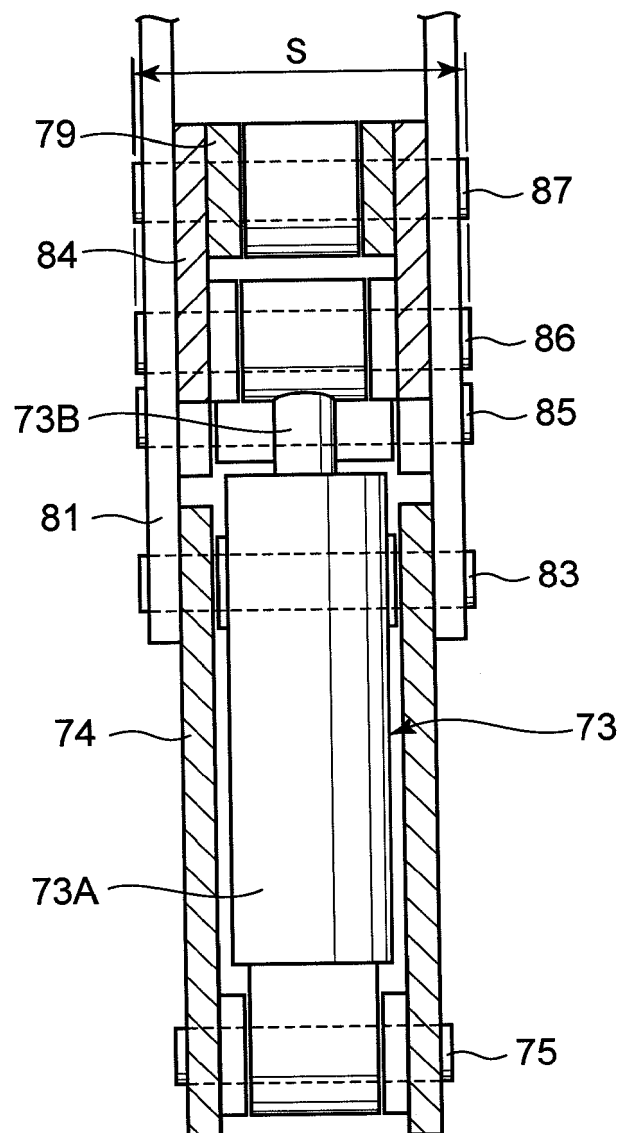


Fig. 24

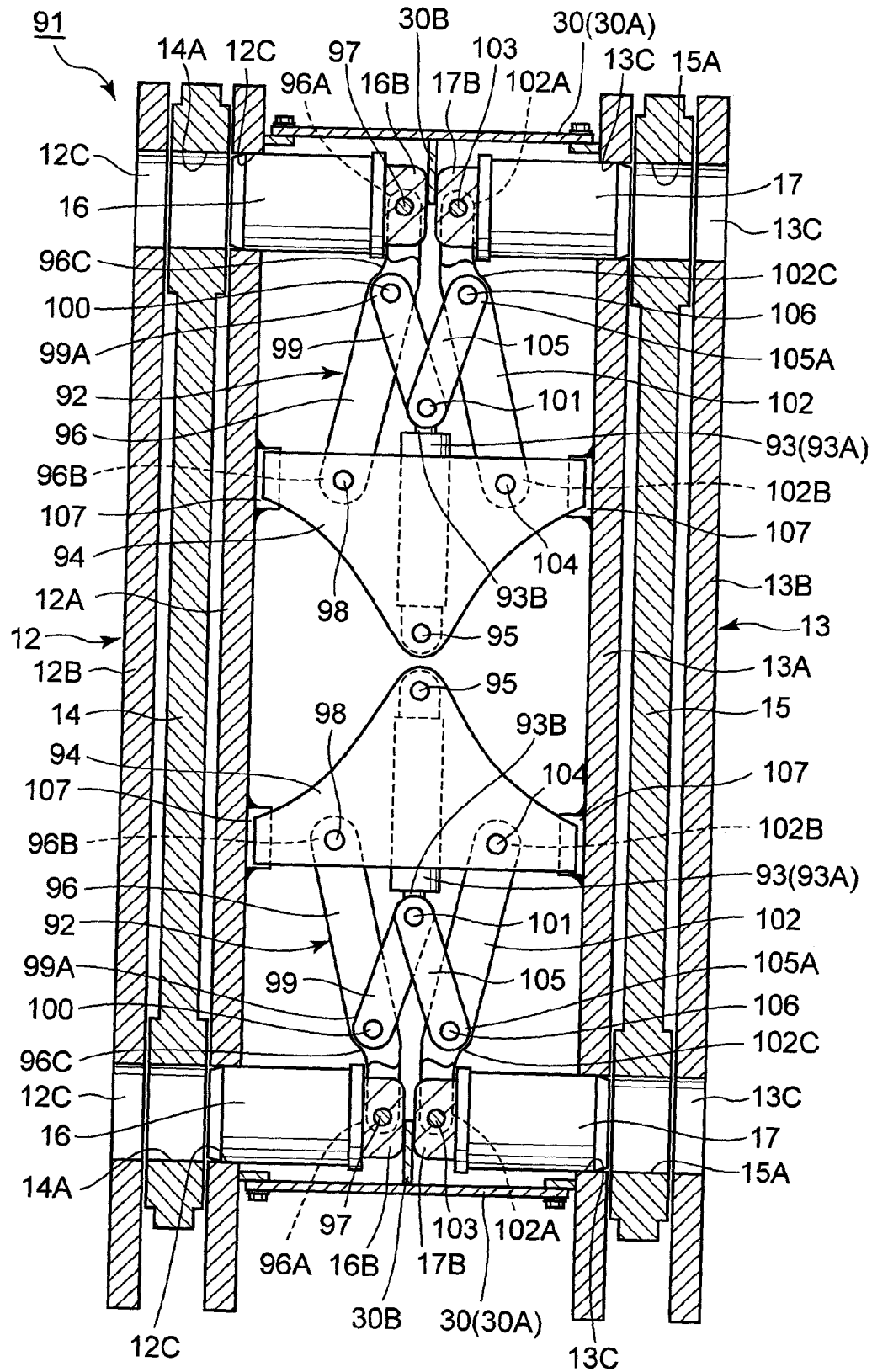
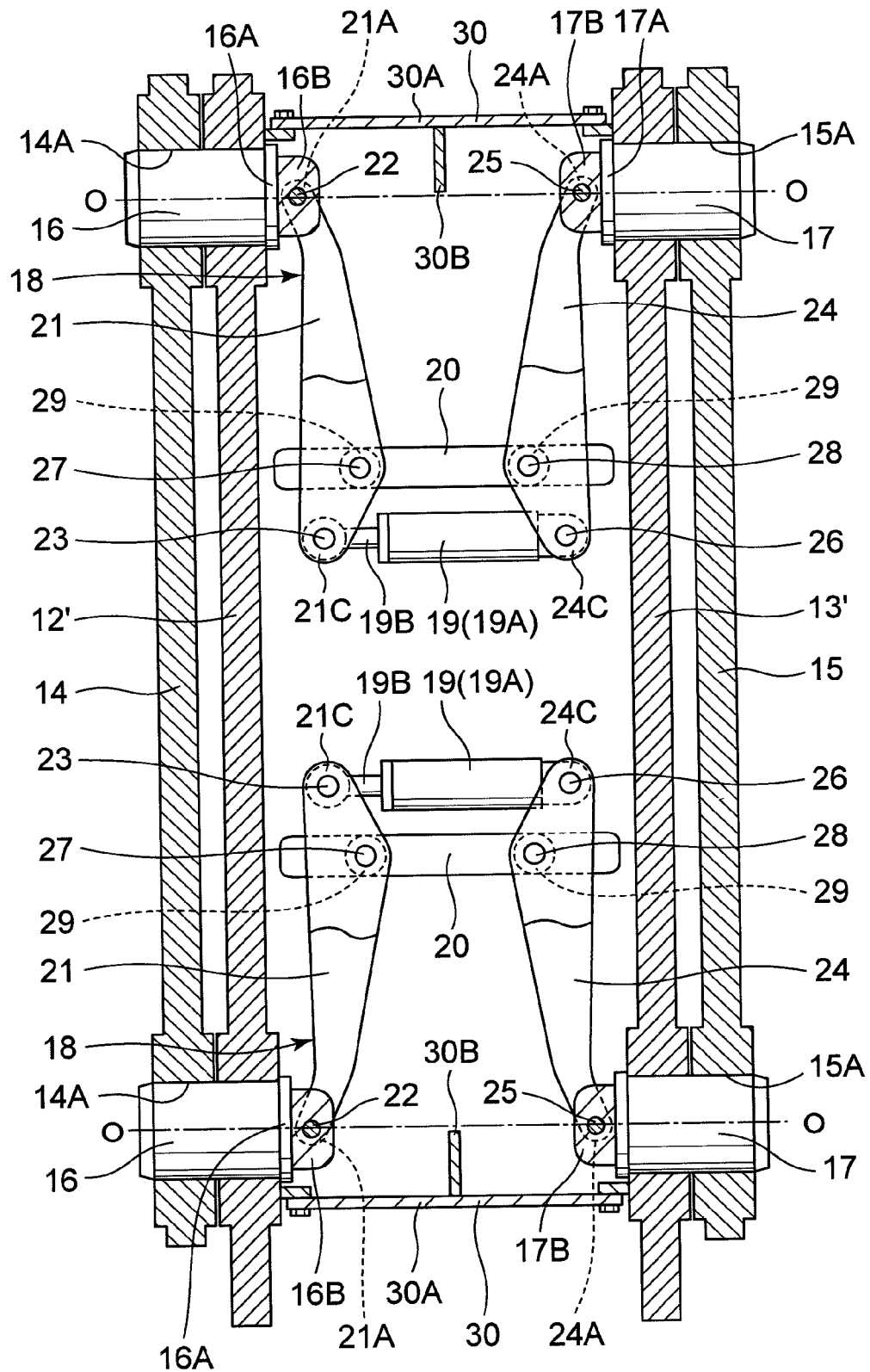


Fig. 25



REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

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