(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) **EP 4 534 762 A1**

(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
09.04.2025 Bulletin 2025/15

(21) Application number: **23201140.3**

(22) Date of filing: **02.10.2023**

(51) International Patent Classification (IPC):
E02F 9/12 *(2006.01)*

(52) Cooperative Patent Classification (CPC):
E02F 9/121; E02F 9/0825; E02F 9/18; E02F 9/0816

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC ME MK MT NL NO PL PT RO RS SE SI SK SM TR
Designated Extension States:
BA
Designated Validation States:
KH MA MD TN

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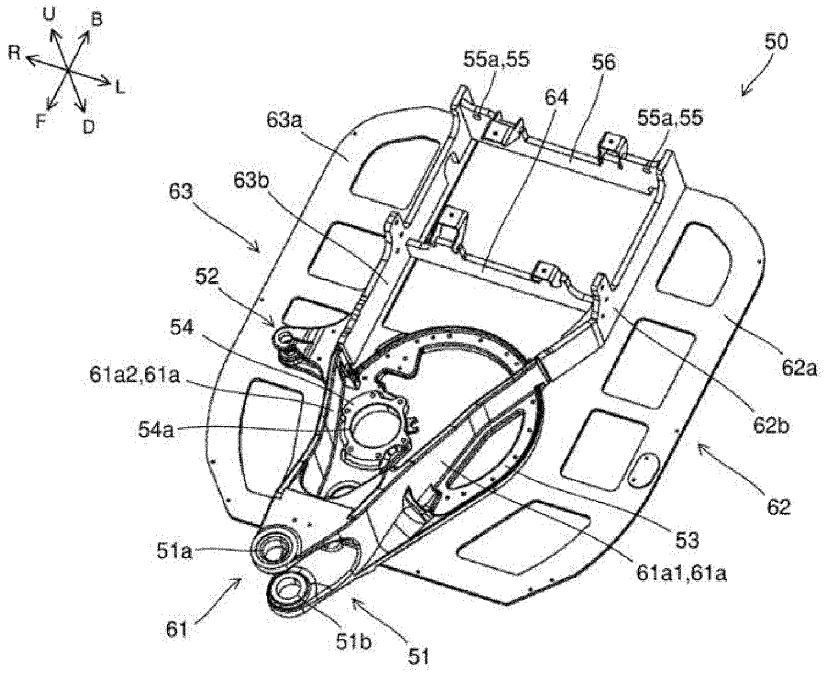
(54) **REVOLVING FRAME AND WORK MACHINE**

(57) [Problem] A revolving frame and a work machine including the revolving frame, which can avoid an increase in the number of types of swing support portions and revolving-bearing support portions in correspondingly to the revolving frames having different sizes, and can reduce a manufacturing cost are provided.

[Solution] A revolving frame of a hydraulic excavator as a work machine has a revolving-bearing support portion which supports a revolving bearing and a swing support portion which supports the work machine swingably in a width direction of a machine body and includes a first block. The first block is a casting integrally having the revolving-bearing support portion and the swing support portion.

FIG. 4



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Description

TECHNICAL FIELD

[0001] The present invention relates to a revolving frame and a work machine including the revolving frame.

BACKGROUND ART

[0002] A revolving frame of a construction machine, which is constituted by welding a plurality of members, is known as a prior art. For example, in Patent Document 1, a revolving frame is constituted by welding a bottom plate to which a revolving bearing is coupled and a pair of vertical plates to which a boom is coupled so as to be rotatable in a vertical direction.

PRIOR ART DOCUMENT

PATENT DOCUMENT

[0003] Patent Document 1: US Patent Application Publication No. 2022/0228344

SUMMARY OF INVENTION

TECHNICAL PROBLEM

[0004] In recent years, a small-sized hydraulic excavator on which a boom swing function is mounted has been proposed. In the hydraulic excavator described above, a boom is swingably supported in a width direction of a machine body by a swing support portion included in the revolving frame. The swing support portion and the revolving-bearing support portion for supporting the revolving bearing are usually constituted by separate components. The swing support portion and the revolving-bearing support portion are joined to each other by welding so as to constitute the revolving frame.

[0005] However, if the swing support portion and the revolving-bearing support portion are separate components, when revolving frames having different sizes are to be manufactured, a swing support portion and a revolving-bearing support portion suitable for each of the revolving frames are to be prepared and welded. Therefore, the types of the swing support portions and the revolving-bearing support portions are increased, and as a result, a manufacturing cost of the revolving frame is increased.

[0006] The present invention has been made to solve the aforementioned problem, and an object of the present invention is to provide a revolving frame and a work machine including the revolving frame, which can avoid an increase in the number of types of swing support portions and revolving-bearing support portions correspondingly to the revolving frames having different sizes, and can reduce the manufacturing cost.

SOLUTION TO PROBLEM

[0007] A revolving frame of a work machine according to one aspect of the present invention is a revolving frame of a work machine including a revolving-bearing support portion which supports a revolving bearing and a swing support portion which supports a work machine swingably in a width direction of a machine body, the revolving frame including a first block, and the first block being a casting integrally including the revolving-bearing support portion and the swing support portion.

ADVANTAGEOUS EFFECTS OF INVENTION

[0008] According to the configuration described above, it is possible to avoid an increase in the number of types of swing support portions and revolving-bearing support portion correspondingly to revolving frames having different sizes, and to reduce the manufacturing cost.

BRIEF DESCRIPTION OF DRAWINGS

[0009]

FIG. 1 is a left side view illustrating a schematic configuration of a hydraulic excavator which is an example of a work machine according to an embodiment of the present invention;
FIG. 2 is a perspective view from front right illustrating a state in which a revolving bearing and a revolving motor are mounted on a revolving frame of the hydraulic excavator;
FIG. 3 is a perspective view from rear left of FIG. 2;
FIG. 4 is a perspective view from front left illustrating a configuration of the revolving frame;
FIG. 5 is a plan view illustrating a state in which a counterweight is mounted on the revolving frame;
FIG. 6 is a perspective view from front left illustrating a configuration of a first block included in the revolving frame;
FIG. 7 is a perspective view from front left illustrating configurations of a second block and a third block included in the aforementioned revolving frame;
FIG. 8 is a left side view of an upper revolving body of a hydraulic excavator having the revolving frames with different sizes;
FIG. 9 is a perspective view from front left illustrating a configuration of the revolving frame in FIG. 8;
FIG. 10 is a perspective view from front left illustrating configurations of a second block and a third block included in the revolving frame shown in FIG. 9;
FIG. 11 is a perspective view from lower left illustrating a configuration of a swing support portion of the first block;
FIG. 12 is a perspective view from front left illustrating a vicinity of a front end part of the revolving frame in FIG. 1 in an enlarged manner; and
FIG. 13 is a perspective view from front left illustrat-

ing a hydraulic pipe passing through an inside of the swing support portion in FIG. 12 partially omitted.

DESCRIPTION OF EMBODIMENTS

[0010] The following is a description of an embodiment of the present invention on the basis of drawings.

[1. Schematic Configuration of Work Machine]

[0011] FIG. 1 is a left side view illustrating a schematic configuration of a hydraulic excavator 1 which is an example of a work machine according to an embodiment of the present invention. The hydraulic excavator 1 includes a lower traveling body 2 (also called a traveling body), a work machine 3, and an upper revolving body 4 (also called a machine body). In this embodiment, a configuration of a revolving frame 50 included in the upper revolving body 4 will be explained on the basis of two hydraulic excavators 1 having the revolving frames 50 with different sizes. Hereinafter, one hydraulic excavator 1 will be explained.

[0012] Here, directions are defined as follows. A direction in which an operator (a manipulator, a driver) seated on a driver's seat 46a disposed in a steering portion 46 of the upper revolving body 4 faces the front shall be referred to as "front", and a direction opposite thereto as "rear". A front-back direction of the upper revolving body 4 matches the front-back direction of the lower traveling body 2 in a state where the upper revolving body 4 is in a non-revolving state (revolving angle of 0 degrees) with respect to the lower traveling body 2. In the drawings, the hydraulic excavator 1 is illustrated when the upper revolving body 4 is in the non-revolving state with respect to the lower traveling body 2. When viewed from the operator seated on the driver's seat 46a, a left side is defined as "left" and a right side is defined as "right". Further, a gravity direction perpendicular to the front-back direction and a left-right direction (also called a width direction) is defined as an up-down direction, and an upstream side of the gravity direction defined as "up" and a downstream side defined as "down". In the drawings, when necessary, front is denoted by a symbol "F", rear by "B", a right by "R", a left by "L", up by "U", and down by "D".

[0013] The lower traveling body 2 includes a pair of left and right crawlers 21, a pair of left and right traveling motors 22, and a blade 23. The left and right traveling motors 22 drive the left and right crawlers 21, respectively, whereby the hydraulic excavator 1 can be moved forward and backward. Each of the traveling motors 22 is constituted by a hydraulic motor. The hydraulic excavator 1 in which the lower traveling body 2 includes the crawler 21 is referred to as a crawler-type hydraulic excavator 1. A blade 23 for a ground leveling work or the like is provided on a front side of the lower traveling body 2. The blade 23 is rotated by a blade cylinder 23a. The blade cylinder 23a is constituted by a hydraulic cylinder.

[0014] The work machine 3 includes a boom 31, an arm 32, and a bucket 33. The boom 31, the arm 32, and the bucket 33 are independently driven, whereby an excavation work of earth and sand or the like can be performed.

[0015] The boom 31 is supported by a swing bracket 41 of the upper revolving body 4. The boom 31 is rotated by a boom cylinder 31a. The boom cylinder 31a has a base end part supported by the swing bracket 41 and is telescopically movable. The arm 32 is supported by the boom 31. The arm 32 is rotated by an arm cylinder 32a. The arm cylinder 32a has a base end part supported by the boom 31 and is telescopically movable. The bucket 33 is supported by the arm 32. A bucket 33 is rotated by a bucket cylinder 33a. The bucket cylinder 33a has a base end part supported by the arm 32 and is telescopically movable. The boom cylinder 31a, the arm cylinder 32a, and the bucket cylinder 33a are constituted by a hydraulic cylinder, respectively.

[0016] The upper revolving body 4 is located above the lower traveling body 2 and is provided to be revolvable with respect to the lower traveling body 2 via a revolving bearing 42. The upper revolving body 4 includes the swing bracket 41, the revolving bearing 42, a counterweight 43, a revolving motor 44, an engine room 45, the steering portion 46, and a revolving frame 50.

[0017] The swing bracket 41 is disposed on a front side of the upper revolving body 4, and the counterweight 43 is disposed on a rear side. The counterweight 43 is a weight for maintaining a favorable weight balance in the front-back direction of the hydraulic excavator 1 particularly during an excavation work or the like. By means of the counterweight 43, the hydraulic excavator 1 can stably perform works.

[0018] A revolving bearing 42 is disposed on a lower side of the upper revolving body 4. A configuration of the revolving bearing 42 will be described later. A revolving motor 44 is disposed inside the upper revolving body 4. The revolving motor 44 is constituted by a hydraulic motor. The upper revolving body 4 revolves with respect to the lower traveling body 2 by drive of the revolving motor 44.

[0019] The swing bracket 41, the revolving bearing 42, the counterweight 43, and the revolving motor 44 are mounted on the revolving frame 50, which will be described in detail later. A configuration of the revolving frame 50 will also be described later.

[0020] An engine EG and a hydraulic pump HP are accommodated in the engine room 45. The engine EG is a drive source of the hydraulic excavator 1. The engine EG is constituted by a diesel engine, but this is not limiting, and it may be constituted by a gasoline engine, for example.

[0021] The hydraulic pump HP is connected to a rotary shaft (output shaft) of the engine EG. The hydraulic pump HP is driven by the engine EG. The hydraulic pump HP is configured by including a variable displacement pump and a fixed displacement pump. The hydraulic pump HP supplies hydraulic oil (pressure oil) to hydraulic motors

(the left and right traveling motors 22 and the revolving motor 44, for example) and hydraulic cylinders (the blade cylinder 23a, the boom cylinder 31a, the arm cylinder 32a, and the bucket cylinder 33a, for example). The hydraulic motor and the hydraulic cylinder driven by the hydraulic oil are collectively referred to as hydraulic actuators (not shown).

[0022] The steering portion 46 is provided on an upper part of the upper revolving body 4. The driver's seat 46a is disposed on the steering portion 46. A plurality of steering members 46b are disposed around the driver's seat 46a. The plurality of steering members 46b are configured by including a lever, a switch, a pedal, and the like. When an operator is seated on the driver's seat 46a and operates the plurality of steering members 46b, the hydraulic actuator described above is driven. As a result, traveling of the lower traveling body 2, the ground leveling work by the blade 23, the excavating work by the work machine 3, the revolving of the upper revolving body 4 and the like can be performed.

[2 Configuration of Revolving Frame]

[0023] A configuration of the revolving frame 50 will be explained. FIG. 2 and FIG. 3 are a perspective view from the front right and a perspective view from the rear left illustrating a mounting state of the swing bracket 41, the revolving bearing 42, and the revolving motor 44 with respect to the revolving frame 50. FIG. 4 is a perspective view from front left illustrating a configuration of the revolving frame 50. In FIG. 3, only some of a plurality of bolts B1 are given reference numerals for convenience. The revolving frame 50 includes a swing support portion 51, a cylinder support portion 52, a revolving-bearing support portion 53, a revolving-motor support portion 54, and a counterweight mounting portion 55.

[0024] As shown in FIGS. 2 and 3, the swing support portion 51 is provided at a front end part of the revolving frame 50. A first coupling hole 51a and a second coupling hole 51b (for both, see FIG. 4) penetrating in the up-down direction are provided by being aligned in the up-down direction on a front end part of the swing support portion 51. The first coupling hole 51a is located on an upper side of the swing support portion 51, and the second coupling hole 51b is located on the lower side.

[0025] The swing bracket 41 is supported by the swing support portion 51. More specifically, on a rear side of the swing bracket 41, a plurality of through holes (not shown) penetrating in the up-down direction are provided in the up-down direction. The swing bracket 41 is disposed such that each of the aforementioned through holes corresponds to the first coupling hole 51a and the second coupling hole 51b. An upper coupling pin P1 is inserted into the first coupling hole 51a and some of the through holes from above. A lower coupling pin P2 is inserted into the second coupling hole 51b and the remaining through holes from below. The upper coupling pin P1 and the lower coupling pin P2 are inserted such that axial directions thereof are along the up-down direction. As a result, the swing bracket 41 is rotatably supported with the upper coupling pin P1 and the lower coupling pin P2 as rotating shafts.

[0026] A support configuration of the swing bracket 41 is not limited to the above. For example, instead of the upper coupling pin P1 and the lower coupling pin P2, a single coupling shaft portion whose axial direction is along the up-down direction may be formed in the swing bracket 41. By inserting the coupling shaft portion into the first coupling hole 51a and the second coupling hole 51b of the swing support portion 51, the swing bracket 41 can be rotatably supported.

[0027] A distal end part of the swing cylinder 41a is coupled with the right side of the swing bracket 41. A base end part of the swing cylinder 41a is supported by the cylinder support portion 52 of the revolving frame 50. The cylinder support portion 52 is provided on a rear of the swing support portion 51 and to the right of the revolving-bearing support portion 53, which will be described later, in the revolving frame 50. The swing cylinder 41a is constituted by a hydraulic cylinder and is telescopically movable. By the expansion and contraction of the swing cylinder 41a, the swing bracket 41 swings in the left-right direction (width direction) with the upper coupling pin P1 and the lower coupling pin P2 as the rotating shafts. Moreover, the swing bracket 41 supports the boom 31 as described above (see FIG. 1). Therefore, the swing support portion 51 provided on the revolving frame 50 swingably supports the boom 31 (work machine 3) in the left-right direction via the swing bracket 41.

[0028] The revolving-bearing support portion 53 is provided near the center of the revolving frame 50. The revolving bearing 42 is supported by the revolving-bearing support portion 53. More specifically, as particularly shown in FIG. 3, the revolving bearing 42 is configured by including an outer ring 42a and an inner ring 42b. The outer ring 42a and the inner ring 42b are formed of an annular metal member. The inner ring 42b is located inside the outer ring 42a. The outer ring 42a and the inner ring 42b rotate relative to each other around an axis extending in the up-down direction.

[0029] The outer ring 42a is fixed to the revolving-bearing support portion 53 from below by a plurality of bolts B1. In the revolving frame 50, a part (annular part on a plan view) to which the outer ring 42a is fixed constitutes the revolving-bearing support portion 53. As described above, in the revolving frame 50, the revolving-bearing support portion 53 which supports the outer ring 42a (the revolving bearing 42) is provided. The inner ring 42b is fixed to an upper part of the lower traveling body 2.

[0030] The revolving-motor support portion 54 is provided on a right front part of the annular revolving-bearing support portion 53 integrally by overlapping the revolving-bearing support portion 53 (see FIG. 4). In particular, as shown in FIG. 3, the revolving motor 44 is supported by the revolving-motor support portion 54 with the rotary shaft 44a directed downward. That is, in the revolving

frame 50, the revolving-motor support portion 54 which supports the revolving motor 44 is provided. The revolving-motor support portion 54 is provided so as to protrude from a fixed side to the outer ring 42a in the revolving-bearing support portion 53 toward an inner side of the inner ring 42b on a plan view.

[0031] A gear 44b is provided on an outer peripheral surface of the rotary shaft 44a of the revolving motor 44. The gear 44b is inserted into an insertion hole 54a (see FIG. 4) of the revolving-motor support portion 54 from above and meshes with the inner ring 42b of the revolving bearing 42. When the revolving motor 44 is driven, and the gear 44b rotates together with the rotary shaft 44a, the inner ring 42b rotates relative to the outer ring 42a. As described above, since the inner ring 42b is fixed to the lower traveling body 2, when the revolving motor 44 is driven, the upper revolving body 4 having the revolving frame 50 to which the outer ring 42a is fixed revolves with respect to the lower traveling body 2 to which the inner ring 42b is fixed.

[0032] As shown in FIG. 4, the counterweight mounting portion 55 is provided at a rear end part of the revolving frame 50. More specifically, the counterweight mounting portion 55 is provided on a beam member 56 of the revolving frame 50. The beam member 56 is constituted by a plate-shaped member made of metal extending in the left-right direction. The counterweight mounting portion 55 includes a mounting hole 55a and a mounting surface portion 55b (see FIG. 3). The mounting hole 55a is provided by penetrating the beam member 56 in the front-back direction. The mounting surface portion 55b is constituted by a rear surface portion of the beam member 56.

[0033] The counterweight 43 is mounted on the counterweight mounting portion 55. A mounting configuration of the counterweight 43 will be described with reference to FIG. 5. FIG. 5 is a plan view illustrating a mounting state of the counterweight 43. On the counterweight 43, a protruding portion 43a that protrudes forward is provided. In the protruding portion 43a, a through hole (not shown) penetrating in the front-back direction is provided.

[0034] A spacer S1 is located between the protruding portion 43a and the mounting surface portion 55b in the front-back direction of the counterweight mounting portion 55. The spacer S1 is formed of a cylindrical metal member. The spacer S1 is disposed such that one end surface (end surface on the front side) is in contact with the mounting surface portion 55b, while an inner peripheral edge is caused to correspond to the mounting hole 55a (see FIG. 3).

[0035] The counterweight 43 is disposed such that the front surface part of the protruding portion 43a is in contact with the other end surface (the end surface on the rear side) of the spacer S1, while the through-hole of the protruding portion 43a is caused to correspond to the inner peripheral edge of the spacer S1. A bolt B2 is inserted into the through hole, the inner peripheral edge of the spacer S1, and the mounting hole 55a from the rear and is screwed into a nut N1 provided in front of the mounting hole 55a. As a result, the counterweight 43 is fixed to the counterweight mounting portion 55. As described above, on the beam member 56 of the revolving frame 50, the counterweight mounting portion 55 for mounting the counterweight 43 is provided. Note that the aforementioned screwing means that a member having a male screw and a member having a female screw are meshed with each other and connected to each other.

[0036] Moreover, as shown in FIG. 4, the revolving frame 50 is configured by including a first block 61, a second block 62, and a third block 63. The first block 61 is located in the vicinity of the center in the left-right direction of the revolving frame 50. Further, the first block 61 is provided from the front end part of the revolving frame 50 to the vicinity of the center in the front-back direction. The second block 62 is disposed on the left side of the first block 61. The third block 63 is disposed on the right side of the first block 61.

[0037] A configuration of the first block 61 will be explained with reference to FIG. 6. FIG. 6 is a perspective view from front left illustrating the configuration of the first block. The first block 61 is made of casting and includes the swing support portion 51, the revolving-bearing support portion 53, the revolving-motor support portion 54, and a pair of vertical plates 61a (a first vertical plate 61a1 and a second vertical plate 61a2).

[0038] The swing support portion 51 is located on the front side of the first block 61. The revolving-bearing support portion 53 is disposed on the rear of the swing support portion 51. That is, the revolving-bearing support portion 53 is disposed by being aligned in one direction (front-back direction) with respect to the swing support portion 51. Further, as described above, the revolving-motor support portion 54 is provided integrally by overlapping the revolving-bearing support portion 53.

[0039] The first vertical plate 61a1 and the second vertical plate 61a2 extend continuously from a rear part of the swing support portion 51 toward the rear side of the first block 61. More specifically, the first vertical plate 61a1 extends from a rear left end part of the swing support portion 51 toward the rear left side of the first block 61. The first vertical plate 61a1 is integrally provided such that a lower end part on the rear side intersects the left side of the rear end of the revolving-bearing support portion 53. Therefore, the first vertical plate 61a1 is integrally connected to the swing support portion 51 and the revolving-bearing support portion 53.

[0040] The second vertical plate 61a2 extends from a rear right end part of the swing support portion 51 toward the rear right side of the first block 61. The second vertical plate 61a2 is integrally provided such that a lower end part on the rear side overlaps a front right part of the revolving-bearing support portion 53. Therefore, the second vertical plate 61a2 is integrally connected to the swing support portion 51 and the revolving-bearing support portion 53.

[0041] As described above, in the first block 61, the

swing support portion 51, the revolving-bearing support portion 53, the revolving-motor support portion 54, and the pair of vertical plates 61a are integrally provided. That is, the first block 61 is made of one cast member including the swing support portion 51, the revolving-bearing support portion 53, the revolving-motor support portion 54, and the pair of vertical plates 61a.

[0042] The configurations of the second block 62 and the third block 63 will be explained with reference to FIG. 7. FIG. 7 is a perspective view from front left illustrating the configurations of the second block 62 and the third block 63.

[0043] The second block 62 includes a first bottom plate 62a and a first reinforcing plate 62b. The first bottom plate 62a is constituted by a plate-shaped member made of metal extending in a horizontal direction. The first reinforcing plate 62b is joined to an upper surface portion of the first bottom plate 62a by welding. The first reinforcing plate 62b is constituted by bending a front end part of a plate-shaped member made of metal extending in the front-back direction diagonally to front right. That is, the first reinforcing plate 62b extends from the front (one side in the front-back direction) toward the rear (the other side in the front-back direction).

[0044] The third block 63 has a second bottom plate 63a and a second reinforcing plate 63b. The second bottom plate 63a is constituted by a plate-shaped member made of metal extending in the horizontal direction. The second reinforcing plate 63b is joined to an upper surface portion of the second bottom plate 63a by welding. The second reinforcing plate 63b is constituted by a plate-shaped member made of metal extending in the front-back direction.

[0045] Some of the devices disposed in the upper revolving body 4 are disposed on the second block 62 and the third block 63. For example, a control valve is disposed on the second block 62, and a hydraulic oil tank is disposed on the third block 63. The control valve is a directional switching valve that controls the flow direction and a flow rate of the hydraulic oil supplied from the hydraulic pump HP (see FIG. 1) to the aforementioned hydraulic actuators (for example, the arm cylinder 32a, the bucket cylinder 33a and the like). The hydraulic oil tank is a container which stores the aforementioned hydraulic oil.

[0046] As shown in FIG. 4, the second block 62 and the third block 63 are joined to the first block 61 by welding, respectively. More specifically, a right edge of a front part of the first bottom plate 62a is joined to a left end part of the first block 61 (a part extending from a rear left end part of the swing support portion 51 to a rear left part of the revolving bearing 42). A front end part of the first reinforcing plate 62b is connected to a rear end part of the first vertical plate 61a1. A left edge of a front part of the second bottom plate 63a is joined to a right end part of the first block 61 (a part extending from a rear right end part of the swing support portion 51 to a front right part of the revolving bearing 42) (see FIG. 2). A front end part of the second reinforcing plate 63b is connected to a rear end part of the second vertical plate 61a2.

[0047] Note that the aforementioned cylinder support portion 52 is provided on the right side of a connecting portion between the second vertical plate 61a2 and the second reinforcing plate 63b. The cylinder support portion 52 is joined to the second vertical plate 61a2, the second bottom plate 63a, and the second reinforcing plate 63b by welding.

[0048] In the revolving frame 50, the aforementioned beam member 56 and a connecting member 64 are provided on the rear of the first block 61. The beam member 56 is located between the second block 62 and the third block 63 in the left-right direction. More specifically, the beam member 56 is disposed such that a left end part thereof is in contact with a right side surface part of the first reinforcing plate 62b and a right end part thereof is in contact with a left side surface part of the second reinforcing plate 63b. In the aforementioned disposition, each of the left and right end parts of the beam member 56 is joined to the first reinforcing plate 62b and the second reinforcing plate 63b by welding. As a result, the beam member 56 is connected to the first reinforcing plate 62b and the second reinforcing plate 63b. That is, the beam member 56 is connected to the second block 62 and the third block 63.

[0049] The connecting member 64 is located on the front of the beam member 56 and between the second block 62 and the third block 63 in the left-right direction. The connecting member 64 is constituted by a plate-shaped member made of metal extending in the left-right direction. Each of the left and right end parts of the connecting member 64 is joined to the first reinforcing plate 62b of the second block 62 and the second reinforcing plate 63b of the third block 63 by welding similarly to the beam member 56.

[3 Sharing of First Block between Revolving Frames of Different Sizes]

[0050] Subsequently, the other hydraulic excavator 1 will be explained on the basis of FIG. 8. FIG. 8 is a left side view of the upper revolving body 4 of the other hydraulic excavator 1. Hereinafter, the revolving frame 50 included in one hydraulic excavator 1 is referred to as the one revolving frame 50, while the revolving frame 50 included in the other hydraulic excavator 1 is referred to as the other revolving frame 50. In addition, for convenience, in the other revolving frame 50, members having the same functions and the same positional relationships as those of the members included in the one revolving frame 50 are given the same reference numerals regardless of whether or not the members have the same shapes.

[0051] When the upper revolving body 4 (see FIG. 1) of the one hydraulic excavator 1 is compared with the upper revolving body 4 of the other hydraulic excavator 1, the other hydraulic excavator 1 is configured to be shorter in the front-back direction. More specifically, the length in

the front-back direction from the front end part of the swing bracket 41 to the rear end part of the counterweight 43 is shorter in the other hydraulic excavator 1. That is, the other hydraulic excavator 1 is configured to be smaller (small revolving type) than the one hydraulic excavator 1. Note that the lower traveling body 2 and the work machine 3 (either of them shown) of the other hydraulic excavator 1 have the same configurations as those of the one hydraulic excavator 1.

[0052] The configuration of the other revolving frame 50 will be explained with reference to FIGS. 9 and 10. FIG. 9 is a perspective view from front left illustrating a configuration of the other revolving frame 50. FIG. 10 is a perspective view from front left illustrating a configuration of the second block 62 and the third block 63 included in the other revolving frame 50.

[0053] As shown in FIG. 9, the other revolving frame 50 is configured by including the beam member 56, the first block 61, the second block 62, and the third block 63 similarly to the one revolving frame 50 (see FIG. 4). Note that, in the other revolving frame 50, the connecting member 64 (see FIG. 4) included in the one revolving frame 50 is removed.

[0054] The beam member 56 and the first block 61 have the same configurations as those of the beam member 56 and the first block 61 shown in FIG. 4 and the like. That is, the other revolving frame 50 has the same beam member 56 and the first block 61 as those of the one revolving frame 50.

[0055] As shown in FIGS. 9 and 10, the second block 62 and the third block 63 are configured such that the second block 62 and the third block 63 shown in FIG. 4 and the like are shorter in the front-back direction. More specifically, the disposed positions of the front end parts of the second block 62 and the third block 63 with respect to the first block 61 are the same as the front end parts of the second block 62 and the third block 63 shown in FIG. 4 and the like. On the other hand, the rear end parts of the second block 62 and the third block 63 are located closer to the front (closer to the first block 61) than the rear end parts of the second block 62 and the third block 63 shown in FIG. 4 and the like. Therefore, the other revolving frame 50 has the second block 62 and the third block 63 which are shorter in the front-back direction than the one revolving frame 50. As described above, the other revolving frame 50 is configured to be shorter than the one revolving frame 50 in the front-back direction while having the same first block 61 as that of the one revolving frame 50.

[0056] According to the aforementioned configuration, it is possible to change the size (particularly, the length in the front-back direction) of the revolving frame 50 (machine body) for each of the hydraulic excavators 1 while using the same first block 61. For example, when there are two units of the hydraulic excavators 1, it is possible to select components other than the first block 61 among the components constituting the revolving frame 50 for each of the hydraulic excavators 1 and to make the revolving frame 50 of the one hydraulic excavator 1 larger or smaller than the revolving frame 50 of the other hydraulic excavator 1.

[0057] As described above, since the first block 61 can be shared by the revolving frames 50 having different sizes, it is not necessary to prepare the swing support portion 51 and the revolving-bearing support portion 53 for each of the revolving frames 50 having different sizes and to join (for example, to weld) the swing support portion 51 and the revolving-bearing support portion 53. Therefore, it is possible to avoid an increase in the number of types of the swing support portion 51 and the revolving-bearing support portion 53 correspondingly to the revolving frames 50 having different sizes. As a result, the manufacturing cost of the revolving frame 50 can be reduced. In addition, since the first block 61 is a casting, a process of welding the swing support portion 51 and the revolving-bearing support portion 53 is not required, and the manufacture of the first block 61 is facilitated.

[0058] From the viewpoint of improving the strength (particularly, bending rigidity in the up-down direction) of a range from the swing support portion 51 to the revolving-bearing support portion 53, as shown in FIG. 6, it is desirable that the first block 61 has a pair of vertical plates 61a (the first vertical plate 61a1 and the second vertical plate 61a2 in this embodiment) connected to the swing support portion 51 and the revolving-bearing support portion 53.

[0059] From the viewpoint of having the size of the revolving frames 50 different for each of the revolving frames 50 while sharing the first block 61, it is desirable that the revolving frame 50 includes the second block 62 and the third block 63 different from the first block 61 as shown in FIGS. 4 and 9. In addition, it is desirable that spaces located on the left and right sides of the first block 61 are effectively used as disposition spaces for devices (for example, the control valve, the hydraulic oil tank and the like described above) disposed in the upper revolving body 4. From this viewpoint, as shown in FIG. 4, it is desirable that the second block 62 is located on one side (the left side in this embodiment) in the left-right direction (the width direction) with respect to the first block 61, and the third block 63 is located on the other side (the right side in this embodiment) in the left-right direction.

[0060] It is desirable to improve the strength (particularly, bending rigidity in the up-down direction) of the range from the first block 61 to the second block 62 and the third block 63. From this viewpoint, as shown in FIGS. 4 and 7, it is desirable that the second block 62 and the third block 63 have a reinforcing plate (the first reinforcing plate 62b and the second reinforcing plate 63b in this embodiment), respectively, connected to either one of the pair of vertical plates 61a (the first vertical plate 61a1 and the second vertical plate 61a2). In particular, it is desirable to improve the strength of the revolving frame 50 in one direction (the front-back direction in this embodiment) in which the revolving-bearing support portion 53 is aligned with respect to the swing support portion 51. Therefore, as shown in FIG. 7, it is

desirable that the reinforcing plates (the first reinforcing plate 62b and the second reinforcing plate 63b) extend from one side to the other side in the one direction.

[0061] From the viewpoint of increasing the rigidity of the revolving frame 50 in the right-left direction, it is desirable that the revolving frame 50 includes the beam member 56 connected to the second block 62 and the third block 63 located on the lateral sides of the revolving frame 50. Further, when the counterweight mounting portion 55 is provided on the beam member 56, the number of components constituting the revolving frame 50 is reduced as compared with a case where a dedicated component for mounting the counterweight 43 is provided. As a result, an increase in the manufacturing cost of the revolving frame 50 can be avoided. Therefore, as shown in FIG. 5, it is desirable that the beam member 56 has the counterweight mounting portion 55 for mounting the counterweight 43.

[0062] When the beam member 56 is connected particularly to each of the reinforcing plates (the first reinforcing plate 62b and the second reinforcing plate 63b) of the second block 62 and the third block 63, the swing support portion 51, the pair of vertical plates 61a, each of the aforementioned reinforcing plates, and the beam member 56 constitute a support structure having a frame shape on a plan view, and the revolving frame 50 is reinforced. From the viewpoint of further improving the strength of the revolving frame 50 with a small number of components, it is desirable that the beam member 56 is connected to each of the reinforcing plates (first reinforcing plate 62b and second reinforcing plate 63b) as shown in FIG. 4.

[0063] Even in the configuration in which the revolving frame 50 has the revolving-motor support portion 54, it is desirable to avoid an increase in the number of types of the revolving-motor support portion 54 correspondingly to the revolving frames 50 having different sizes. From this viewpoint, as shown in FIGS. 4 and 6, it is desirable that the first block 61 shared by the plurality of revolving frames 50 has the revolving-motor support portion 54.

[4 Internal Configuration of Swing Support Portion]

[0064] An internal configuration of the swing support portion 51 included in the first block 61 will be explained with reference to FIGS. 11, 12, and 13. FIG. 11 is a perspective view from lower left illustrating a configuration of the swing support portion 51. FIG. 12 is a perspective view from front left illustrating a vicinity of a front end part of the revolving frame 50 (that is, the swing support portion 51 in FIG. 1 in an enlarged manner. FIG. 13 is a perspective view from front left by omitting illustration of a first hydraulic pipe 73a included in a hydraulic pipe 73, which will be described later, in FIG. 12. In FIGS. 12 and 13, the lower traveling body 2, the boom cylinder 31a and the like are not shown for convenience.

[0065] As shown in FIG. 11, the swing support portion 51 includes an upper wall portion 51c, a lower wall portion 51d, and a rear wall portion 51e. The rear wall portion 51e is constituted by extending in the up-down direction. The rear wall portion 51e is provided with an opening portion 51e1 penetrating in the front-back direction. The upper wall portion 51c extends forward continuously from an upper end part of the rear wall portion 51e horizontally. The aforementioned first coupling hole 51a is provided in the front side of the upper wall portion 51c. The lower wall portion 51d extends forward continuously from a lower end part of the rear wall portion 51e horizontally. The aforementioned second coupling hole 51b is provided in the front side of the lower wall portion 51d. Therefore, the upper wall portion 51c and the lower wall portion 51d are provided so as to protrude forward from the rear wall portion 51e. Note that a space located in front of the rear wall portion 51e and between the upper wall portion 51c and the lower wall portion 51d (overlapping both the upper wall portion 51c and the lower wall portion 51d on a plan view) is referred to as an inside 51IN of the swing support portion 51.

[0066] A fixing portion 51f is provided on a lower surface portion of the upper wall portion 51c by protruding downward. The fixing portion 51f is disposed closer to the coupling portion between the upper wall portion 51c and the rear wall portion 51e. Moreover, a lower end part of the fixing portion 51f is located above the lower wall portion 51d. Therefore, the fixing portion 51f is located in front of the rear wall portion 51e and between the upper wall portion 51c and the lower wall portion 51d. That is, the fixing portion 51f is located in the inside 51IN of the swing support portion 51. Therefore, the fixing portion 51f is less likely contaminated with earth and sand or the like.

[0067] As shown in FIGS. 12 and 13, a support member 71 is mounted on the fixing portion 51f. More specifically, the support member 71 is formed by bending rearward an upper end part of a plate-shaped member made of metal extending in the up-down direction. An upper end part of the support member 71 is fixed to the fixing portion 51f by a bolt (not shown). The support member 71 may be fixed to the fixing portion 51f by welding or the like. Since the support member 71 is located below the fixing portion 51f, the support member 71 is disposed in the inside 51IN of the swing support portion 51. Therefore, the support member 71 is less likely contaminated by earth and sand or the like.

[0068] In particular, as shown in FIG. 13, in the support member 71, a plurality of support holes 71a penetrating in the front-back direction are provided. A plurality of joint portions 72 are inserted into and fixed to some of the plurality of support holes 71a. That is, the support member 71 supports the plurality of joint portions 72. Note that the support holes 71a of the support member 71 may be provided correspondingly to the number of the joint portions 72. That is, it may be so configured that the joint portions 72 are inserted into all of the plurality of support holes 71a.

[0069] As shown in FIG. 12, the plurality of hydraulic pipes 73 (a first hydraulic pipe 73a and a second hydrau-

lic pipe 73b) are connected to the plurality of joint portions 72. The first hydraulic pipe 73a and the second hydraulic pipe 73b are caused to communicate with each other by the joint portion 72.

[0070] One end part of the first hydraulic pipe 73a is connected to the front side of the joint portion 72. The first hydraulic pipe 73a extends from the joint portion 72 toward the boom 31 through the inside 51IN (in particular, a front side of the inside 51IN) of the swing support portion 51 and the inside of the swing bracket 41. Thereafter, the first hydraulic pipe 73a extends inside the boom 31, and the other end part thereof is connected to either one of the arm cylinder 32a and the bucket cylinder 33a (for both, see FIG. 1).

[0071] One end part of the second hydraulic pipe 73b is connected to the rear side of the joint portion 72. The second hydraulic pipe 73b extends rearward from the joint portion 72 through the inside 51IN (in particular, a rear side of the inside 51IN) of the swing support portion 51 and the opening portion 51e1 provided in the rear wall portion 51e of the swing support portion 51. The other end part of the second hydraulic pipe 73b is connected to hydraulic equipment (not shown) disposed on the rear of the rear wall portion 51e inside the upper revolving body 4. The aforementioned hydraulic equipment includes the control valve and the like described above. As described above, the hydraulic pipe 73 is provided by extending toward the boom 31 (work machine 3) through the inside 51IN of the swing support portion 51.

[0072] The first hydraulic pipe 73a and the second hydraulic pipe 73b are constituted by hydraulic hoses. Note that the first hydraulic pipe 73a and the second hydraulic pipe 73b may be constituted by, for example, a metal pipe, but the first hydraulic pipe 73a is preferably formed of a bendable hydraulic hose because the first hydraulic pipe 73a passes through the inside of the swing bracket 41 and the vicinity of the base end part of the boom 31.

[0073] In the configuration in which the swing support portion 51 has the fixing portion 51f in the inside 51IN, the support member 71 is fixed to the fixing portion 51f, and the support member 71 supports the joint portion 72 of the hydraulic pipe 73, even when the hydraulic pipe 73 extending toward the work machine 3 passes through the inside 51IN of the swing support portion 51, the hydraulic pipe 73 is stably supported via the joint portion 72. That is, from the viewpoint of realizing stable support for the hydraulic pipe 73, the aforementioned configuration in which the support member 71 supports the joint portion 72 in the inside 51IN of the swing support portion 51 is preferable.

[5. Supplementary Description]

[0074] In this embodiment, the configuration in which the swing cylinder 41a is disposed on the right end side of the swing bracket 41 (see FIG. 2) has been explained, but the disposed position of the swing cylinder 41a is not limited to the above. For example, the swing cylinder 41a may be disposed on the left end side of the swing bracket 41.

[0075] In this embodiment, the configuration in which the first bottom plate 62a and the first reinforcing plate 62b are joined by welding in the second block 62 has been explained, but the first bottom plate 62a and the first reinforcing plate 62b may be connected by another method. For example, the first bottom plate 62a and the first reinforcing plate 62b may be connected by a fastening member such as a bolt. The same applies to the third block 63.

[0076] In this embodiment, the configuration in which the revolving frame 50 includes the connecting member 64 (see FIG. 4) and the configuration excluding the connecting member 64 (see FIG. 9) have been explained, but the connecting member 64 may be provided as necessary. When the connecting member 64 is provided at the rear part of the revolving frame 50, rigidity of the rear part of the revolving frame 50 in the left-right direction is increased. Therefore, particularly in the revolving frame 50 which is longer in the front-back direction shown in FIG. 4 and the like, a configuration including the connecting member 64 is preferable.

[0077] The hydraulic excavator 1 may be configured to drive the hydraulic pump HP by using an electric motor instead of the engine EG (for example, an electric excavator).

[0078] In this embodiment, the crawler-type hydraulic excavator 1 has been explained as an example of the work machine, but the work machine is not limited to the crawler-type hydraulic excavator 1 and may be a construction machine such as the hydraulic excavator 1 (wheel excavator) in which the lower traveling body 2 has wheels (tires).

[6. Supplementary Notes]

[0079] The hydraulic excavator 1 and the revolving frame 50 explained in this embodiment can also be expressed as a work machine and a revolving frame as illustrated in the following Supplementary Notes.

[0080] A revolving frame of a work machine in the Supplementary Note 1 is a revolving frame of a work machine, including:

a revolving-bearing support portion which supports a revolving bearing; and
a swing support portion which swingably supports the work machine in a width direction of a machine body,
including a first block, and
the first block being a casting integrally having the revolving-bearing support portion and the swing support portion.

[0081] The revolving frame of the work machine in the Supplementary Note (2) is characterized in that, in the

revolving frame of the work machine in the Supplementary Note (1),

[0082] the first block has a pair of vertical plates; and the pair of vertical plates are connected to the swing support portion and the revolving-bearing support portion.

[0083] The revolving frame of a work machine in the Supplementary Note (3) includes, in the revolving frame of the work machine in the Supplementary Note (2),

a second block located on one side in the width direction with respect to the first block and
a third block located on the other side in the width direction with respect to the first block.

[0084] The revolving frame of the work machine in the Supplementary Note (4) is characterized in that, in the revolving frame of the work machine in the Supplementary Note (3),

the second block and the third block respectively have a reinforcing plate connected to either one of the pair of vertical plates, respectively,
the revolving-bearing support portion is disposed by being aligned in one direction with respect to the swing support portion, and
each of the reinforcing plates extends from one side to the other side in the one direction.

[0085] The revolving frame of the work machine in the Supplementary Note (5) includes, in the revolving frame of the work machine in the Supplementary Note (4),

a beam member connected to the second block and the third block, in which
the beam member has a counterweight mounting portion for mounting a counterweight.

[0086] The revolving frame of the work machine in the Supplementary Note (6) is characterized in that, in the revolving frame of the work machine in the Supplementary Note (5),
the beam member is coupled with each of the reinforcing plates.

[0087] The revolving frame of the work machine in the Supplementary Note (7) is characterized in that, in the revolving frame of the work machine in any one of the Supplementary Notes (1) to (6),
the first block has a revolving-motor support portion that supports a revolving motor.

[0088] The revolving frame of a work machine in the Supplementary Note (8) is characterized in that, in the revolving frame of the work machine in any one of the Supplementary Notes (1) to (7),

the swing support portion has a fixing portion therein,
a support member is fixed to the fixing portion, and
the support member supports a joint portion of a hydraulic pipe extending through the inside of the swing support portion toward the work machine.

[0089] The work machine in the Supplementary Note (9) includes a traveling body and

the machine body provided to be revolvable with respect to the traveling body, in which
the machine body includes the revolving frame in any one of the Supplementary Notes (1) and (8).

[0090] The embodiments of the present invention have been explained above, but the scope of the present invention is not limited thereto, and can be worked with expansion or modification within a range not departing from the gist of the invention.

INDUSTRIAL APPLICABILITY

[0091] The present invention is applicable to work machines such as a construction machine, for example.

REFERENCE SIGNS LIST

[0092]

1 Hydraulic excavator (work machine)
2 Lower traveling body (traveling body)
3 Work machine
4 Upper revolving body (machine body)
42 Revolving bearing
43 Counterweight
44 Revolving motor
50 Revolving frame
51 Swing support portion
51f Fixing portion
51IN Inside
53 Revolving-bearing support portion
54 Revolving-motor support portion
55 Counterweight mounting portion
56 Beam member
61 First block
61a Vertical plate
62 Second block
62b First reinforcing plate (reinforcing plate)
63 Third block
63b Second reinforcing plate (reinforcing plate)
71 Support member
72 Joint portion
73 Hydraulic pipe

Claims

1. A revolving frame of a work machine, comprising a revolving-bearing support portion which supports a revolving bearing and a swing support portion which swingably supports the work machine in a width

direction of a machine body, the revolving frame comprising a first block, and the first block being a casting integrally having the revolving-bearing support portion and the swing support portion.

2. The revolving frame of the work machine according to claim 1, wherein the first block has a pair of vertical plates and the pair of vertical plates are connected to the swing support portion and the revolving-bearing support portion.

3. The revolving frame of the work machine according to claim 2, further comprising a second block located on one side in the width direction with respect to the first block and a third block located on the other side in the width direction with respect to the first block.

4. The revolving frame of the work machine according to claim 3, wherein the second block and the third block respectively have a reinforcing plate connected to either one of the pair of vertical plates, respectively, the revolving-bearing support portion is disposed by being aligned in one direction with respect to the swing support portion, and each of the reinforcing plates extends from one side to the other side in the one direction.

5. The revolving frame of the work machine according to claim 4, further comprising a beam member connected to the second block and the third block, wherein the beam member has a counterweight mounting portion for mounting a counterweight.

6. The revolving frame of the work machine according to claim 5, wherein the beam member is connected to each of the reinforcing plates.

7. The revolving frame of the work machine according to any one of claims 1 to 6, wherein the first block has a revolving-motor support portion that supports a revolving motor.

8. The revolving frame of the work machine according to any one of claims 1 to 7, wherein the swing support portion has a fixing portion inside, a support member is fixed to the fixing portion, and the support member supports a joint portion of a hydraulic pipe extending through the inside of the swing support portion toward the work machine.

9. A work machine comprising a traveling body and the machine body provided to be revolvable with respect to the traveling body, wherein the machine body includes the revolving frame according to any one of claims 1 to 8.

FIG. 1

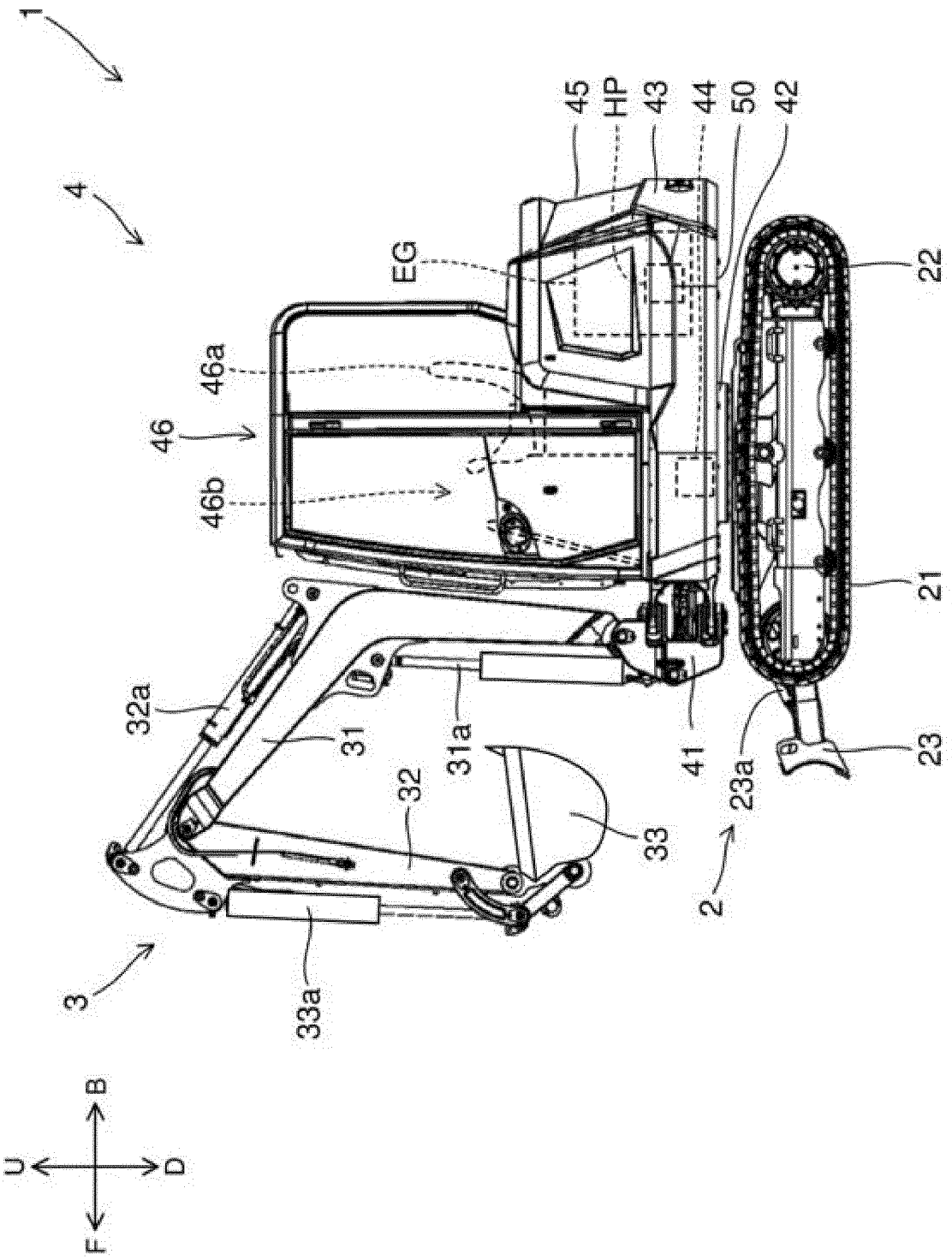
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FIG. 2

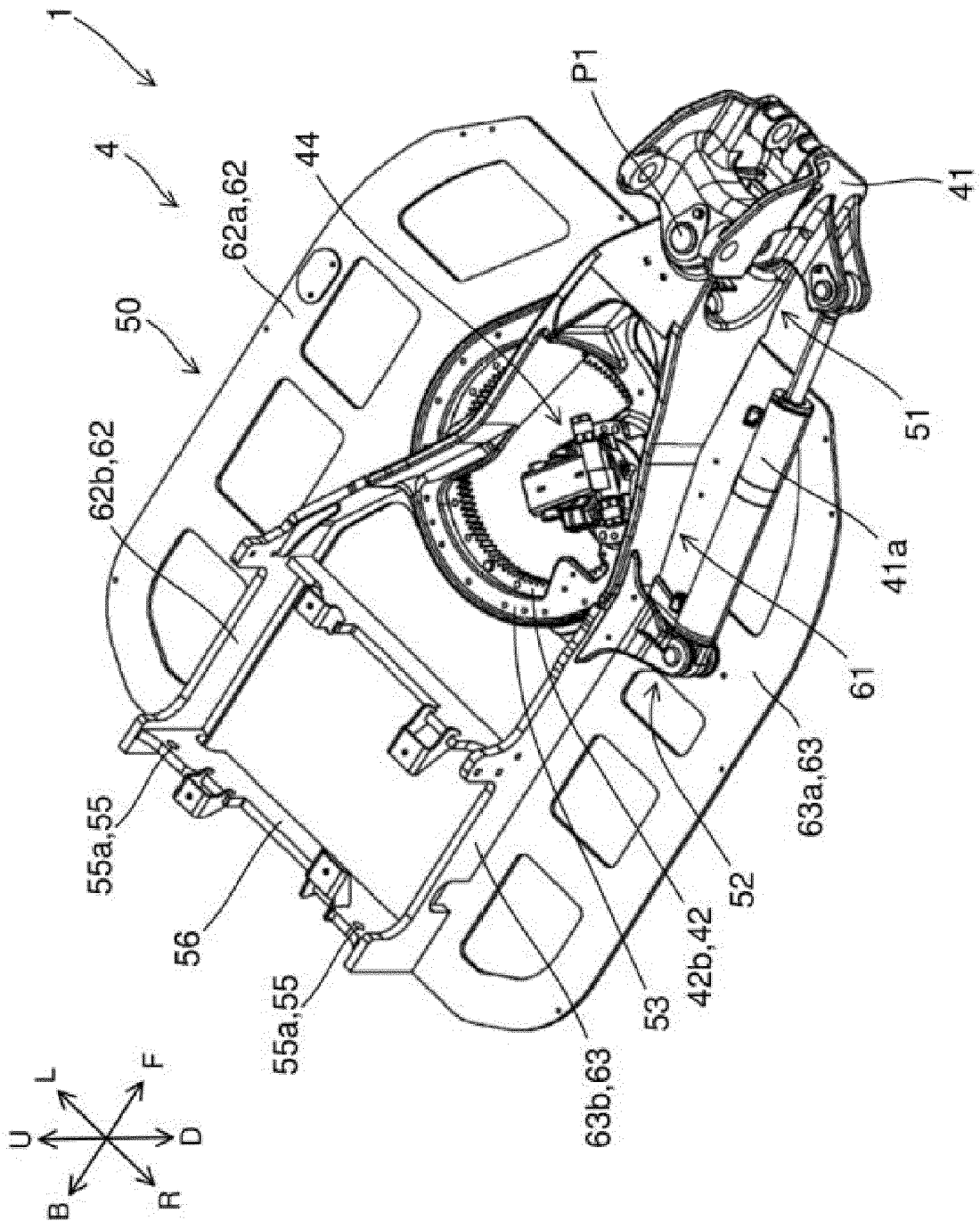
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FIG. 3

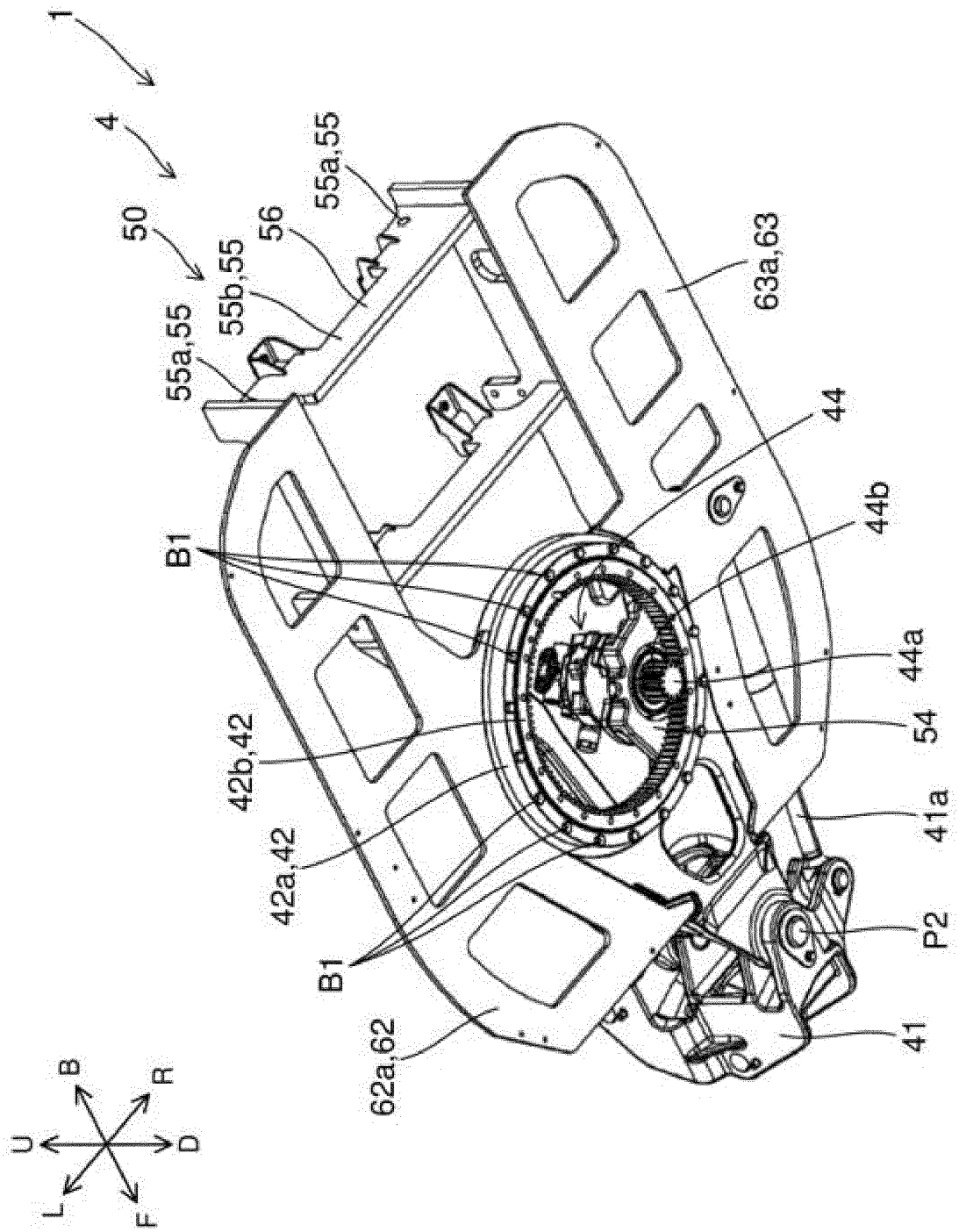
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FIG. 4

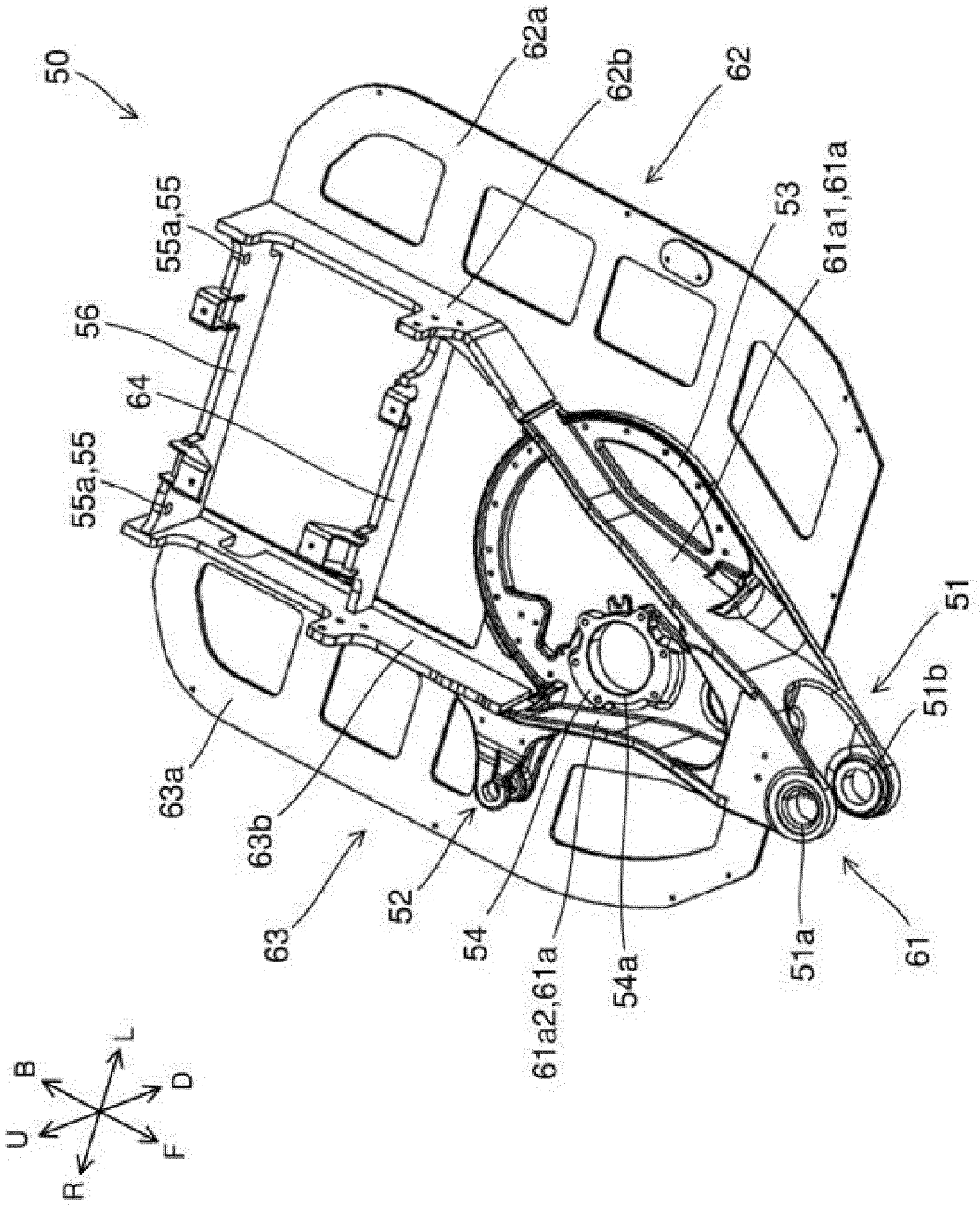
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FIG. 5

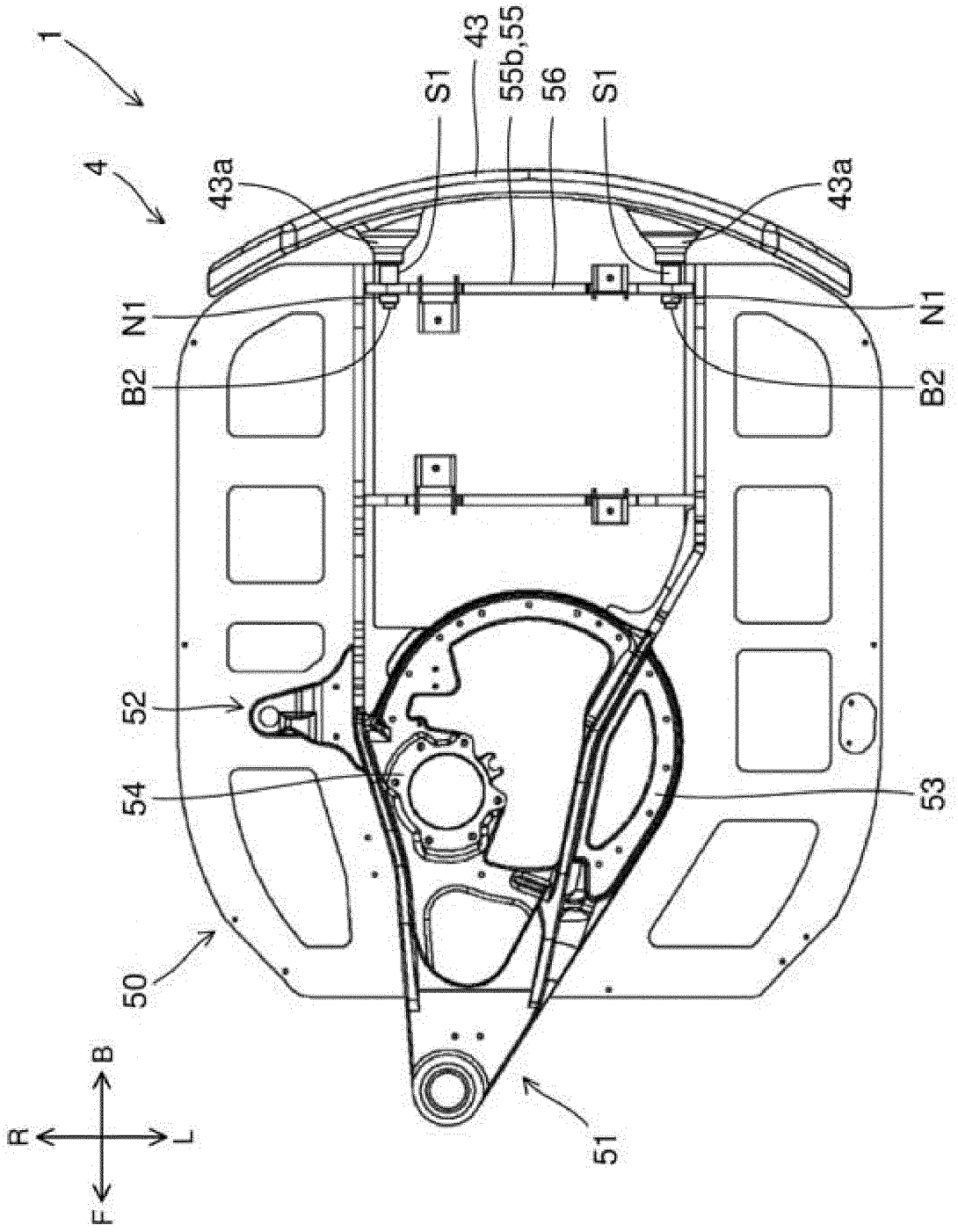

FIG. 6

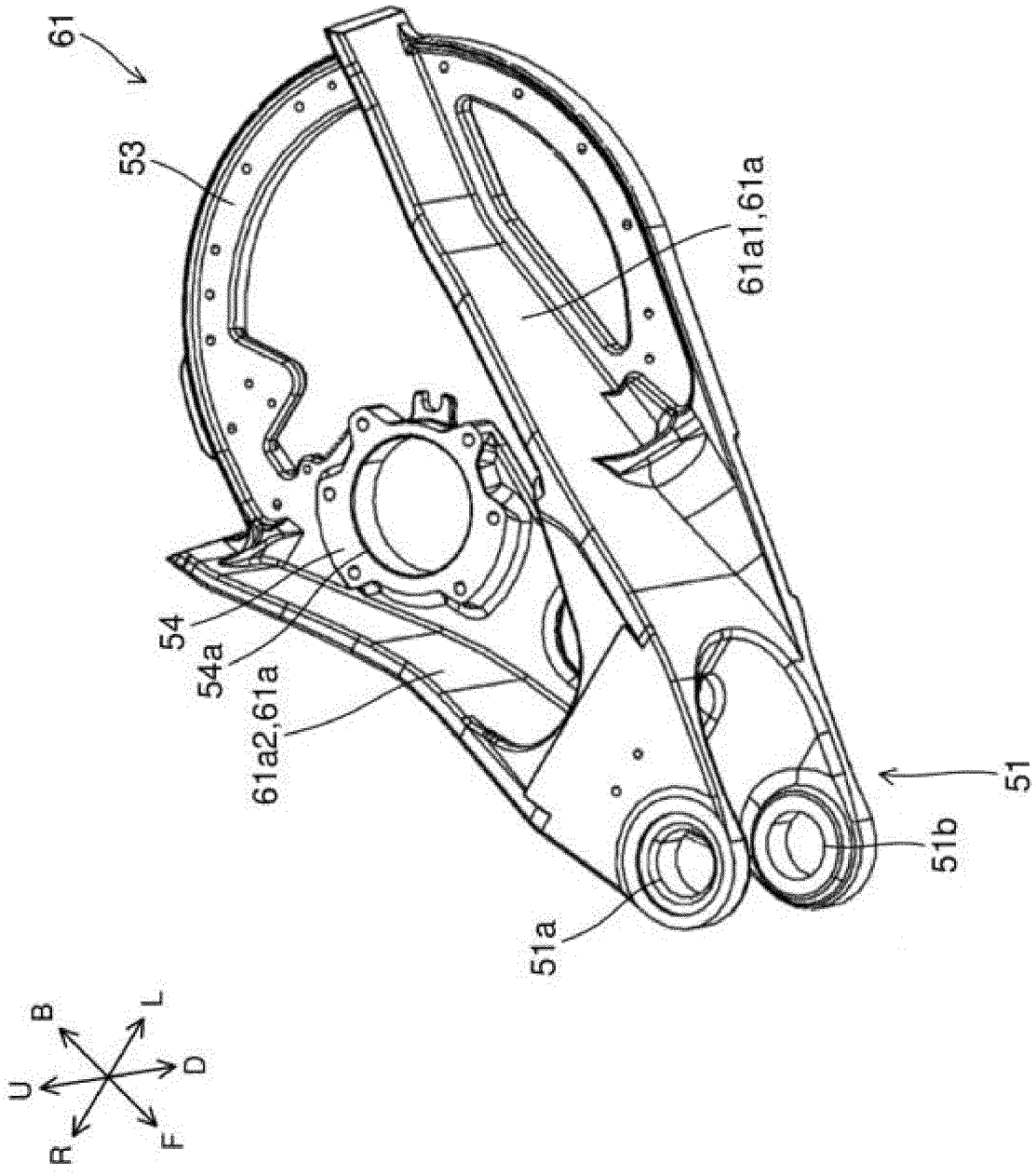

FIG. 7

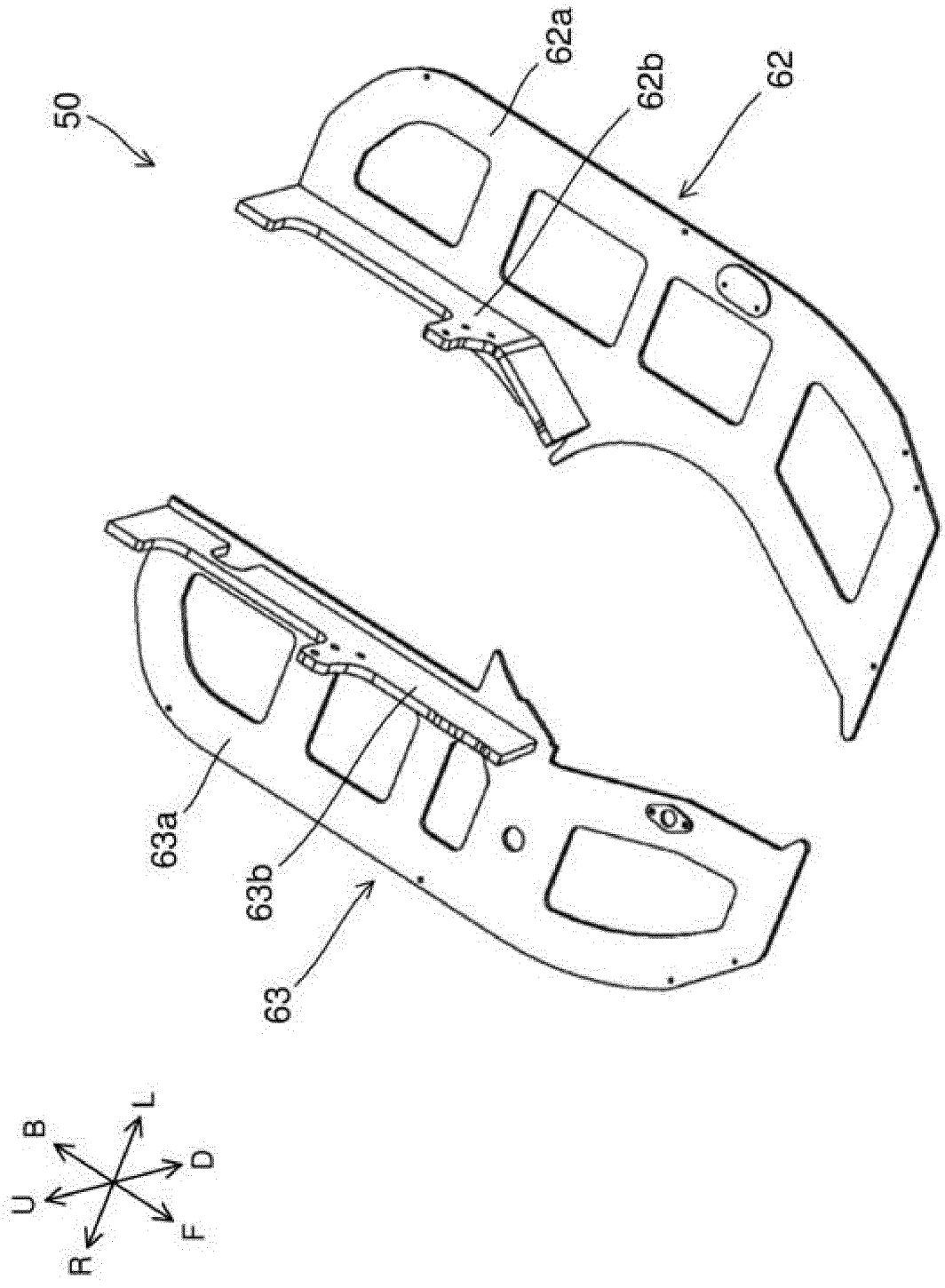

FIG. 8

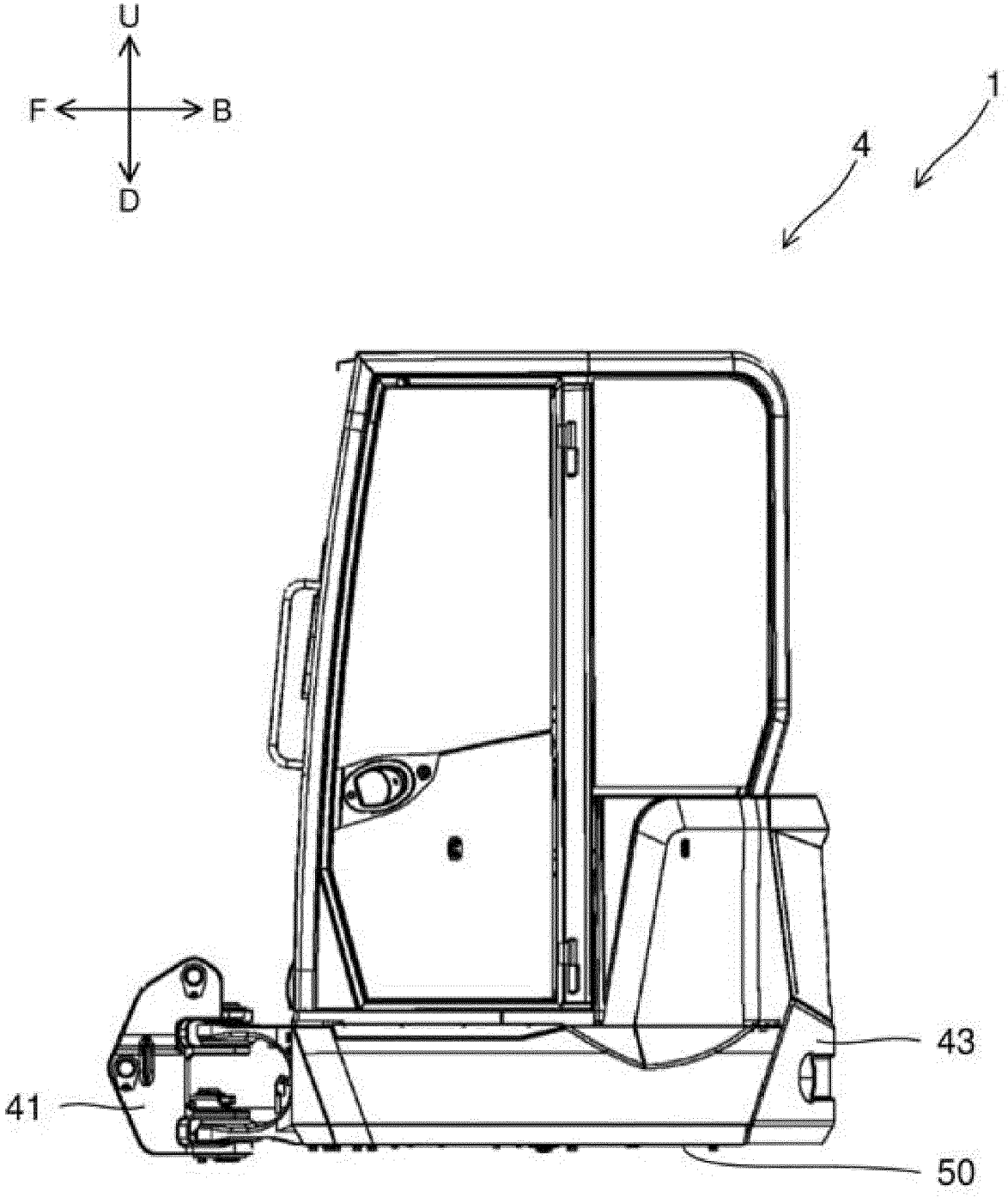

FIG. 9

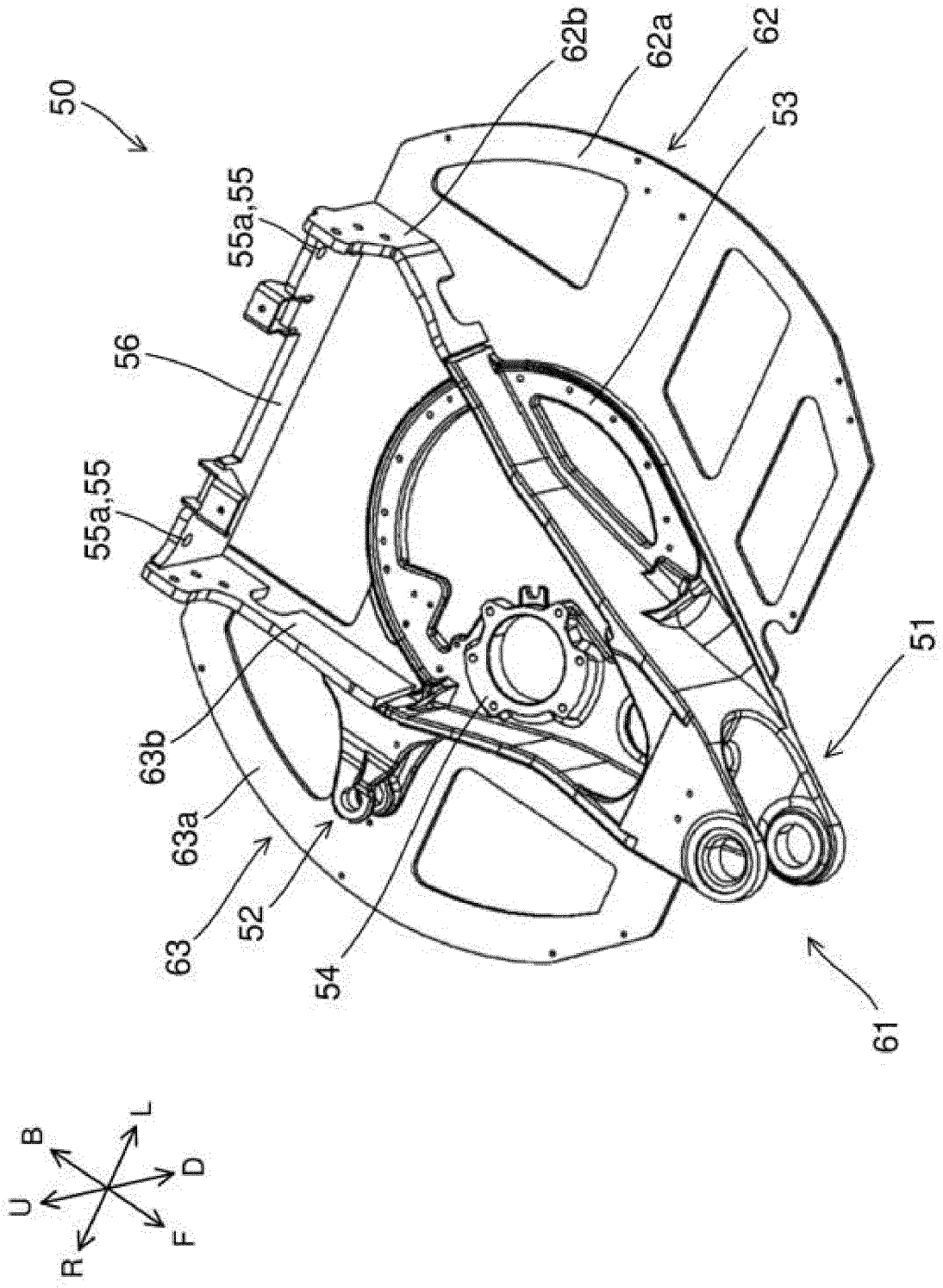

FIG. 10

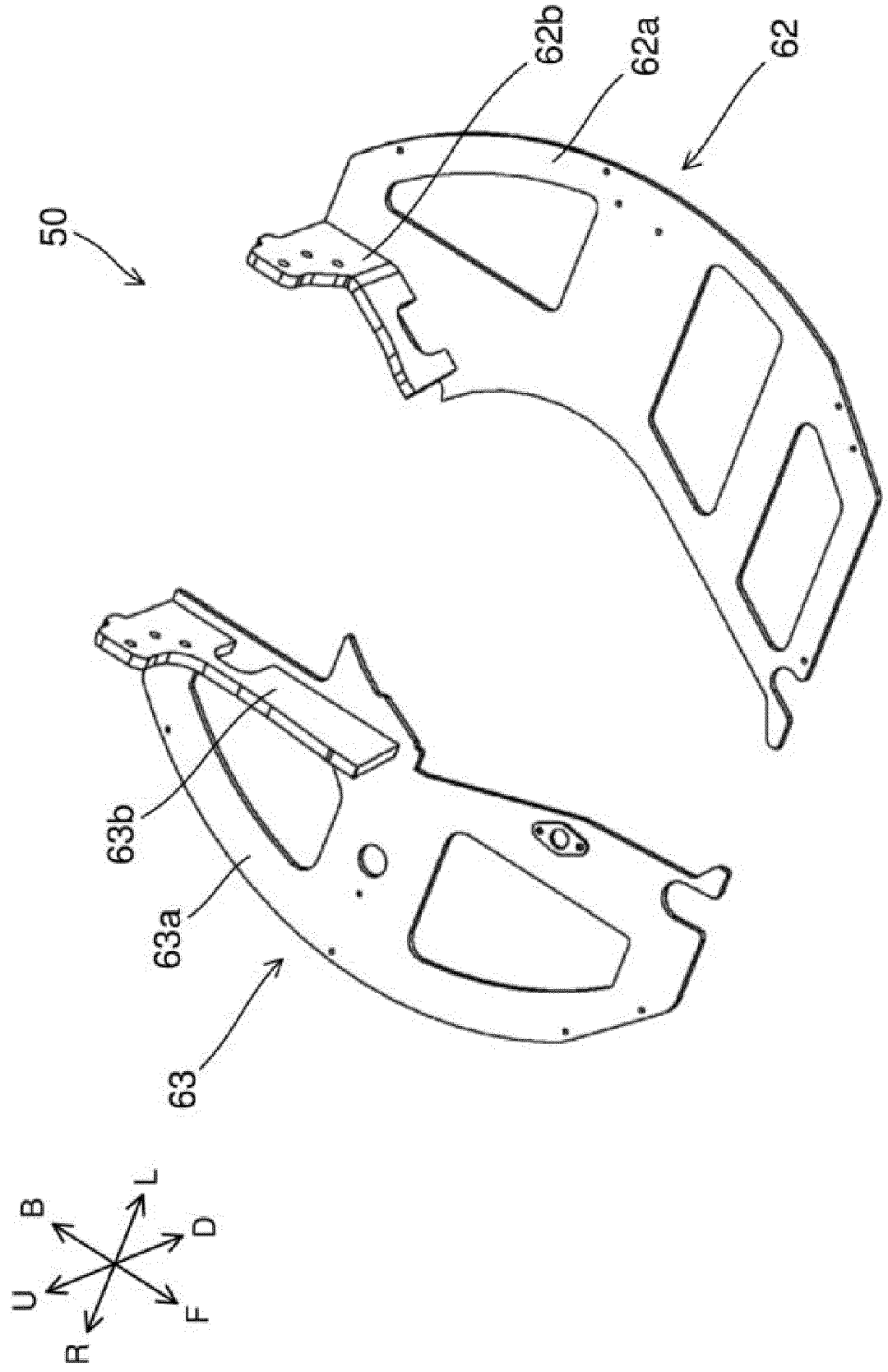

FIG. 11

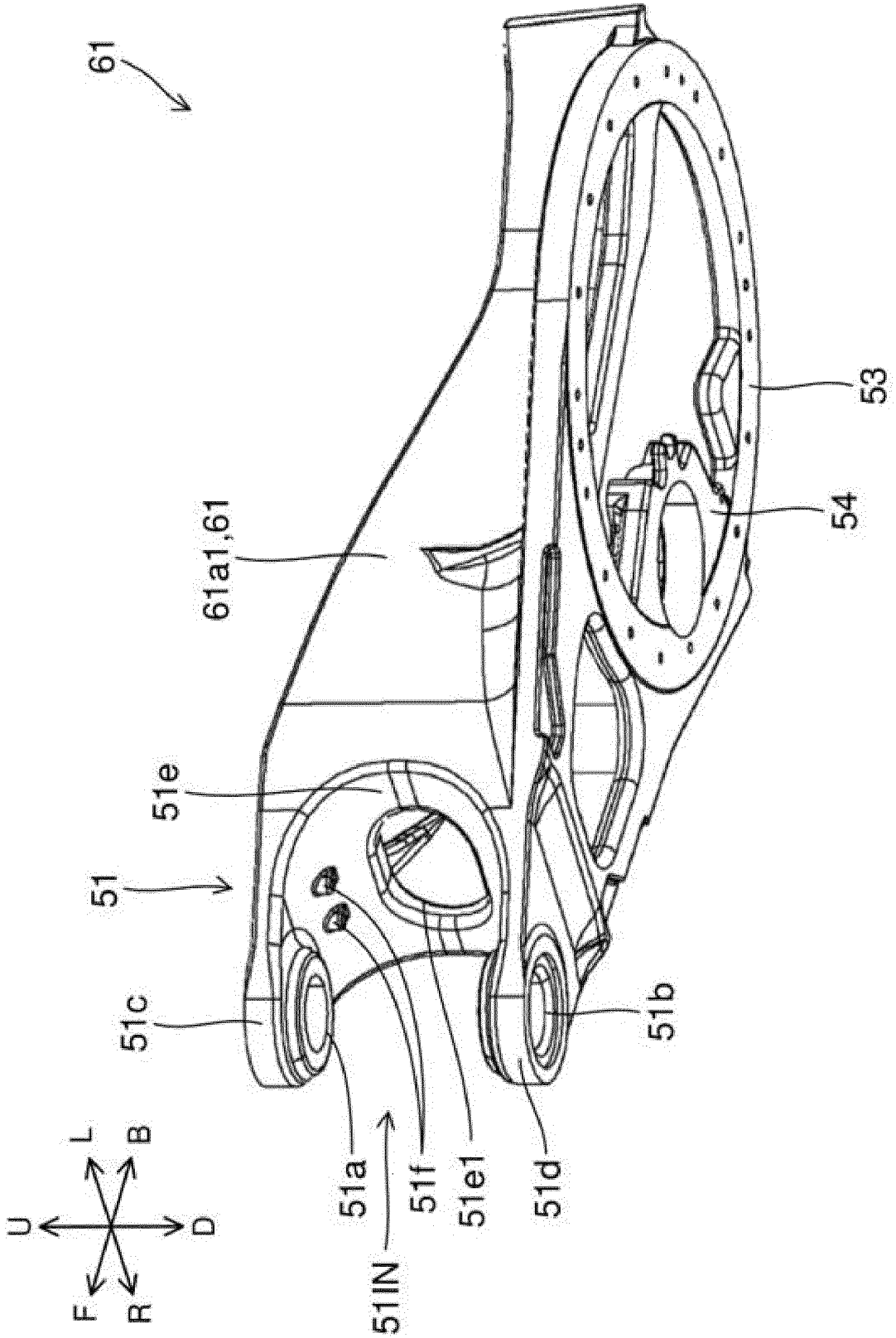

FIG. 12

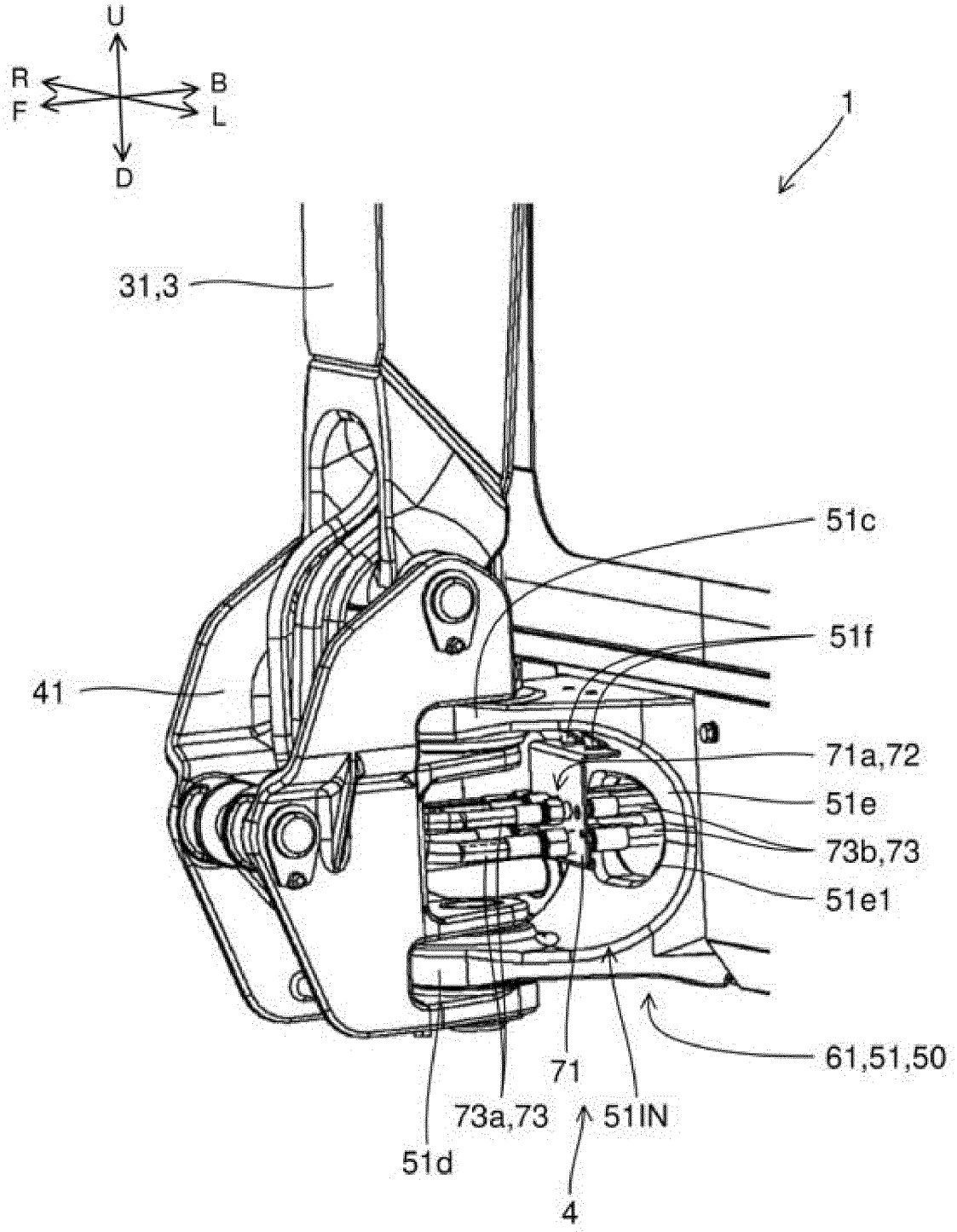
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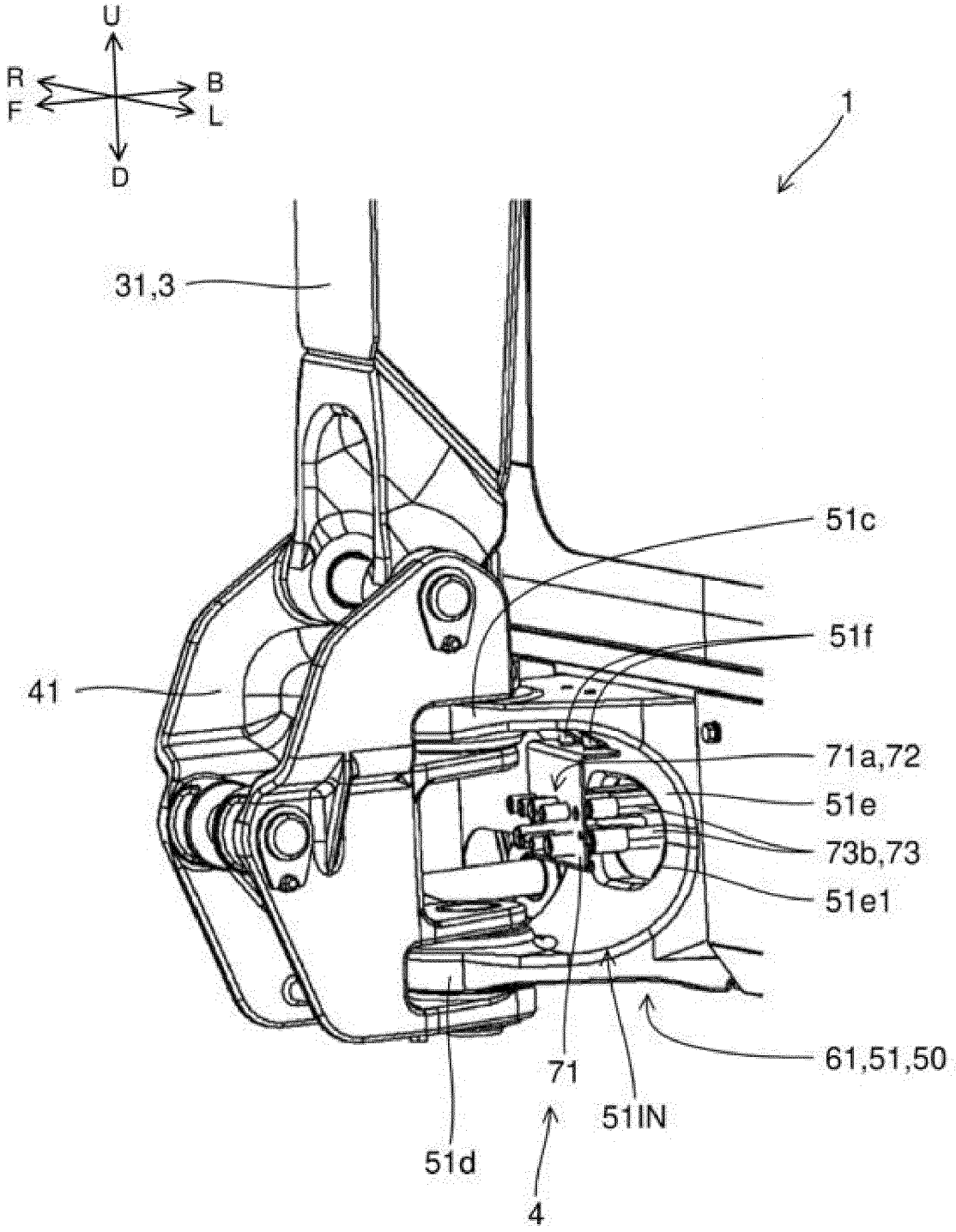
FIG. 13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51IN
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EUROPEAN SEARCH REPORT

Application Number
EP 23 20 1140

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A	* paragraphs [0036] - [0042], [0048] - [0050]; figures 2,3 *	4-6,8	
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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	19 February 2024	Dreyer, Christoph

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19-02-2024

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