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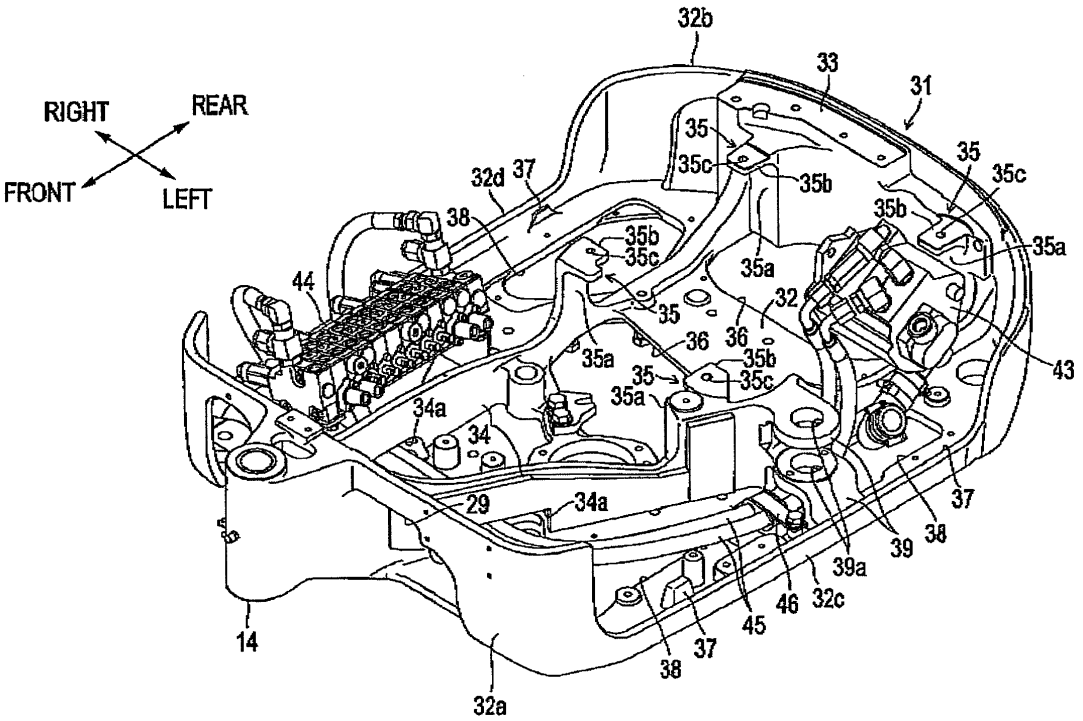
(54) **Frame structure of construction machine**

(57) A rotating frame (31) and a reinforcing rib (34) which stands upright on a bottom plate (32) of the rotating frame and extends in a front-rear direction are formed integrally with each other by casting. A tube insertion hole (34a) is formed in a base portion of the reinforcing rib (34) in a standing direction thereof such that the tube insertion hole (34a) extends through the base portion of the reinforcing rib in a thickness direction thereof. A communication hole (34b) which communicates with the tube insertion hole (34a) is formed in the bottom plate (32) of the rotating frame (31) such that the communication hole (34b) extends through the bottom plate of the rotating frame in a thickness direction thereof at a position corresponding to the tube insertion hole (34a).

FIG. 3



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Description

BACKGROUND OF THE INVENTION

1. Field of the Invention

[0001] The present invention relates to a frame structure of a construction machine.

2. Description of the Related Art

[0002] A construction machine, such as a hydraulic excavator, including a crawler-type lower travelling body, an upper rotating body mounted on the lower travelling body such that the upper rotating body is rotatable, and a working attachment provided on a front section of the upper rotating body is known (see, for example, Japanese Unexamined Patent Application Publication No. 2001-107388). A rotating frame is disposed in a lower section of the upper rotating body. The rotating frame functions as a support structure on which an engine, a hydraulic pump, a driver's seat, a counterweight, etc., are mounted. The rotating frame includes a flat bottom plate and reinforcing ribs wielded to the bottom plate at left and right sides of a central section of the bottom plate in a width direction thereof, and has sufficient strength and rigidity against an excavation load applied in an excavation process.

[0003] If the thickness of the bottom plate of the rotating frame is small, there is a risk that welding deformation will occur in the process of welding the reinforcing ribs to the bottom plate. To prevent this, Japanese Unexamined Patent Application Publications Nos. 2005-2572 and 2007-303129, for example, disclose a frame structure in which the rotating frame and the reinforcing ribs are integrally formed by casting to provide sufficient strength and rigidity.

[0004] In the frame structure of the construction machine according to the related art, a hydraulic tube which connects the hydraulic pump to a control valve and a pilot tube which connects an operation lever to the control valve are disposed such that the tubes extend above the engine in an engine room.

[0005] However, when both the hydraulic tube and the pilot tube are disposed above the engine, the hydraulic tube and the pilot tube overlap each other and maintenance of the construction machine is hindered by the tubes. Thus, sufficient working space cannot be provided and the work efficiency is reduced. Therefore, the hydraulic tube and the pilot tube are preferably disposed at separate positions (for example, positions spaced from each other in the height direction).

[0006] In the frame structure of the construction machine according to the related art, reinforcing ribs are disposed at left and right sides of a central portion of the rotating frame in the width direction thereof. Therefore, in the case where, for example, the hydraulic pump and the control valve are disposed at opposite sides of the reinforcing ribs in the width direction of the rotating frame, the process of placing the hydraulic tube such that the hydraulic tube extends along the top surface of the bottom plate of the rotating frame is hindered by the reinforcing ribs.

[0007] Accordingly, tube insertion holes may be formed in the reinforcing ribs, so that the hydraulic tube can be inserted through the tube insertion holes. However, in the case where the rotating frame and the reinforcing ribs are formed integrally with each other by casting, it is difficult to form the tube insertion holes in the reinforcing ribs. In the frame structure according to the related art, cores are placed in a mold unit at positions corresponding to the tube insertion holes in the reinforcing ribs before molten metal is poured into the mold unit. Thus, the metal is prevented from flowing into the tube insertion holes. Then, the cores are removed after the casting process so that the tube insertion holes are formed. In this case, additional processes of placing and removing the cores are required, and the number of processes to be performed is increased.

[0008] The tube insertion holes may also be formed in the reinforcing ribs by machining after the rotating frame and the reinforcing ribs are formed integrally with each other by casting without using the cores. However, also in this case, the number of processes to be performed is increased.

SUMMARY OF THE INVENTION

[0009] An object of the present invention is to provide a frame structure of a construction machine in which tube insertion holes may be easily formed in reinforcing ribs without using cores in the process of forming the rotating frame and the reinforcing ribs integrally with each other by casting.

[0010] To achieve the above-described object, according to the present invention, the shape of the bottom plate of the rotating frame is designed such that the tube insertion holes can be easily formed in the reinforcing ribs without using cores in the casting process.

[0011] The present invention can be applied to a frame structure of a construction machine including a lower travelling body and an upper rotating body mounted on the lower travelling body such that the upper rotating body is rotatable.

[0012] According to the present invention, the frame structure includes a rotating frame disposed in a lower section of the upper rotating body and including a bottom plate and a reinforcing rib which stands upright on the bottom plate of the rotating frame and extends in a front-rear direction. The rotating frame and the reinforcing rib are formed integrally with each other by casting. A hydraulic pump and a control valve are disposed on the rotating frame at opposite sides of the reinforcing rib in a width direction of the rotating frame. The hydraulic pump ejecting working oil. The control valve is connected to the hydraulic pump by a hydraulic tube, and controls

an operation of supplying the working oil ejected from the hydraulic pump. A tube insertion hole through which the hydraulic tube extends is provided in a base portion of the reinforcing rib in a standing direction thereof such that the tube insertion hole extends through the base portion of the reinforcing rib in a thickness direction thereof. A communication hole which communicates with the tube insertion hole is provided in the bottom plate of the rotating frame such that the communication hole extends through the bottom plate of the rotating frame in a thickness direction thereof at a position corresponding to the tube insertion hole.

[0013] According to the present invention, the rotating frame is disposed in the lower section of the upper rotating body. The rotating frame is formed integrally with the reinforcing rib which stands upright on the bottom plate of the rotating frame and extends in the front-rear direction by casting. The tube insertion hole is formed in the base portion of the reinforcing rib in the standing direction thereof such that the tube insertion hole extends through the base portion of the reinforcing rib in the thickness direction thereof. In addition, the communication hole which communicates with the tube insertion hole is formed in the bottom plate of the rotating frame such that the communication hole extends through the bottom plate of the rotating frame in a thickness direction thereof at a position corresponding to the tube insertion hole. The hydraulic pump and the control valve are disposed on the rotating frame at opposite sides of the reinforcing rib in the width direction of the rotating frame. The hydraulic pump and the control valve are connected to each other by the hydraulic tube, and the hydraulic tube is inserted through the tube insertion hole in the reinforcing rib.

[0014] Thus, the tube insertion hole is formed in the base portion of the reinforcing rib in the standing direction thereof, and the communication hole which communicates with the tube insertion hole is formed in the bottom plate of the rotating frame. Therefore, the tube insertion hole can be formed without using a core in the process of forming the rotating frame and the reinforcing rib integrally with each other by casting.

[0015] In the frame structure according to the related art, a core is placed in a mold unit at a position corresponding to the tube insertion hole in the reinforcing rib before molten metal is poured into the mold unit. Thus, the metal is prevented from flowing into the tube insertion hole. Then, the core is removed after the casting process so that the tube insertion hole is formed. However, in this case, additional processes of placing and removing the core are required, and the number of processes to be performed is increased.

[0016] In contrast, according to the present invention, instead of placing the core at a position corresponding to the tube insertion hole in the reinforcing rib, a lower mold having a bulging portion at a position corresponding to the tube insertion hole is used. Therefore, after the molten metal is poured into a mold unit obtained by assembling an upper mold and the lower mold together, the upper and lower molds can be separated from each other in the vertical direction to release the rotating frame. At this time, the tube insertion hole and the communication hole are formed in the bottom plate of the rotating frame in an area corresponding to the bulging portion, and the upper and lower molds can be smoothly separated from each other. Therefore, it is not necessary to place or remove the core, and the process of forming the rotating frame and the reinforcing rib integrally with each other can be facilitated.

[0017] In addition, in the process of placing the hydraulic tube, which connects the hydraulic pump and the control valve to each other, such that the hydraulic tube extends along the top surface of the bottom plate of the rotating frame, the hydraulic tube can be viewed through the communication hole and can also be held through the communication hole. Therefore, the hydraulic tube can be easily inserted through the tube insertion hole. In addition, the hydraulic tube and other tubes, such as a pilot tube, can be arranged such that they are spaced from each other in the height direction. Therefore, the tubes can be prevented from overlapping each other and a sufficiently large working space can be provided for maintenance of the construction machine. As a result, the work efficiency can be improved.

[0018] In addition, according to the present invention, preferably, the frame structure further includes a front attachment provided in a front section of the rotating frame, a swing cylinder which swings the front attachment in a left-right direction, and a swing cylinder bracket which supports a base end portion of the swing cylinder such that the base end portion of the swing cylinder is rotatable. The swing cylinder bracket is positioned above the bottom plate of the rotating frame with a gap provided between the swing cylinder bracket and the bottom plate, and is formed integrally with the rotating frame by casting. The hydraulic tube extends through the gap. A through hole which communicates with the gap is provided in the bottom plate of the rotating frame such that the through hole extends through the bottom plate of the rotating frame in the thickness direction thereof at a position corresponding to the gap.

[0019] In this case, the front attachment is provided in the front section of the rotating frame. The front attachment is caused to swing in the left-right direction by the swing cylinder. The base end portion of the swing cylinder is supported by the swing cylinder bracket such that the base end portion of the swing cylinder is rotatable. The swing cylinder bracket is positioned above the bottom plate of the rotating frame with a gap provided therebetween, and is formed integrally with the rotating frame by casting. The hydraulic tube is inserted through the gap. The through hole which communicates with the gap is formed in the bottom plate of the rotating frame such that the through hole extends through the bottom plate of the rotating frame in the thickness direction thereof at a position corresponding to the gap.

[0020] Therefore, in the process of placing the hydraulic tube such that the hydraulic tube extends along the top surface of the bottom plate of the rotating frame, the hydraulic tube can be viewed through the through hole and can also be held through the through hole. As a result, the hydraulic tube can be easily inserted through the gap below the swing cylinder bracket.

BRIEF DESCRIPTION OF THE DRAWINGS

[0021]

Fig. 1 is a side view illustrating the structure of a construction machine according to an embodiment of the present invention;
Fig. 2 is a perspective view of an upper rotating body viewed from the rear;
Fig. 3 is a perspective view illustrating the structure of a rotating frame;
Fig. 4 is a plan view illustrating the structure of the rotating frame; and
Fig. 5 is a plan view of the rotating frame viewed from below.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0022] An embodiment of the present invention will be described in detail with reference to the drawings. The preferred embodiment described below is basically an example, and is not intended to limit the present invention, the applications thereof, or the uses thereof.

[0023] Fig. 1 is a side view illustrating the structure of a construction machine 1 according to the embodiment of the present invention, and Fig. 2 is a perspective view of an upper rotating body 30 viewed from the rear. As shown in Figs. 1 and 2, the construction machine 1 is a so-called mini excavator, which is a small, canopy-type excavator including a lower travelling body 20 to which crawlers 21 and 21 are attached and the upper rotating body 30 which is mounted on the lower travelling body 20 such that the upper rotating body 20 is rotatable.

[0024] The construction machine 1 is structured as an excavator with a short rear swing radius so that a rotation radius of a rear end of the upper rotating body 30 is substantially within the width of the lower travelling body 20.

[0025] The upper rotating body 30 includes a driving space A in which a driver's seat 5 and control boxes 6 are disposed. An engine housing space for housing an engine 40 is provided in a rear section of the driving space A, and is covered with an engine cover 22. The engine 40 is supported by supporting brackets 35, which will be described below, with engine mounts 41 interposed between the engine 40 and the supporting brackets 35. Thus, the engine 40 is attached to a rotating frame 31 disposed in a lower lection of the upper rotating body 30. The driver's seat 5, in which an operator sits, is provided on the engine cover 22. An equipment space for housing hydraulic devices is provided on the left side of the driver's seat 5, and is covered with a side cover 23. A fuel tank (not shown) is provided on the right side of the driver's seat 5, and is covered with another side cover 23.

[0026] An opening which functions as an entrance which allows the operator to get to the driver's seat 5 is provided in a left front section of the driving space A, and a floor F having an irregular surface is provided to prevent slipping and to allow the operator to scrape off the dirt on the bottom of the shoes.

[0027] A swing post 14 to which a front attachment 10 is attached such that the front attachment 10 can be replaced depending on the operation to be performed is provided at the front section of the upper rotating body 30. A swing bracket 15 capable of pivoting the front attachment 10 about a vertical shaft 14a is connected to the swing post 14.

[0028] The front attachment 10 includes a boom 11, an arm 12, a bucket 13, and also includes a boom cylinder 11a, an arm cylinder 12a, and a bucket cylinder 13a for driving the boom 11, the arm 12, and the bucket 13, respectively. The boom 11 is connected to the swing bracket 15 at a base end thereof. The boom 11 can be moved so as to pivot forward and downward or upward toward the driver's seat 5 by extending or contracting the boom cylinder 11a. The swing bracket 15 can be moved so as to swing leftward or rightward by extending or contracting a swing cylinder 15a (see Fig. 4).

[0029] The control boxes 6, which are used for performing various control operations, are provided on the left and right sides of the driver's seat 5. Operation levers 7 used to operate the front attachment 10 are provided at front ends of the control boxes 6.

[0030] Operation levers 8 which project upward from the floor F of the upper rotating body 30 are disposed in front of the driver's seat 5. The lower travelling body 20 can be moved forward or backward by operating the operation levers 8. A lower front guard 9 for protecting a lower section of the driver's seat 5 is disposed in front of the movable areas of the operation levers 8.

[0031] A front canopy column 25, a rear canopy column 26, and a side canopy column 27 are provided so as to surround the driver's seat 5 at a right front position, a right rear position, and a left side position (side at which the entrance is provided), respectively, of the driver's seat 5. A roof 28 for protecting the operator from falling objects is attached to the front canopy column 25, the rear canopy column 26, and the side canopy column 27 at the top ends thereof. Thus, the roof 28 is supported above the driver's seat 5.

[0032] The structure of the rotating frame 31 disposed in a lower lection of the upper rotating body 30 will now be described. The rotating frame 31 is a characteristic part of the present invention. Figs. 3 and 4 are a perspective view and a plan view, respectively, illustrating the structure of the rotating frame 31. Fig. 5 is a plan view of the rotating frame 31 viewed from below.

[0033] As shown in Figs. 3 to 5, the rotating frame 31 is a support structure on which the engine 40, a hydraulic

pump 43, a control valve 44, etc., are mounted. The engine 40 serves as a drive source. The hydraulic pump 43 ejects working oil, and the control valve 44 controls an operation of supplying the working oil ejected from the hydraulic pump 43. The rotating frame 31 is obtained by integrally casting a flat bottom plate 32, peripheral walls including a front wall 32a, a rear wall 32b, a left side wall 32c, and a right side wall 32d which respectively stand upright on the bottom plate 32 at the front, rear, left, and right sides thereof, and supporting brackets 35 which support the engine 40.

[0034] In the rotating frame 31, the heights of the front wall 32a and the rear wall 32b are larger than the heights of the left side wall 32c and the right side wall 32d. The swing post 14 to which the front attachment 10 can be connected is formed integrally with the front wall 32a at the front side thereof by casting. In addition, a cylinder insertion hole 29 is formed in the front wall 32a so as to extend through the front wall 32a in a thickness direction thereof at a position on the left of the swing post 14. An end portion of a rod of the swing cylinder 15a extends through the cylinder insertion hole 29.

[0035] A counterweight 33 is formed integrally with the rear wall 32b of the rotating frame 31 at the front side thereof by casting. The counterweight 33 is provided to achieve a good weight balance between the counterweight 33 and the front attachment 10, and is formed as a heavy, thick, plate-shaped body.

[0036] A swivel joint 50 is disposed at the center of rotation of the rotating frame 31. The swivel joint 50 is provided to connect hydraulic tubes 45 disposed in the upper rotating body 30 and the lower travelling body 20 to each other. The swivel joint 50 rotates in association with the rotation of the upper rotating body 30, so that the hydraulic tubes 45 can be held without being twisted.

[0037] Reinforcing ribs 34 stand upright on the bottom plate 32 of the rotating frame 31 at left and right sides of a central section of the bottom plate 32 in a width direction thereof. The reinforcing ribs 34 extend in different directions from an area near the swing post 14 on the front wall 32a toward the rear wall 32b. The reinforcing ribs 34 are formed integrally with the bottom plate 32 by casting, and ensure the strength and rigidity against an excavation load applied in an excavation process.

[0038] The reinforcing ribs 34 have tube insertion holes 34a which extend through the reinforcing ribs 34 in the thickness direction thereof. The tube insertion holes 34a are formed in base portions of the reinforcing ribs 34 in the standing direction thereof at positions near front ends of the reinforcing ribs 34. The tube insertion holes 34a allow the hydraulic tubes 45 which connect the hydraulic pump 43 and the control valve 44 to each other to extend therethrough. The hydraulic pump 43 and the control valve 44 are respectively disposed at the left and right sides with the reinforcing ribs 34 provided therebetween.

[0039] More specifically, the hydraulic pump 43 is disposed at a left rear position of the rotating frame 31, and the control valve 44 is disposed at a right front position of the rotating frame 31. The hydraulic pump 43 and the control valve 44 are connected to each other with the hydraulic tubes 45. The hydraulic tubes 45 are held together by a binding member 46 and extend along the top surface of the bottom plate 32 of the rotating frame 31 such that the hydraulic tubes 45 are inserted through the tube insertion holes 34a in the reinforcing ribs 34.

[0040] Communication holes 34b which communicate with the tube insertion holes 34a are formed in the bottom plate 32 of the rotating frame 31 at positions corresponding to the tube insertion holes 34a such that the communication holes 34b extend through the bottom plate 32 in the height direction thereof. Since the communication holes 34b are formed, in the casting process for forming the rotating frame 31 and the reinforcing ribs 34 integrally with each other, the tube insertion holes 34a can be easily formed simply by separating upper and lower molds from each other without placing cores at positions corresponding to the tube insertion holes 34a.

[0041] In the casting process for forming the rotating frame 31, instead of placing cores at positions corresponding to the tube insertion holes 34a in the reinforcing ribs 34, a lower mold having bulging portions at positions corresponding to the tube insertion holes 34a is used. After molten metal is poured into a mold unit obtained by assembling the upper mold and the lower mold together, the upper and lower molds are separated from each other in the vertical direction to release the rotating frame 31. At this time, the tube insertion holes 34a and the communication holes 34b are formed in the bottom plate 32 of the rotating frame 31 in areas corresponding to the bulging portions, and the upper and lower molds can be smoothly separated from each other. Therefore, it is not necessary to place or remove the cores, and the process of forming the rotating frame 31 and the reinforcing ribs 34 integrally with each other can be facilitated.

[0042] In addition, in the process of placing the hydraulic tubes 45, which connect the hydraulic pump 43 and the control valve 44 to each other, such that the hydraulic tubes 45 extend along the top surface of the bottom plate 32 of the rotating frame 31, the hydraulic tubes 45 can be viewed through the communication holes 34b and held through the communication holes 34b. Therefore, the hydraulic tubes 45 can be easily inserted through the tube insertion holes 34a. In addition, the hydraulic tubes 45 and other tubes, such as pilot tubes, can be arranged such that they are spaced from each other in the height direction. Therefore, the tubes can be prevented from overlapping each other and a sufficiently large working space can be provided for maintenance of the construction machine. As a result, the work efficiency can be improved.

[0043] The engine 40 (see Fig. 1) is mounted on a rear section of the rotating frame 31. The engine 40 is supported by the supporting brackets 35 with the engine mounts 41 interposed therebetween. The engine mounts 41 are composed of elastic bodies made of resin, rubber, or the like. The engine mounts 41 absorb vibrations of

the engine 40 and suppress the vibrations from being transmitted to the rotating frame 31.

[0044] The supporting brackets 35 are formed integrally with the rotating frame 31 by casting. Each of the supporting brackets 35 includes an upright portion 35a which stands upright on the bottom plate 32 of the rotating frame 31 and a flat portion 35b which protrudes horizontally from a top end of the upright portion 35a. The flat portion 35b of each supporting bracket 35 has a bolt insertion hole 35c through which a bolt 42 is inserted.

[0045] Four supporting brackets 35 are provided in the rotating frame 31 with gaps therebetween in the front-rear and left-right directions. The flat portions 35b of the supporting brackets 35 are disposed on the same plane. The engine 40 is placed on the flat portions 35b with the engine mounts 41 interposed therebetween. The bolts 42 are inserted through the bolt insertion holes 35c from below the engine 40 so that the engine 40 is fixed to the supporting brackets 35.

[0046] Of the four flat portions 35b of the supporting brackets 35, the flat portions 35b disposed at the left front and right front positions protrude horizontally inward from the top ends of the upright portions 35a which stand upright at central positions of the left and right reinforcing ribs 34 in the front-rear direction. The flat portions 35b disposed at the left rear and right rear positions protrude horizontally forward from the top ends of parts of the rear wall 32b which serve as the upright portions 35a.

[0047] Through holes 36 are formed in the bottom plate 32 of the rotating frame 31 at positions where the through holes 36 overlap the flat portions 35b of the supporting brackets 35 in plan view. The though hole 36 which corresponds to the flat portions 35b at the left front and right front positions extend between the left and right reinforcing ribs 34 such that the swivel joint 50 can be viewed through the through hole 36. The though hole 36 which corresponds to the flat portions 35b at the left rear and right rear positions is surrounded by the rear wall 32b and the left and right reinforcing ribs 34 such that the engine 40 can be viewed through the through hole 36.

[0048] Thus, according to the present embodiment, the through holes 36 are formed in the bottom plate 32 of the rotating frame 31 at positions where the through holes 36 overlap the flat portions 35b of the supporting brackets 35 in plan view. The reason for this will now be described.

[0049] That is, in the case where the rotating frame 31 and the supporting brackets 35 are formed integrally with each other by casting, if there are portions, such as the flat portions 35b of the supporting brackets 35, which protrude in the horizontal direction, the following problem occurs. That is, in the step of pouring molten metal into the mold unit obtained by assembling the upper mold and the lower mold together, the metal flows into gaps between the bottom plate 32 of the rotating frame 31 and the flat portions 35b of the supporting brackets 35. Therefore, in the step of separating the upper and lower molds from each other in the vertical direction to release the rotating frame 31, the molds cannot be separated from each other in the vertical direction. The metal can be prevented from flowing into the above-described gaps by placing cores at the positions corresponding to the gaps. Then, the cores can be removed after the casting process. However, in this case, additional processes of placing and removing the cores are required, and the number of processes to be performed is increased.

[0050] In contrast, according to the present embodiment, instead of placing the cores at the positions corresponding to the gaps between the bottom plate 32 of the rotating frame 31 and the flat portions 35b of the supporting brackets 35, a lower mold having bulging portions at positions corresponding to the gaps is used. Therefore, after the molten metal is poured into the mold unit obtained by assembling the upper mold and the lower mold together, the upper and lower molds can be separated from each other in the vertical direction to release the rotating frame 31. At this time, the through holes 36 are formed in the bottom plate 32 of the rotating frame 31 in areas corresponding to the bulging portions, and the upper and lower molds can be smoothly separated from each other. Therefore, it is not necessary to place or remove the cores, and the process of forming the rotating frame 31 and the supporting brackets 35 integrally with each other can be facilitated.

[0051] In addition, the though hole 36 which corresponds to the flat portions 35b at the left front and right front positions is formed at a position where the swivel joint 50 can be viewed through the through hole 36. Therefore, the operator can connect the hydraulic tubes 45 to the swivel joint 50 while viewing the swivel joint 50 through the through hole 36 from below the rotating frame 31. Thus, the work efficiency can be improved.

[0052] In addition, the though hole 36 which corresponds to the flat portions 35b at the left rear and right rear positions is formed at a position where the engine 40 can be viewed through the through hole 36. Therefore, the operator can easily perform maintenance of the engine 40 while viewing the engine 40 from below the rotating frame 31. Thus, the work efficiency can be improved. In addition, even when pilot tubes (not shown) connected to the operation levers 7 or the like and other electric wirings are disposed above the engine 40, the engine 40 can be fixed without being hindered by the pilot tubes or the like since the engine 40 placed on the flat portions 35b of the supporting brackets 35 can be fixed with the bolts 42 from below the engine 40. Thus, the work efficiency can be improved in the process of attaching the engine 40.

[0053] In addition to the above-described through holes 36, through holes 38 for reducing the weight of the rotating frame 31 are formed in the bottom plate 32 of the rotating frame 31 with intervals therebetween in the front-rear direction at positions outside the left and right reinforcing ribs 34.

[0054] Guide portions 37 which stand upright on the bottom plate 32 are formed integrally with the rotating

frame 31 by casting at positions near the left and right side walls 32c and 32d and inside the left and right side walls 32c and 32d. The guide portions 37 are arranged with gaps therebetween in the front-rear direction, and four guide portions 37 are provided in total. Sealing members (not shown) are disposed in gaps between the left side wall 32c and the guide portions 37 at the left side, and a bottom edge portion of the left side cover 23 is fitted into the gaps while the bottom edge portion is sealed by the sealing members. Thus, the left side cover 23 is restrained from moving in the thickness direction thereof and rainwater and the like is prevented from entering the machine. In addition, similarly, a bottom edge portion of the right side cover 23 is fitted into gaps between the right side wall 32d and the guide portions 37 at the right side so that the right side cover 23 is restrained from moving in the thickness direction thereof.

[0055] Top surfaces of the four guide portions 37 disposed at the left front, right front, left rear, and right rear positions of the rotating frame 31 are positioned on the same plane, and serve as reference surfaces in the process of cutting the rotating frame 31. After the rotating frame 31 is formed by casting, it is necessary to perform a cutting process for portions, such as the flat portions 35b of the supporting brackets 35, which are required to be flat. In the cutting process, the rotating frame 31 is placed upside down on a workbench (not shown) such that the top surfaces of the guide portions 37 face downward. Thus, the cutting process for the above-mentioned portions can be performed while the flatness is ensured. In this case, the cutting process can be performed with high accuracy. In the present embodiment, the guide portions 37, which provide reference surfaces, are provided at four positions in the rotating frame 31. However, the flatness can be ensured in the cutting process as long as the guide portions 37 are provided at two or more positions.

[0056] A pair of swing cylinder brackets 39 which support a base end portion of the swing cylinder 15a such that the base end portion of the swing cylinder 15a is rotatable are provided at a central position of a left side section of the rotating frame 31 in the front-rear direction thereof. The pair of swing cylinder brackets 39 are arranged in the vertical direction. The lower swing cylinder bracket 39 is shaped such that the lower swing cylinder bracket 39 stands upright on the bottom plate 32 of the rotating frame 31 and a top end portion of the lower swing cylinder bracket 39 protrudes horizontally inward. The protruding end of the lower swing cylinder bracket 39 is formed integrally with a side wall surface of the left reinforcing rib 34. Thus, the lower swing cylinder bracket 39 is positioned above the bottom plate 32 of the rotating frame 31 with a predetermined gap therebetween. The upper swing cylinder bracket 39 is shaped such that the upper swing cylinder bracket 39 protrudes horizontally outward from the top edge portion of the left reinforcing rib 34.

[0057] The upper and lower swing cylinder brackets 39 have coaxial rotation holes 39a formed therein. The base end portion of the swing cylinder 15a is held between the upper and lower swing cylinder brackets 39 such that a rotation shaft (not shown) thereof is inserted through the rotation holes 39a. Thus, the base end portion of the swing cylinder 15a is supported such that the base end portion of the swing cylinder 15a can pivot about the rotation shaft.

[0058] The gap between the lower swing cylinder bracket 39 and the bottom plate 32 of the rotating frame 31 serves as a tube arrangement space through which the hydraulic tubes 45 which connect the hydraulic pump 43 and the control valve 44 to each other extend. One of the through holes 38 formed in the bottom plate 32 of the rotating frame 31 for reducing the weight of the rotating frame 31 is at a position corresponding to the above-mentioned gap. Therefore, in the process of placing the hydraulic tubes 45 such that the hydraulic tubes 45 extend along the top surface of the bottom plate 32 of the rotating frame 31, the hydraulic tubes 45 can be viewed through the through hole 38 and held through the through hole 38. As a result, the hydraulic tubes 45 can be easily inserted through the gap below the lower swing cylinder bracket 39.

[0059] The end portion of the rod of the swing cylinder 15a extends through the cylinder insertion hole 29 formed in the front wall 32a and is connected to the swing bracket 15. When the swing cylinder 15a is extended, the swing bracket 15 rotates rightward around the vertical shaft 14a. When the swing cylinder 15a is contracted, the swing bracket 15 rotates leftward around the vertical shaft 14a.

[0060] As described above, in the frame structure of the construction machine 1 according to the present embodiment, the tube insertion holes 34a are formed in the base portions of the reinforcing ribs 34 in the standing direction thereof. In addition, the communication holes 34b which communicate with the tube insertion holes 34a are formed in the bottom plate 32 of the rotating frame 31. Therefore, the tube insertion holes 34a can be formed without using cores in the process of forming the rotating frame 31 and the reinforcing ribs 34 integrally with each other by casting. In addition, in the process of placing the hydraulic tubes 45, which connect the hydraulic pump 43 and the control valve 44 to each other, such that the hydraulic tubes 45 extend along the top surface of the bottom plate 32 of the rotating frame 31, the hydraulic tubes 45 can be viewed through the communication holes 34b and can also be held through the communication holes 34b. Therefore, the hydraulic tubes 45 can be easily inserted through the tube insertion holes 34a.

[0061] Although the invention has been described with reference to the preferred embodiments in the attached figures, it is noted that equivalents may be employed and substitutions made herein without departing from the scope of the invention as recited in the claims.

[0062] A rotating frame and a reinforcing rib which stands upright on a bottom plate of the rotating frame

and extends in a front-rear direction are formed integrally with each other by casting. A tube insertion hole is formed in a base portion of the reinforcing rib in a standing direction thereof such that the tube insertion hole extends through the base portion of the reinforcing rib in a thickness direction thereof. A communication hole which communicates with the tube insertion hole is formed in the bottom plate of the rotating frame such that the communication hole extends through the bottom plate of the rotating frame in a thickness direction thereof at a position corresponding to the tube insertion hole.

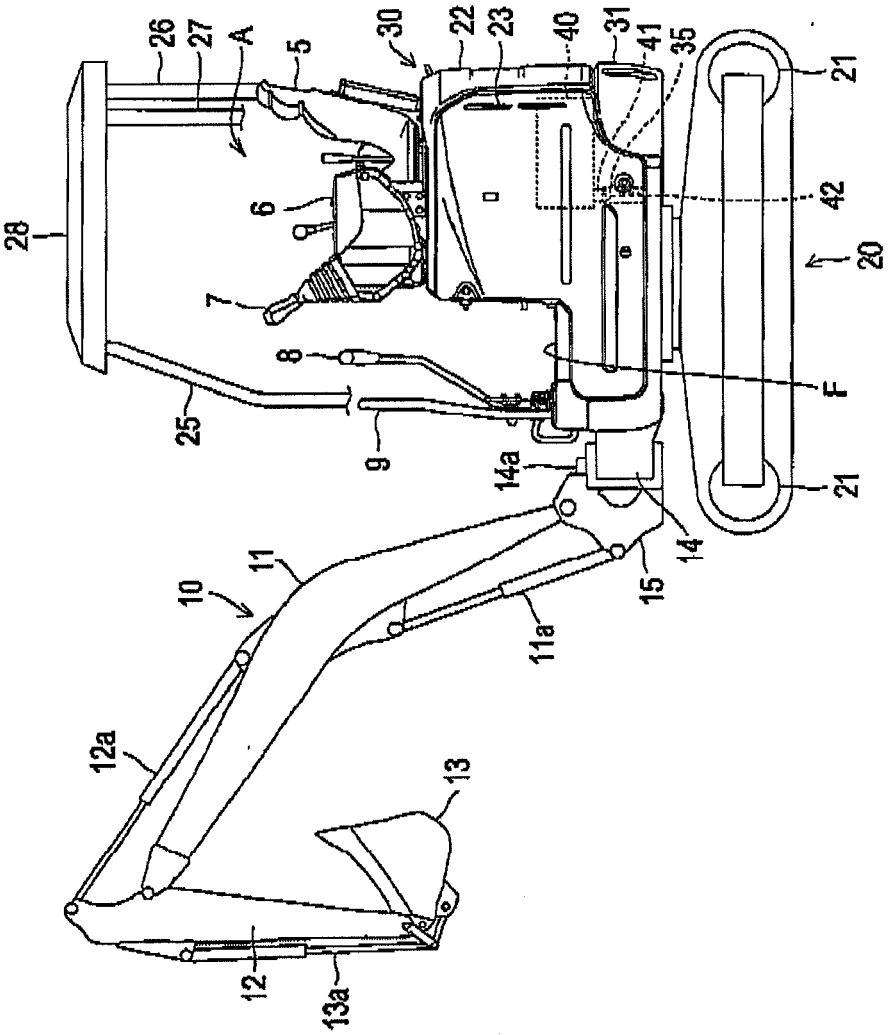
Claims

1. A frame structure of a construction machine including a lower travelling body and an upper rotating body which is mounted on the lower travelling body such that the upper rotating body is rotatable, **characterized by** that the frame structure comprises
a rotating frame disposed in a lower section of the upper rotating body and including a bottom plate and a reinforcing rib which stands upright on the bottom plate of the rotating frame and extends in a front-rear direction,
the rotating frame and the reinforcing rib are formed integrally with each other by casting,
a hydraulic pump and a control valve are disposed on the rotating frame at opposite sides of the reinforcing rib in a width direction of the rotating frame, the hydraulic pump ejecting working oil, the control valve being connected to the hydraulic pump by a hydraulic tube and controlling an operation of supplying the working oil ejected from the hydraulic pump,
a tube insertion hole through which the hydraulic tube extends is provided in a base portion of the reinforcing rib in a standing direction thereof such that the tube insertion hole extends through the base portion of the reinforcing rib in a thickness direction thereof, and
a communication hole which communicates with the tube insertion hole is provided in the bottom plate of the rotating frame such that the communication hole extends through the bottom plate of the rotating frame in a thickness direction thereof at a position corresponding to the tube insertion hole.

2. The frame structure according to claim 1, further comprising:

a front attachment provided in a front section of the rotating frame;
a swing cylinder which swings the front attachment in a left-right direction; and
a swing cylinder bracket which supports a base end portion of the swing cylinder such that the base end portion of the swing cylinder is rotatable,
wherein the swing cylinder bracket is positioned above the bottom plate of the rotating frame with a gap provided between the swing cylinder bracket and the bottom plate and is formed integrally with the rotating frame by casting, the hydraulic tube extending through the gap, and
wherein a through hole which communicates with the gap is provided in the bottom plate of the rotating frame such that the through hole extends through the bottom plate of the rotating frame in the thickness direction thereof at a position corresponding to the gap.

FIG. 1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A
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15
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12a
13
12
13a

FIG. 2

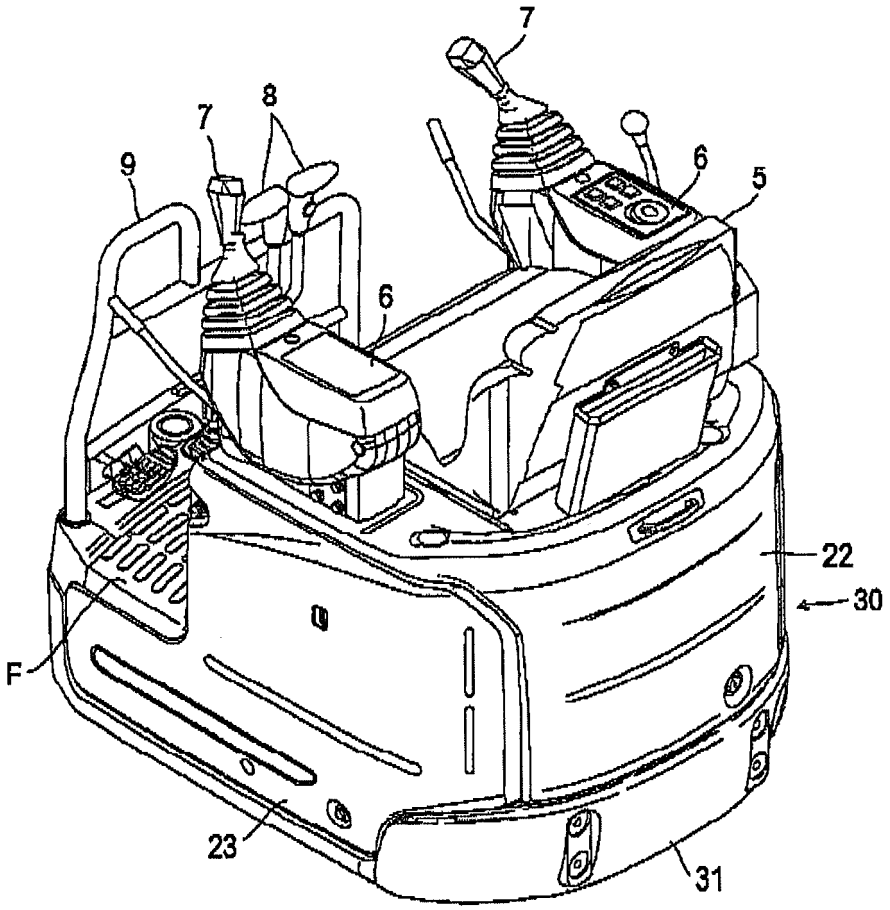
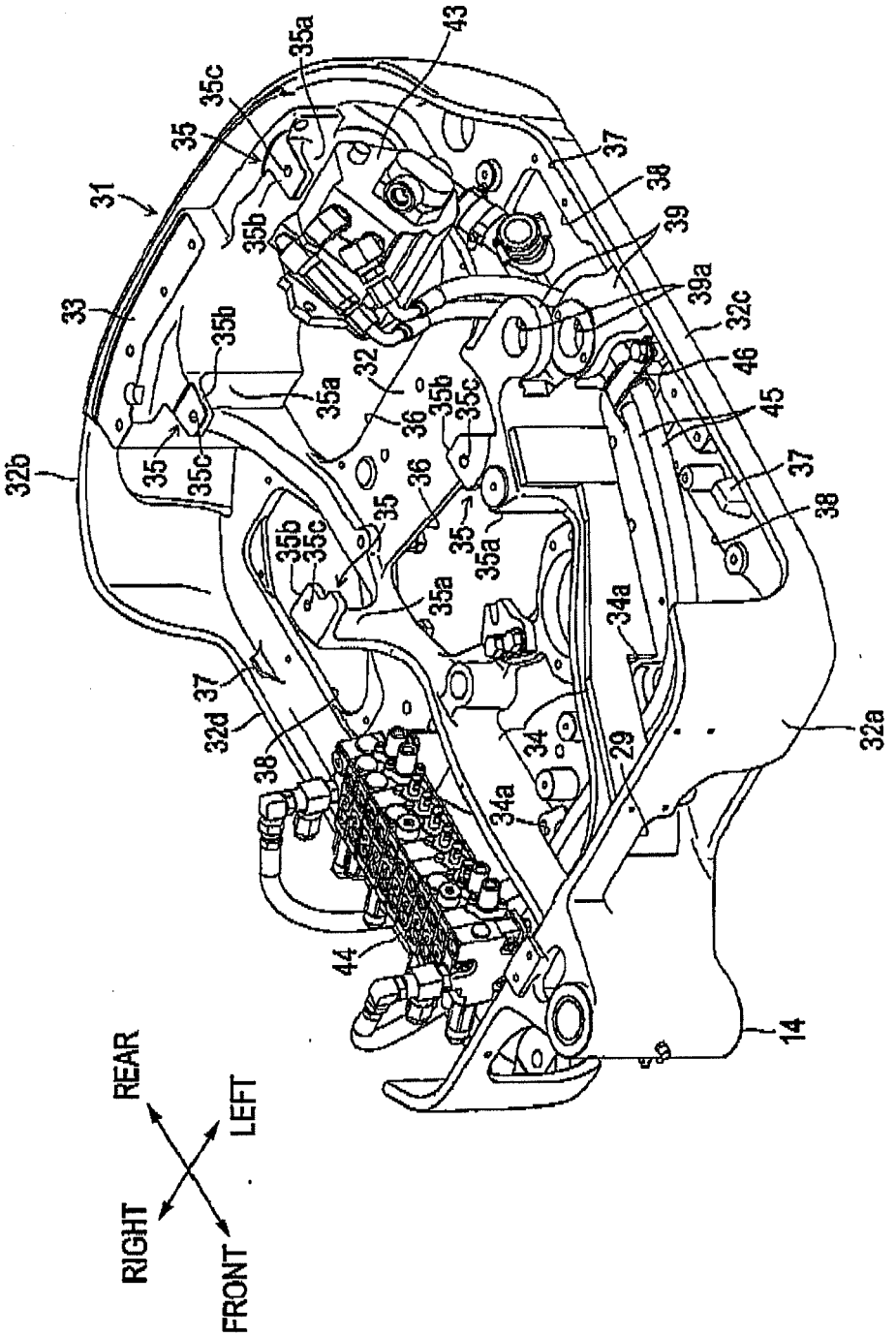


FIG. 3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39a
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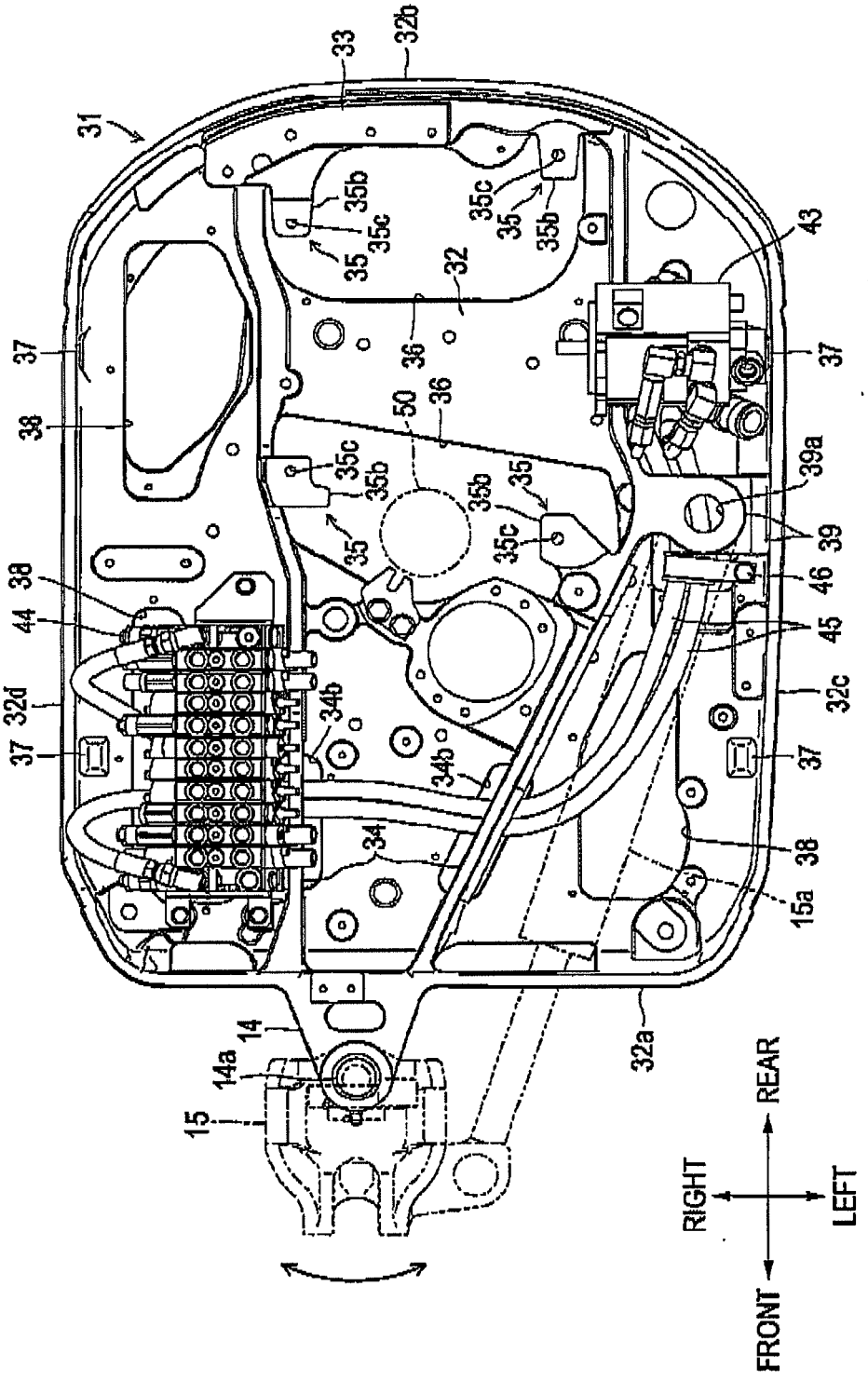
34a
29
14

FIG. 4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32a
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RIGHT
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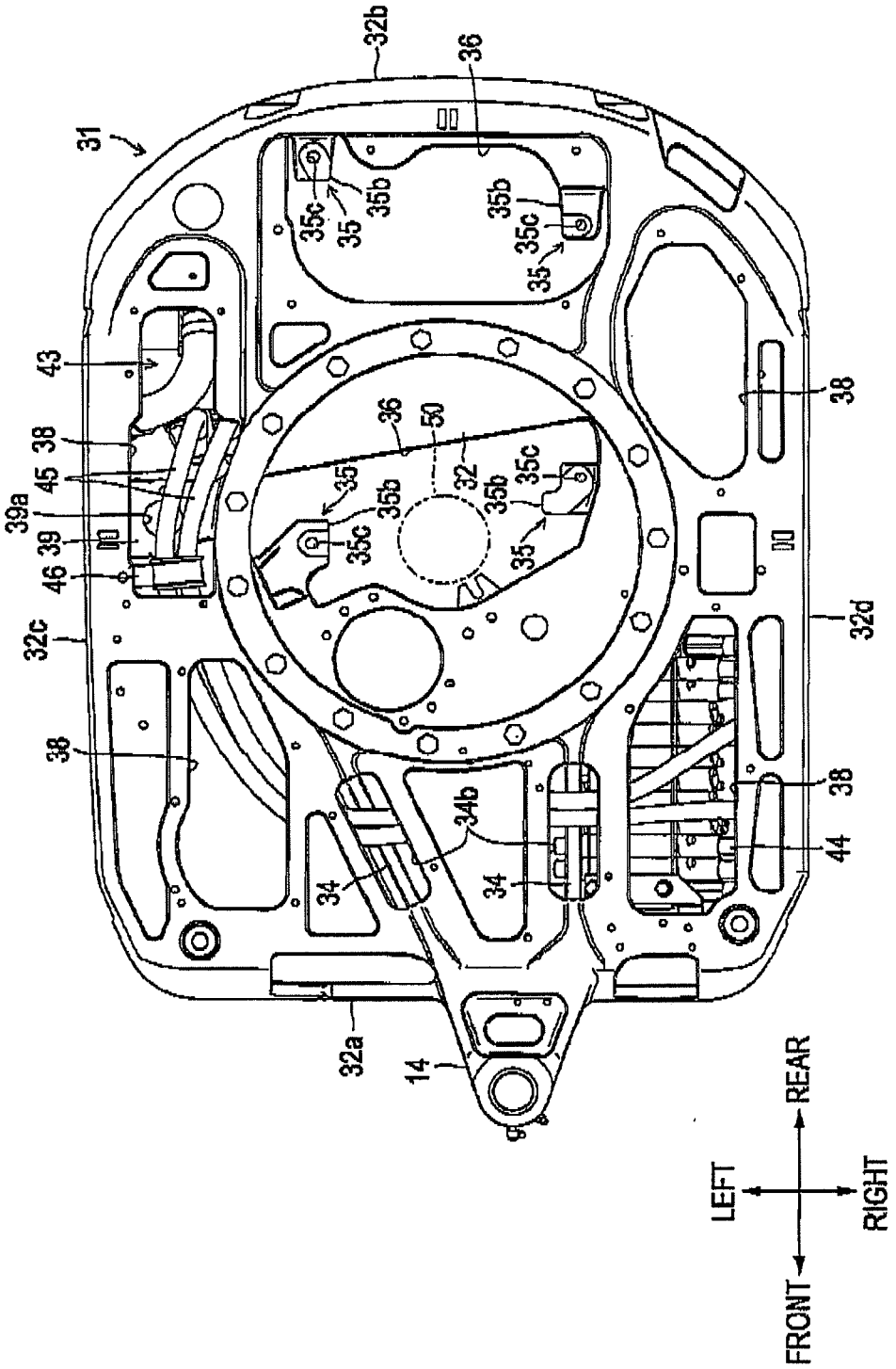
LEFT
FRONT

FIG. 5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35b
39
35c
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32a
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LEFT
REAR
RIGHT
FRONT

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

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- JP 2005002572 A **[0003]**
- JP 2007303129 A **[0003]**