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

(11) **EP 3 744 897 A1**

(12) **EUROPEAN PATENT APPLICATION**
published in accordance with Art. 153(4) EPC

(43) Date of publication:
02.12.2020 Bulletin 2020/49

(21) Application number: **19726301.5**

(22) Date of filing: **13.05.2019**

(51) Int Cl.:
E01C 19/34 *(2006.01)* ***E01C 19/35*** *(2006.01)*
E02D 3/046 *(2006.01)*

(86) International application number:
PCT/JP2019/018906

(87) International publication number:
WO 2020/202585 (08.10.2020 Gazette 2020/41)

(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 MK MT NL NO PL PT RO RS SE SI SK SM TR
Designated Extension States:
BA ME
Designated Validation States:
KH MA MD TN

(30) Priority: **05.04.2019 PCT/JP2019/015211**

(71) Applicant: **HONDA MOTOR CO., LTD.**
Tokyo 107-8556 (JP)

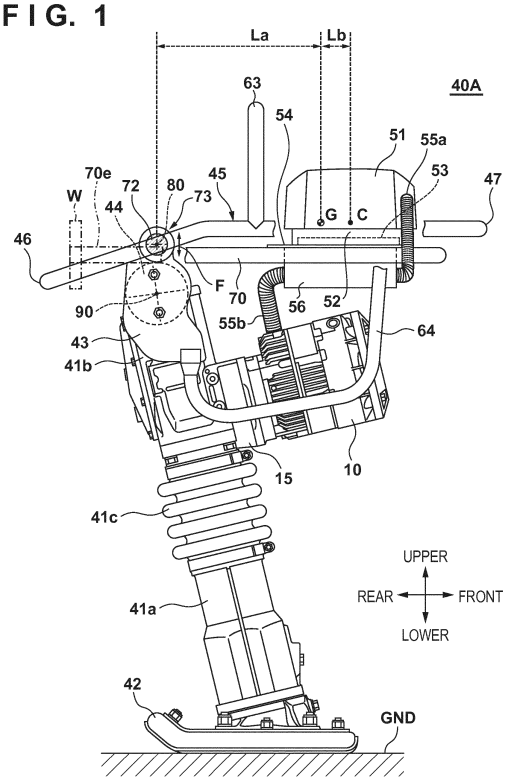
(72) Inventors:
- **MIZUGUCHI, Hiroshi**
  Wako-shi
  Saitama
  3510193 (JP)
- **ISHIZUKA, Kunihiko**
  Wako-shi
  Saitama
  3510193 (JP)

(74) Representative: **Kiwit, Benedikt**
Mitscherlich PartmbB
Patent- und Rechtsanwälte
Sonnenstraße 33
80331 München (DE)

(54) **GROUND CONSOLIDATION DEVICE**

(57) A ground compacting device having a ground leveling plate and a motor for driving the ground leveling plate includes a support portion attached to an upper half of the ground compacting device via an anti-vibration member separately from a handle, and an electrical component for driving the motor is attached to the support portion.

FIG. 1



EP 3 744 897 A1

Description

TECHNICAL FIELD

[0001] The present invention relates to a ground compacting device for compacting a ground surface by vertical vibration of a ground leveling plate.

BACKGROUND ART

[0002] Patent literature 1 discloses, as an example of a configuration of a ground compacting device, a rammer including an engine for driving and a handle in which a fuel tank is disposed at an upper end portion of a rammer body. When performing a ground leveling operation, an operator applies a vertical vibration to a ground leveling plate provided at a lower end portion of a rammer body while holding a grip portion of a handle provided at an upper end portion of the rammer body, and thereby levels the ground by the vibration.

[0003] In addition, due to a recent increase in environmental regulations, there is an increasing need for electric ground compacting devices in which a motor is used as a drive source instead of an engine, and a fuel tank is replaced with a battery.

CITATION LIST

PATENT LITERATURE

[0004] PTL1: Japanese Patent Laid-Open No. 2002-363915

SUMMARY OF INVENTION

TECHNICAL PROBLEM

[0005] Assuming that the apparatus configuration is electric, it is necessary to suppress the vibration of electrical components such as the battery because the durability of electrical components against the vibration is low. In addition, when a ground leveling operation is performed, it is also necessary to suppress the vibration of the handle in order to reduce the burden on the operator due to the vibration on their hands and arms transmitted to the grip portion of the handle.

[0006] In the apparatus configuration of Patent Literature 1, when an electrical component such as a battery is disposed on the handle instead of a fuel tank, it may be necessary to provide a handle with an anti-vibration measure for reducing both the vibration of the electrical component and the vibration of the grip portion.

[0007] However, since the positions on the handle and masses of the electrical components and the grip portions are different from each other, the anti-vibration measures for electrical components and anti-vibration measures for the grip portions are required to be different from each other. Therefore, it may be difficult to apply, on the handle, different anti-vibration measures respectively to the electrical components and the grip portions of the handle.

[0008] It is an object of the present invention to provide a ground compacting device capable of reducing vibration of an electrical component separately from a handle.

SOLUTION TO PROBLEM

[0009] A ground compacting device according to one aspect of the present invention is a ground compacting device having a ground leveling plate and a motor for driving the ground leveling plate, the ground compacting device comprising: a support portion which is attached to an upper half of the ground compacting device via an anti-vibration member separately from a handle,
wherein an electrical component for driving the motor is attached to the support portion.

ADVANTAGEOUS EFFECTS OF INVENTION

[0010] By virtue of the present invention, it is possible to provide a ground compacting device capable of reducing vibration of an electrical component separately from a handle.

[0011] Other features and advantages of the present invention will become apparent from the following description with reference to the accompanying drawings. Note that in the accompanying drawings, the same or similar components are denoted by the same reference numerals.

BRIEF DESCRIPTION OF DRAWINGS

[0012]

FIG. 1 is a view showing an example of a configuration of a ground compacting device according to a first embodiment.
FIG. 2 is a view showing a structure of a support portion.
FIG. 3 is a view for explaining a mounting structure of an electrical component.
FIG. 4 is a view from above of the ground compacting device according to a first embodiment.
FIG. 5 is a view showing an example of a configuration of a ground compacting device according to a second embodiment.
FIG. 6 is a view for explaining a mounting/demounting structure of a battery.
FIG. 7 is a view showing Variation 1 of the ground compacting device according to the first embodiment.
FIG. 8 is a view showing Variation 2 of the ground compacting device according to the first embodiment.
FIG. 9 is a view showing Variation 3 of the ground compacting device according to the first embodi-

ment.

FIG. 10 is a view showing an example of a configuration of a PDU case used in Variation 3.

DESCRIPTION OF EMBODIMENTS

[0013] An embodiment of the present invention will be described below with reference to the figures. The components described in this embodiment are illustrative only and limitation is not made to the following embodiment.

[First Embodiment]

(Configuration Example of Ground compacting device: Rammer)

[0014] FIG. 1 is a view showing a configuration of a rammer 40A as an example of a configuration of the ground compacting device according to the first embodiment. In FIG. 1, the right side of the page surface is the front of the apparatus, the left side of the page surface is the rear of the apparatus, and directions intersecting the front-rear directions are upper-lower directions of the apparatus. As shown in FIG. 1, the rammer 40A includes a motor 10 as a drive source, an upper portion (hereinafter, also referred to as "upper half 41b") on the upper side of an anti-vibration member 41c described later, an expandable/contractable anti-vibration member 41c, a lower portion (hereinafter, also referred to as "lower half 41a ") on the lower side of the anti-vibration member 41c, and a ground leveling plate 42. The ground leveling plate 42 is connected to the lower half 41a, and the lower half 41a is connected to the upper half 41b via the anti-vibration member 41c.

[0015] The upper half 41b is provided with a handle 45 and a support portion 70 separate from the handle 45. Mounted to the support portion 70 is a mounting plate 54 to which electrical components such as batteries and Power Drive Units (PDUs) can be mounted. A battery 51 for supplying electric power to the motor 10 is mounted on the upper surface of the mounting plate 54 via a holding tray 53. A PDU case 56 on which a PDU 55 for controlling the driving of the motor 10 is disposed is mounted on the lower surface of the mounting plate 54. A mounting structure of these electrical components will be described later in detail with reference to FIG. 3.

[0016] The motor 10 is attached to the upper half 41b via a spacer 15, and is driven based on electric power supplied from the battery 51. A vibration mechanism (not shown) accommodated in the upper half 41b is connected to an output shaft of the motor 10. In a crankcase formed from the upper half 41b to the lower half 41a, a rotational drive of the output shaft of the motor 10 is converted into a reciprocating linear motion (vertical motion) by a piston rod (not shown), and the converted vertical motion is transmitted to the ground leveling plate 42. As a result, the ground leveling plate 42 vibrates in the vertical direction. The ground GND can be compacted by the vibration of the ground leveling plate 42.

[0017] The anti-vibration member 41c is provided between the upper half 41b and the lower half 41a. When the ground surface GND is hit by the ground leveling plate 42, a reaction moves the rammer 40A up and down, but the vibration of the ground leveling plate 42 and the lower half 41a side is transmitted to the upper half 41b side such that it is reduced by to the interposition of the anti-vibration member 41c.

(Structure for Mounting Electrical Components)

[0018] FIG. 3 is a diagram illustrating a mounting structure of the electrical components (the battery 51, the PDU 55). In FIG. 3, the mounting plate 54 is a plate attached to the support portion 70, and electrical components such as the battery 51 and the PDU can be attached to an upper surface 354A (first surface) and a lower surface 354B (second surface which is the back surface of the first surface) of the mounting plate 54.

[0019] A holding tray 53 for mountably/demountably holding the battery 51 is attached to the upper surface 354A of the mounting plate 54 by a fastening member 53f (for example, a bolt). The battery 51 is mountably/demountably held by the holding tray 53, and is attached to the upper surface 354A of the mounting plate 54 via the holding tray 53. In the battery 51, the motor connection portion 51a can be connected to a connector cable 55a which is electrically connected to the motor 10 via a PDU 55. The motor 10 and the PDU 55 are electrically connected via a cable 55b, and the connector cable 55a is connected to the motor connection portion 51a in a state in which the battery 51 is mounted on the holding tray 53, whereby the motor 10 and the battery 51 are electrically connected via the connector cable 55a, the PDU 55, and the cable 55b.

[0020] An external member 52 (cosmetic member) has an opening 352 in its center. The external member 52 is attached to the upper surface 354A of the mounting plate 54 by a fastening member 52a (e.g., bolt), and in a state in which it is mounted on the mounting plate 54, the external member 52 covers the outer periphery of the holding tray 53 and the lower portion of the battery 51.

[0021] The PDU 55 is disposed in a protective PDU case 56, and the PDU case 56 with the PDU 55 disposed thereon is attached to the lower surface 354B of the mounting plate 54 by a fastening member 56a.

[0022] In a structure in which an electrical component (the battery 51 included in the electrical component) is attached to the upper surface 354A of the mounting plate 54 and another electrical component (another electrical component (for example, the PDU 55) included in the electrical component) is attached to the lower surface 354B, the space of the lower surface side of the mounting plate 54 can be more effectively utilized as compared with a structure in which the electrical components are stacked on the surface on one side (for example, the upper surface side), and therefore the device configura-

tion can be made smaller. Since the battery 51 needs to be charged by a charger outside the device at a predetermined time, the frequency of mounting/demounting of the battery 51 is higher than that of the PDU 55. By mountably/demountably attaching the battery 51 which has a high mounting/demounting frequency to the upper surface 354A side of the mounting plate 54 via the holding tray 53 which has a mounting/demounting mechanism, it is possible to improve work efficiency by an operator. Further, when a remaining battery power display unit is provided on the upper surface of the battery, a worker can easily visually recognize the remaining capacity during operation, and therefore can easily know when to charge the battery.

(Mounting/demounting structure for battery 51)

[0023] FIG. 6 is a view for explaining a mounting/demounting structure of the battery 51. In FIG. 6, the right side of the page surface corresponds to the left side of the apparatus, and the left side of the page surface corresponds to the right side of the apparatus. ST61 is a view showing a state in which the battery 51 is placed on the holding tray 53. The operator can carry the battery 51 by gripping a battery gripping portion 156 provided on the upper portion of the battery 51, and can place the battery 51 on the holding tray 53 following the arrow 50A. An engagement convex portion 53c is formed at a right end portion of the holding tray 53, and the engagement convex portion 53c engages with an engagement concave portion 51e formed at the right end portion of the battery 51, thereby defining a holding position for the battery 51 on the holding tray 53.

[0024] ST62 is a view showing a state in which the battery 51 has been placed on the holding tray 53. When the battery 51 is placed on the holding tray 53 in a state in which the holding position is determined by the engagement between the engagement convex portion 53c and the engagement concave portion 51e, seats 51a and 51b provided on the lower surface of the battery 51 come into contact with elastic bodies (for example, rubbers 53a and 53b) provided on the holding tray 53, respectively.

[0025] In the configuration of the ground compacting device, a holding wire 57 for holding the battery 51 placed on the holding tray 53 is provided at the right end portion (left side in the page surface) of the holding tray 53, and the left end portion (right side in the page surface) of the holding wire 57 is rotatably supported by a wire support portion 53d. A holding lever 58 is provided at a right end portion (the left side of the page surface) of the holding wire 57. The holding lever 58 is rotatable about a rotation fulcrum 58a, and when the holding lever 58 is rotated about the rotation fulcrum 58a as indicated by an arrow 50B, the holding convex portion 58b formed at the distal end portion of the holding lever 58 engages with a holding concave portion 51d formed at the upper portion of the battery 51 to be held.

[0026] ST63 is a view showing a state in which the battery 51 has been held on the holding tray 53. The battery 51 is held on the holding tray 53 by the engagement of the engagement convex portion 53c and the engagement concave portion 51e on the right side (the left side of the apparatus) of the page surface, and is held on the holding tray 53 by the engagement of a holding convex portion 58b and a holding concave portion 51d on the left side (the right side of the apparatus) of the page surface.

[0027] The flow up to placing and holding the battery 51 on the holding tray 53 has been described above. When the holding tray 53 detaches the battery 51, the battery 51 can be detached from the holding tray 53 by performing procedures opposite to the flow of ST63 from the ST61.

(Configuration of the support portion 70)

[0028] FIG. 2 is a view showing a configuration of the support portion. Electrical components (the battery 51 and the PDU 55 which is disposed in the PDU case 56) are attached to the support portion 70 via the mounting plate 54. In the example shown in FIG. 2, the support portion 70 is formed as a substantially U-shaped frame body by the left and right frames 70a and 70b and a center frame 70c, and the mounting plate 54 is mounted between the left and right frames 70a and 70b by the fastening member 54a (for example, a bolt). Connecting portions 71a and 71b for connecting the support portion 70 to an anti-vibration member 73 are provided at the end portions of the left and right frames 70a and 70b. The connection portion 71b is formed with a through hole 71c that a rotating support member 77a (e.g., a bolt) passes through.

[0029] In FIG. 2, ST21 shows a cross-sectional view of the anti-vibration member 73 along a rotational axis 80. The anti-vibration member 73 has an anti-vibration member main body 73a having a hollow cylindrical shape, an elastic member 72 inserted into the anti-vibration member main body 73a, and a collar 76 inserted into an opening 72a formed in a central portion of the elastic member 72. An inner diameter 76a of the collar 76 is formed so as to be able to pass through the rotating support member 77a.

[0030] The rotating support member 77a that has passed through the through hole 71c and the collar 76 of the anti-vibration member 73 engages with the rotating engagement member 77b (for example, a nut) so that the anti-vibration member 73 is attached to the connection portion 71b of the right frame 70b.

[0031] In the configuration of FIG. 2, a configuration example is shown in which the anti-vibration member 73 is attached to the connection portion 71b of the right frame 70b, but the same is true for a left frame 70a, and the anti-vibration member 73 is attached to the connection portion 71a of the left frame 70a by engaging the rotating engagement member 77b with the rotating support member 77a passing through the through hole 71c

formed in the connection portion 71a of the left frame 70a and the collar 76 of the anti-vibration member 73.

[0032] An upper anti-vibration mounting member 74 has a semi-cylindrical arc portion 74a and flange portion 74b formed at both ends of the arc portion 74a. A through hole 78c is formed in the flange portion 74b such that a fastening member 78a (e.g., a bolt) can pass through.

[0033] A lower anti-vibration mounting member 75 has a semi-cylindrical arc portion 75a, a first flange portion 75b formed at both ends of the arc portion 75a, a step portion 75d formed in the vertical direction from the end of the first flange portion 75b, and a second flange portion 75c formed at the end of the step portion 75d. The first flange portion 75b is formed with an engagement portion 78b (e.g., a screw hole) that engages with the fastening member 78a. A through hole 79b is formed in the second flange portion 75c such that a fastening member 79a (e.g., a bolt) can pass through.

[0034] The upper anti-vibration mounting member 74 and the lower anti-vibration mounting member 75 are mounted on the support portion 70 by engaging the fastening member 78a with the engagement portion 78b in a state in which the anti-vibration member 73 is sandwiched therebetween vertically. In engaged state of the fastening member 78a, the arc portion 74a and the arc portion 75a sandwich the outer circumference of the anti-vibration member main body 73a vertically, rotatably hold the support portion 70, and hold the position of the support portion 70 in the rotated state.

[0035] By engaging the fastening member 79a with an engagement portion (e.g., a screw hole) of a component on the upper half 41b side in a state in which the second flange portion 75c is in contact with the component on the upper half 41b side, the support portion 70 can be attached to the upper half 41b via the anti-vibration member 73. FIG. 2 shows an example in which the second flange portion 75c is brought into contact with a handle holding member 44, which holds the handle 45, and fastened by the fastening member 79a, but the present invention is not limited to this, and the frame may be extended upward from the spacer 15, and the support portion 70 may be provided on the frame via the anti-vibration member 73. The shape of the second flange portion 75c is not limited to a planar shape, and can be formed according to a shape of a component (the handle holding member 44) on the side of the upper half 41b that comes into contact with it. For example, if the handle holding member 44 is a component having a cylindrical outer shape, the second flange portion 75c may be formed as an arc shape having a curvature matched with the cylindrical outer shape. If the handle holding member 44 is a component having a planar outer shape, the second flange portion 75c may be formed to be flat.

(Mounting Structure of Handle 45 and Support Portion 70)

[0036] The handle 45 is rotatably attached to the upper half 41b by the handle holding member 44 having the same structure as the anti-vibration member 73, and is configured to be rotatable in the vertical direction about a rotational axis 90 of the handle holding member 44 as a rotation center (FIG. 1). The support portion 70 is attached to the handle holding member 44 by engagement between the fastening member 79a passing through the through hole 79b of the second flange portion 75c (FIG. 2) and the handle holding member 44, and is configured to be rotatable in the vertical direction where the rotational axis 80 of the anti-vibration member 73 is the center of rotation.

[0037] Vibration transmitted from the ground leveling plate 42 acts on the anti-vibration member 73 as an exciting force F at the center of the anti-vibration member 73, i.e., the rotational axis 80. The support portion 70 has a cantilever structure supported by the anti-vibration member 73, and the support portion 70 of the cantilever structure is excited by the exciting force F.

[0038] In FIG. 1, the center of gravity G indicates the overall center of gravity of the support portion 70 and the electrical components (battery 51, PDU 55), the external member 52, the holding tray 53, the mounting plate 54, and the PDU case 56 (hereinafter, these overall configurations are also referred to as "support units"). La represents the distance (length) from the center (the rotational axis 80) of the anti-vibration member 73 to the center of gravity G of the support unit. Further, in FIG. 1, a point C indicates a position at which the electrical components (the battery 51 and the PDU 55) are attached to the mounting plate 54 (the center position of the electrical components in the front-rear directions), and Lb indicates a distance (length) from the center of gravity G to the position C.

[0039] Assuming that the moment of inertia around the center of gravity G of the support unit is IG and the mass of the support unit is M, the position C which is not affected by vibration in the vertical direction by the exciting force F can be obtained as $Lb=IG/(M\cdot La)$, according to impact center theory. By attaching the electrical components at the position C defined by Lb, the influence of vibration in the vertical direction (translation direction) can be reduced.

[0040] In addition, by setting the elastic modulus (spring constant) of the elastic member 72 of the anti-vibration member 73 to be sufficiently smaller than the vibration frequency of the rammer 40A, the influence of resonance can be reduced.

[0041] An elastic member is also provided inside the handle holding member 44 as in the anti-vibration member 73 (ST21 of FIG. 2). As the elastic members of the anti-vibration member 73 of the support portion 70 and the handle holding member 44 of the handle 45, it is possible to use members having a different elastic modulus in accordance with the vibration characteristics of the support portion 70 and the vibration characteristics of the handle 45. The anti-vibration member 73 of the support portion 70 is provided separately from the anti-vibration

member of the handle 45 (the handle holding member 44 including the anti-vibration member), and interposed between the upper half 41b and the support portion 70. This makes it possible to individually suppress the vibration of the handle 45 and the electrical components attached to the support portion 70. According to the apparatus configuration of the present embodiment, it is possible to reduce vibration of the electrical components separately from the handle.

[0042] In the device configuration shown in FIG. 1, in a side view, the support portion 70 is provided lower than the handle 45, and the handle 45 is configured to cover at least a part of the electrical components (e.g., the battery 51 and the PDU 55 disposed in the PDU case 56) attached to the support portion 70. As a result, while the apparatus configuration can be made smaller, the electrical components can be protected by the handle 45 when the apparatus falls over or the like in a state where the rammer 40A is not in use. A reinforcing member 63 is attached between the right handle frame 48 and the left handle frame 49 constituting the handle 45, and the reinforcing member 63 protects the battery 51. The reinforcing member 64 connects the handle 45 to a movable plate 43 of the upper half 41b, and covers at least a part of the electrical components (e.g., the battery 51 and the PDU 55 disposed in the PDU case 56) attached to the support portion 70 and at least a part of the motor 10. As a result, the electrical components and the motor 10 can be protected by the reinforcing member 64 when the apparatus falls over or the like.

[0043] FIG. 4 is a view of the rammer 40A as seen from above. The handle 45 has a front frame 47, a rear frame 46, the right handle frame 48, and the left handle frame 49, and is formed as a substantially rectangular frame body. The support portion 70 is formed as a substantially U-shaped frame body by the left and right frames 70a and 70b and the center frame 70c, and the support portion 70 is disposed inside the frame body of the handle 45. When a worker engages in a ground leveling operation, the worker must hold the front frame 47 (handle portion) on the handle 45 of the rammer 40A, and perform an operation of rotating the handle 45 upwardly and downwardly, and pushing downwards; however, by providing the support portion 70 inside the frame body of the handle 45, the device configuration can be made compact and interference with the support portion 70 when the handle 45 is rotated can be prevented. In addition, since the handle holding member 44 is provided separately from the anti-vibration member 73 and the electrical components are provided in the support portion 70 (the electrical components are not provided in the handle 45), the electrical components do not rotate in conjunction with the rotation of the handle, and so it is possible to suppress interference of the electrical components with other components (motors and the like) of the apparatus.

[Variations of the First Embodiment]

(Coaxial structure of anti-vibration members)

[0044] In the example shown in FIG. 1 and FIG. 4, as the structure of the anti-vibration member, a structure in which the anti-vibration member 73 of the support portion 70 and the handle holding member 44 of the handle 45 are separately arranged has been described, but it is also possible to arranged the anti-vibration member 73 and the handle holding member 44 coaxially to configure an integrated anti-vibration member. In this case, the anti-vibration member 73 may be disposed in the handle holding member 44 by arranging the rotational axis 80 of the anti-vibration member 73 in the support portion 70 coaxially with the rotational axis 90 of the handle holding member 44. As a result, it is possible to prevent interference with the support portion 70 during rotation of the handle 45 while reducing the size and weight of the device configuration.

(Height of the support portion 70 with respect to the handle 45)

[0045] In the example of FIG. 1, the support portion 70 is disposed lower than the handle 45 as the apparatus configuration, but in addition to this example, it is also possible to adopt an apparatus configuration in which the support portion 70 is disposed higher than the handle 45 as the apparatus configuration. In this case, the vertical height of the step portion 75d of the lower anti-vibration mounting member 75 illustrated in FIG. 2 may be formed to be a length such that the support portion 70 is disposed higher than the handle 45, or the upper end portion (the upper half 41b) of the device may be formed so as to project higher than the handle 45, and the support portion 70 may be provided through the anti-vibration member 73 in the protruding portion.

(Weight-adjusting portion of the support portion 70)

[0046] As a configuration of the support portion 70, a weight-adjusting portion may be provided on the support portion 70 on a side opposite to a position where the electrical components (the battery 51 and the PDU 55) are mounted via the anti-vibration member 73 of the support portion 70. For example, as shown by a dashed-dotted line in FIG. 4, it is also possible to form extension frames 70d and 70e in which the left and right frames 70a and 70b constituting the support portion 70 are extended to the rear side of the apparatus, and to provide counterweights W in the extension frames 70d and 70e as weight-adjusting portions.

[0047] The counterweights W can be adjusted by increasing or decreasing the weight, and the moment about the center of gravity G of the electrical components (clockwise direction) can be reduced by the moment about the center of gravity G of the weight-adjusting por-

tion (the counterweights W) (counterclockwise direction). By reducing the moment about the center of gravity G of the electrical components, the position C at which the electrical components are attached can be moved towards the center of gravity G, and the protrusion length L1 (FIG. 1) of the support portion 70 which protrudes forward from the electrical component can be shortened. By shortening the protrusion length L1 of the support portion 70, the clearance L2 between the center frame 70c of the support portion 70 and the front frame 47 of the handle 45 can be enlarged. As a result, it is possible to prevent interference with the support portion 70 during rotation of the handle 45 while making the device configuration more compact.

(Configuration in which the support portion 70 is formed by a plate)

[0048] In FIG. 2, a configuration example of a plurality of frames (the left and right frames 70a and 70b and the center frame 70c) is shown as the support portion 70, but the support portion 70 may be configured by a plate-shaped member (a plate) in addition to this example. In this case, an opening for avoiding interference with the PDU case 56 attached to the lower surface 354B of the mounting plate 54 may be formed in the plate-shaped member.

(Variation 1 of the mounting plate 54 (FIG. 7))

[0049] FIG. 7 is a view showing Variation 1 of the mounting plate 54, and is a view of the rammer 40A (FIG. 1) as seen from above. The mounting structure of the electrical components (the battery 51 and the PDU 55) to the mounting plate 54 is the same as that shown in FIGS. 3 and 4, and the structure for connecting the end portions of the left and right frames 70a and 70b of the support portion 70 to the anti-vibration member 73 is the same as that shown in FIG. 2. The structure of the weight-adjusting portion (counterweight W) of the support portion 70 is similar to that shown in FIG. 4.

[0050] As shown in FIG. 7, the mounting plate 54 has a rectangular shape in a plan view, and is mounted by the fastening member 54a (for example, a bolt) so as to cover the upper surface of the support portion 70. Here, the support portion 70 is formed as a substantially U-shaped frame body by the left and right frames 70a and 70b and the center frame 70c, and the portion of the structure of the support portion 70 shown by broken lines is provided on the lower surface of the mounting plate 54.

[0051] In a state in which the mounting plate 54 is mounted on the support portion 70, a left end portion 254a of the mounting plate 54 protrudes from the left frame 70a of the support portion 70 to the outside of the frame body (an overhang length Ls). Similarly, a right end portion 254b of the mounting plate 54 protrudes from the right frame 70b of the support portion 70 to the outside of the frame body (the overhang length Ls). Also, a front end portion 254c of the mounting plate 54 protrudes from the center frame 70c to the outside of the frame body (the overhang length Ls). It is also possible to form the overhang length Lf of the front end portion 254c similarly to the overhang length Ls of the left end portion 254a and the right end portion 254b (Lf=Ls). It is also possible to shorten the overhang length Lf of the front end portion 254c as compared to the overhang length Ls of the left end portion 254a and the right end portion 254b so that the worker can easily grasp the front frame 47 of the handle 45 (Lf < Ls).

[0052] By virtue of the configuration of Variation 1 of the mounting plate 54 shown in FIG. 7, since the region in which the mounting plate 54 abuts the support portion 70 (the region of the support portion 70 shown by the broken line in FIG. 7) can be increased, the number of the fastening member 54a corresponding to the left frame 70a, the right frame 70b, and the center frame 70c of the support portion 70 can be increased.

[0053] For example, in the example shown in FIG. 4, the mounting plate 54 is attached to the left frame 70a by the fastening member 54a at two locations, and is attached to the right frame 70b by the fastening member 54a at two locations. In contrast, in the example shown in FIG. 7, the mounting plate 54 is attached to the left frame 70a by the fastening member 54a at three locations, and is attached to the right frame 70b by the fastening member 54a at three locations, and furthermore is attached to the center frame 70c by the fastening member 54a at two locations. As a result, the mounting plate 54 can be disposed stably on the upper surface of the support portion 70, and the outer edge of the mounting plate 54 can be more firmly attached to the support portion 70.

(Variation 2 of the mounting plate 54 (FIG. 8))

[0054] FIG. 8 is a view showing Variation 2 of the mounting plate 54, and is a view of the rammer 40A (FIG. 1) as seen from above. As shown in FIG. 8, the mounting plate 54 has a rectangular shape in a plan view, and similarly to Variation 1 in FIG. 7, its structure is mounted by the fastening member 54a (for example, a bolt) so as to cover the upper surface of the support portion 70. In the structure of the support portion 70, a portion indicated by broken lines is provided on the lower surface of the mounting plate 54. The structure of the weight-adjusting portion (counterweight W) of the support portion 70 is similar to that shown in FIG. 4 and FIG. 7. However, in Variation 2, since the device width WD2 is narrower than the device width WD1 of Variation 1 (WD2<WD1), the length LP2 of the mounting plate 54 in the left/right direction in FIG. 8 is configured to be shorter than the length LP1 of the mounting plate 54 the left/right direction in FIG. 7 (LP2<LP1).

[0055] The structure that connects the ends of the left and right frames 70a and 70b of the support portion 70 to the anti-vibration member 73 is the same as in FIG. 2,

but the orientation for mounting the electrical components (the battery 51) to the mounting plate 54 is different from that in FIGS. 4 and 7 in Variation 2 of FIG. 8. For example, in FIG. 7, the longitudinal direction of the battery 51 is disposed along the left/right direction of the rammer 40A, but in Variation 2 of FIG. 8, the longitudinal direction of the battery 51 is disposed along the front-rear direction of the rammer 40A.

[0056] By virtue of the configuration of Variation 2 of the mounting plate 54 shown in FIG. 8, similarly to in Variation 1, as a result, the mounting plate 54 can be disposed stably on the upper surface of the support portion 70, and the outer edge of the mounting plate 54 can be more firmly attached to the support portion 70. Further, by virtue of the configuration of Variation 2, the device width (WD2) of the rammer 40A of Variation 2 can be reduced (WD2<WD1) as compared with the device width (WD1) of the rammer 40A of Variation 1, and a more compact rammer 40A can be provided.

(Variation 3 of the mounting plate 54 (FIG. 9))

[0057] FIG. 9 is a view showing Variation 3 of the mounting plate 54, and is a view of the rammer 40A (FIG. 1) as seen from above. As shown in FIG. 9, the mounting plate 54 has a rectangular shape in a plan view, and is mounted by the fastening member 54a (for example, a bolt) so as to cover the upper surface of the support portion 70. In the structure of the support portion 70, a portion indicated by broken lines is provided on the lower surface of the mounting plate 54. In

[0058] Variation 3 of FIG. 9, the structure of the support portion 70 is different from the structure of Variations 1 and 2 of the first embodiment of FIG. 4, FIG. 7 and FIG. 8.

[0059] In FIG. 4, FIG. 7, and FIG. 8, the support portion 70 is formed as a substantially U-shaped frame body by the left and right frames 70a and 70b, and the center frame 70c, but in Variation 3 of FIG. 9, there is a difference in that the support portion 70 is formed in a substantially T-like shape by a front/rear direction frame 170a and a left/right direction frame 170b. In Variation 3 of FIG. 9, a member width WD4 of the front/rear direction frame 170a and the left/right direction frame 170b is formed wider than a member width WD3 of the frames (the left frame 70a, the right frame 70b, and the center frame 70c) shown in FIG. 7 and FIG. 8, for example, so that the stiffness of the support portion 70 is not lowered as compared with Variations 1 and 2 of the first embodiment of FIG. 4, FIG. 7, and FIG. 8 (WD4>WD3).

[0060] In Variation 3 of FIG. 9, an example is shown in which the member width WD4 is formed wider than the member width WD3, but the present invention is not limited to this example, and the member thicknesses of the front/rear direction frame 170a and the left/right direction frame 170b may be formed thicker than the member thicknesses of the frames (the left frame 70a, the right frame 70b, and the center frame 70c) shown in FIG. 7 and FIG. 8, for example, in the direction perpendicular to the page surface. By forming at least one of the member width and the member thickness such that a cross-sectional characteristic (moment of inertia of area) of the support portion 70 is a predetermined value, a stiffness equivalent to that of the support portion 70 shown in FIG. 4, FIG. 7 and FIG. 8 can be realized.

[0061] In the first embodiment of FIG. 4, and in Variations 1 and 2 of FIG. 7 and FIG. 8, the structure is such that the ends of the left and right frames 70a and 70b of the support portion 70 are connected to the left and right anti-vibration members 73, respectively (FIG. 2), but in Variation 3 of FIG. 9, the structure is such that the end of the front/rear direction frame 170a is connected to a single anti-vibration member 73. By virtue of the configuration of Variation 3 of the mounting plate 54 shown in FIG. 9, it is possible to reduce the number of components (for example, the elastic member 72, the upper anti-vibration mounting member 74, the lower anti-vibration mounting member 75, the collar 76, and the like shown in FIG. 2) for connection to the anti-vibration member 73, and it is possible to simplify the structure of the anti-vibration member 73.

[0062] In the first embodiment of FIG. 4, the Variations 1 and 2 of FIG. 7 and FIG. 8, the right and left counterweights W are used as the weight-adjusting portions. In Variation 3 of FIG. 9, by providing two counterweights 2W as one counterweight, the same weight adjustment effect as that of the first embodiment of FIG. 4 and the Variations 1 and 2 of FIG. 7 and FIG. 8 can be realized.

[0063] Also, in FIG. 4, FIG. 7, and FIG. 8, the structure is such that the PDU case 56 is mounted to the lower surface 354B (FIG. 3) of the mounting plate 54, but in the Variation 3 of FIG. 9, the PDU case 56 can be attached to the lower surface 354B (FIG. 3) of the mounting plate 54 by forming the notches 56b and 56c (FIG. 10) in the PDU case 56 that can intersect with the front/rear direction frame 170a while avoiding interference with the front/rear direction frame 170a. As a result, the space on the lower surface side of the mounting plate 54 can be effectively utilized in Variation 3 as in Variations 1 and 2 of the first embodiment of FIG. 4, FIG. 7, and FIG. 8, and so the device configuration can be reduced in size.

[0064] In Variation 3 of FIG. 9, an example is shown in which the longitudinal direction of the battery 51 is disposed in the left/right direction of the rammer 40A as in the first embodiment of FIG. 4 and Variation 1 of FIG. 7. The arrangement direction of the battery 51 is not limited to this example, and for example, as in Variation 2 of FIG. 8, the rammer 40A may be configured such that the longitudinal direction of the battery 51 is disposed in the front-rear direction of the rammer 40A. This makes it possible to reduce the device width of the rammer 40A of Variation 3 as in Variation 2, and to provide a more compact rammer 40A.

[Second Embodiment]

(Configuration Example of Ground compacting device: plate compactor)

[0065] In the first embodiment, an example of a configuration of the rammer 40A has been described as an example of the configuration of a ground compacting device, but other than this example, for example, the mounting structures of the support portion 70 and the electrical components (the battery 51 and the PDU 55) can be applied to a plate compactor. FIG. 5 is a view showing a configuration of a plate compactor 40B as an example of a configuration of the ground compacting device according to the second embodiment.

[0066] The plate compactor 40B includes a motor 150 functioning as a drive source, upper halves 144 and 154 upward of an anti-vibration member 146, the anti-vibration member 146, a lower half 145 downward of the anti-vibration member 146, an excitation mechanism 158, and a ground leveling plate 142. A handle 147 is configured as a substantially rectangular frame body like the handle 45 described in the first embodiment. The handle 147 is attached to the upper half 144. The ground leveling plate 142 is connected to the lower half 145, and the lower half 145 and the ground leveling plate 142 vibrate by vibration of the excitation mechanism 158.

[0067] In FIG. 5, the motor 150 is provided in an upper half 154 via a spacer 151, and a drive pulley 152 is attached to an output shaft 150a of the motor 150. A driven pulley 153 is attached to a rotational axis 153a of the excitation mechanism 158, and a power transmission mechanism 155 (drive belt) is provided between the drive pulley 152 and the driven pulley 153. The rotational driving force of the motor 150 is transmitted to the excitation mechanism 158 via the drive pulley 152, the power transmission mechanism 155, and the driven pulley 153, and the lower half 145 and the ground leveling plate 142 vibrate by vibration of the excitation mechanism 158 based on the transmitted rotational driving force.

[0068] The reaction to the vibration of the ground leveling plate 142 causes a plate compactor 40B to move up and down, but the vibration of the ground leveling plate 142 and the lower half 145 side, after being reduced by the interposition of the anti-vibration member 146, is transmitted to the upper halves 144 and 154 and the side of the handle 147 attached to the upper half 144. The anti-vibration member 146 functions as an anti-vibration member for the upper halves 144 and 154 and the handle 147 attached to the upper half 144, and has a configuration separate from the anti-vibration member 73 of the support portion 70, which will be described later.

[0069] In the plate compactor 40B, the support portion 70 is attached to the upper half 154 via the anti-vibration member 73 separately from the anti-vibration member 146 of the handle 147, and electrical components for driving the motor 150 are attached to the support portion 70. Here, the structures of the upper anti-vibration mounting member 74, the lower anti-vibration mounting member 75, and the elastic member 72 for mounting the anti-vibration member 73 to the upper half 154 are similar to those of the first embodiment. In addition, as a structure for a weight-adjusting portion, a structure in which an extension frame 70e in which the support portion 70 is extended to the rear side of the apparatus is formed, and as the weight-adjusting portion, the counterweight W is provided in the extension frame 70e, is also similar to in the first embodiment.

[0070] The structure for attaching the electrical components to the support portion 70 is also the similar to the structure described with reference to FIG. 2 and FIG. 3. In a structure in which an electrical component (the battery 51 included in the electrical component) is attached to the upper surface 354A of the mounting plate 54 and another electrical component (another electrical component (for example, the PDU 55) included in the electrical component) is attached to the lower surface 354B, the space of the lower surface side of the mounting plate 54 can be more effectively utilized as compared with a structure in which the electrical components are stacked on the surface on one side, and therefore the device configuration can be made smaller.

[0071] By mountably/demountably attaching the battery 51 which has a high mounting/demounting frequency to the upper surface 354A side of the mounting plate 54 via the holding tray 53 which has a mounting/demounting mechanism, it is possible to improve work efficiency by an operator. Further, when a remaining battery power display unit is provided on the upper surface of the battery, a worker can easily visually recognize the remaining capacity during operation, and therefore can easily know when to charge the battery.

[0072] The relative positional relationship between the handle 147 and the support portion 70 described in the first embodiment can be applied to the handle 147 and the support portion 70 of the second embodiment. By virtue of the present embodiment, it is possible to provide a plate compactor capable of reducing vibration of an electrical component separately from a handle. Variations 1 to 3 of the mounting plate 54 described with reference to FIG. 7 to FIG. 10 can also be applied to the mounting plate 54 (FIG. 5) of the second embodiment.

[Summary of Embodiments]

[0073]

Configuration 1. A ground compacting device of above-described embodiments is a ground compacting device (e.g., 40A in FIG. 1 and 40B in FIG. 5) having a ground leveling plate (e.g., 42 in FIG. 1 and 142 in FIG. 5) and a motor (e.g., 10 in FIG. 1 and 150 in FIG. 5) for driving the ground leveling plate (42, 142),
the ground compacting device comprising a support portion (e.g., 70 in FIG. 1 and FIG. 5) which is at-

tached to an upper half of the ground compacting device (e.g., 41b in FIG. 1 and 144 and 154 in FIG. 5) via an anti-vibration member (e.g., 73 in FIG. 1 and FIG. 5) separately from a handle (e.g., 45 in FIG. 1 and 147 in FIG. 5),

wherein an electrical component (e.g., 51 and the PDU 55 in FIG. 1 and FIG. 5) for driving the motor (10 and 150) is attached to the support portion (70).

By virtue of the ground compacting device of Configuration 1, it is possible to provide a ground compacting device capable of reducing vibration of an electrical component separately from a handle.

Configuration 2. In a ground compacting device of the above embodiments, wherein the anti-vibration member (73) is provided between the upper half (41b, 144, and 154) and the support portion (70) separately from an anti-vibration member (e.g., 44 in FIG. 1 and FIG. 5) of a handle (45 and 147).

According to the ground compacting device of Configuration 2, since the anti-vibration member of the support portion and the anti-vibration member of the handle are separate from each other, vibration can be easily suppressed individually. Further, since the electrical components do not rotate in conjunction with the handle being rotated, it is possible to suppress interference with other members (such as the motor).

Configuration 3. In a ground compacting device of the above embodiments, wherein the support portion (70) has a rotational axis (e.g., 80 of FIG. 1) that is coaxial to the handle.

By virtue of the ground compacting device of Configuration 3, it is possible to prevent interference with the support portion during rotation of the handle while reducing the size and weight of the device configuration.

Configuration 4. In a ground compacting device of the above embodiments, wherein the handle (45) is configured as a frame body in an upper surface view of the ground compacting device, and

the support portion (70) being disposed inside the frame body of the handle.

By virtue of the ground compacting device of Configuration 4, it is possible to prevent interference with the support portion during rotation of the handle while making the device configuration compact.

Configuration 5. In a ground compacting device of the above embodiments, a weight-adjusting portion (for example, W in FIG. 1, FIG. 4, and FIG.5) is further provided on a side opposite to a position where an electrical component is attached, via the anti-vibration member (73) of a support portion (70).

By virtue of the ground compacting device of Configuration 5, it is possible to shorten a length of protrusion of the support portion which protrudes forward from the electrical component. By shortening the protrusion length of the support portion, the clearance between the support portion and the handle can be increased. As a result, it is possible to prevent interference with the support portion during rotation of the handle 45 while making the device configuration more compact.

Configuration 6. In a ground compacting device of the above embodiments, wherein the support portion (70) is provided lower than a handle (45) in a side view of the ground compacting device, and the handle (45) covers at least a part of the electrical component (e.g., 51).

By virtue of the ground compacting device of Configuration 6, it is possible to make the device configuration smaller while protecting the electrical components with the handle when the device falls over or the like in the non-use state.

Configuration 7. In the ground compacting device of the above embodiments, wherein the support portion (70) has at least a plate (e.g., 54), and

a battery (e.g., 51 in FIG. 3 and FIG. 5) included in the electrical component is attached to an upper surface (e.g., 354A in FIG. 2) of the plate, and

another electrical component (e.g., the PDU 55 of FIG. 3 and FIG. 5) included in the electrical component is attached to the lower surface (e.g., 354B of FIG. 2) of the plate, which is the back surface of the upper surface (354A).

By virtue of the ground compacting device of Configuration 7, the space on the lower surface side of the plate can be more effectively utilized compared with a structure in which electrical components (the battery 51 and the PDU 55) are stacked on one surface side (for example, the upper surface side), and therefore the configuration of the device can be reduced in size.

Also, since the battery needs to be charged by a charger outside the device at a predetermined time, the frequency of mounting/demounting of the battery is higher than that of the other electrical component (the PDU 55). By mountably/demountably attaching the battery which has a high mounting/demounting frequency to the upper surface side of the attachment plate via the holding tray, it is possible to improve work efficiency of the operator. Further, when a remaining battery power display unit is provided on the upper surface of the battery, a worker can easily visually recognize the remaining capacity during operation, and therefore can easily know when to charge the battery.

Configuration 8. In a ground compacting device of the above embodiments, the ground compacting device further comprises a reinforcing member (e.g., 64 in FIG. 1) connecting the handle (45) and the upper half (41b),

wherein the reinforcing member (64) covers at least a part of the electrical component attached to the support portion (70).

By virtue of the ground compacting device of Configuration 8, the electrical component can be protect-

ed by the reinforcing member when the ground compacting device falls over, or the like.
Configuration 9. In the ground compacting device of the above embodiments, wherein the reinforcing member (64) covers at least a part of the motor (10).

[0074] By virtue of the ground compacting device of the Configuration 9, the motor can be protected by the reinforcing member when the device falls over or the like.
[0075] The present invention is not limited to the above-described embodiments, and various modifications and variations are possible without departing from the spirit and scope of the present invention. Therefore, to apprise the public of the scope of the invention, the following claims are appended.
[0076] This application claims priority on the basis of the International Application No. PCT/JP2019/015211 filed April 5, 2019, the content of which is incorporated herein by reference in its entirety.

REFERENCE SIGNS LIST

[0077] 10: motor, 15: spacer, 40A: ground compacting device (rammer), 40B: ground compacting device (plate compactor), 41a: lower half, 41b: upper half, 41c: anti-vibration member, 42: ground leveling plate, 45: handle, 51: battery, 52: External Member, 53: holding tray, 54: attachment plate, 55: PDU, 56: PDU case, 70: support portion, 73: anti-vibration member, 144 and 154: upper halves, 145: lower half, 146: anti-vibration member, 147: handle, 150: motor, 152: drive pulley, 153: driven pulley, 158: excitation mechanism

Claims

1. A ground compacting device having a ground leveling plate and a motor for driving the ground leveling plate, the ground compacting device comprising:

   a support portion which is attached to an upper half of the ground compacting device via an anti-vibration member separately from a handle,
   wherein an electrical component for driving the motor is attached to the support portion.

2. The ground compacting device according to claim 1, wherein the anti-vibration member is provided between the upper half and the support portion separately from an anti-vibration member of the handle.

3. The ground compacting device according to claim 1 or 2, wherein the support portion has a rotational axis that is coaxial to the handle.

4. The ground compacting device according to any one of claims 1 to 3, wherein the handle is configured as a frame body in an upper surface view of the ground compacting device, and
   the support portion is disposed inside the frame body of the handle.

5. The ground compacting device according to any one of claims 1 to 4, further comprising a weight-adjusting portion on a side opposite to a position where the electrical component is attached, via the anti-vibration member of the support portion.

6. The ground compacting device according to any one of claims 1 to 5, wherein the support portion is provided lower than the handle in a side view of the ground compacting device, and the handle covers at least a part of the electrical component.

7. The ground compacting device according to any one of claims 1 to 6, wherein the support portion has at least a plate, and

   a battery included in the electrical component is attached to an upper surface of the plate, and
   another electrical component included in the electrical component is attached to the lower surface of the plate, which is a back surface of the upper surface.

8. The ground compacting device according to any one of claims 1 to 7, further comprising a reinforcing member connecting the handle and the upper half, wherein the reinforcing member covers at least a part of the electrical component attached to the support portion.

9. The ground compacting device according to claim 8, wherein the reinforcing member covers at least a part of the motor.

FIG. 1

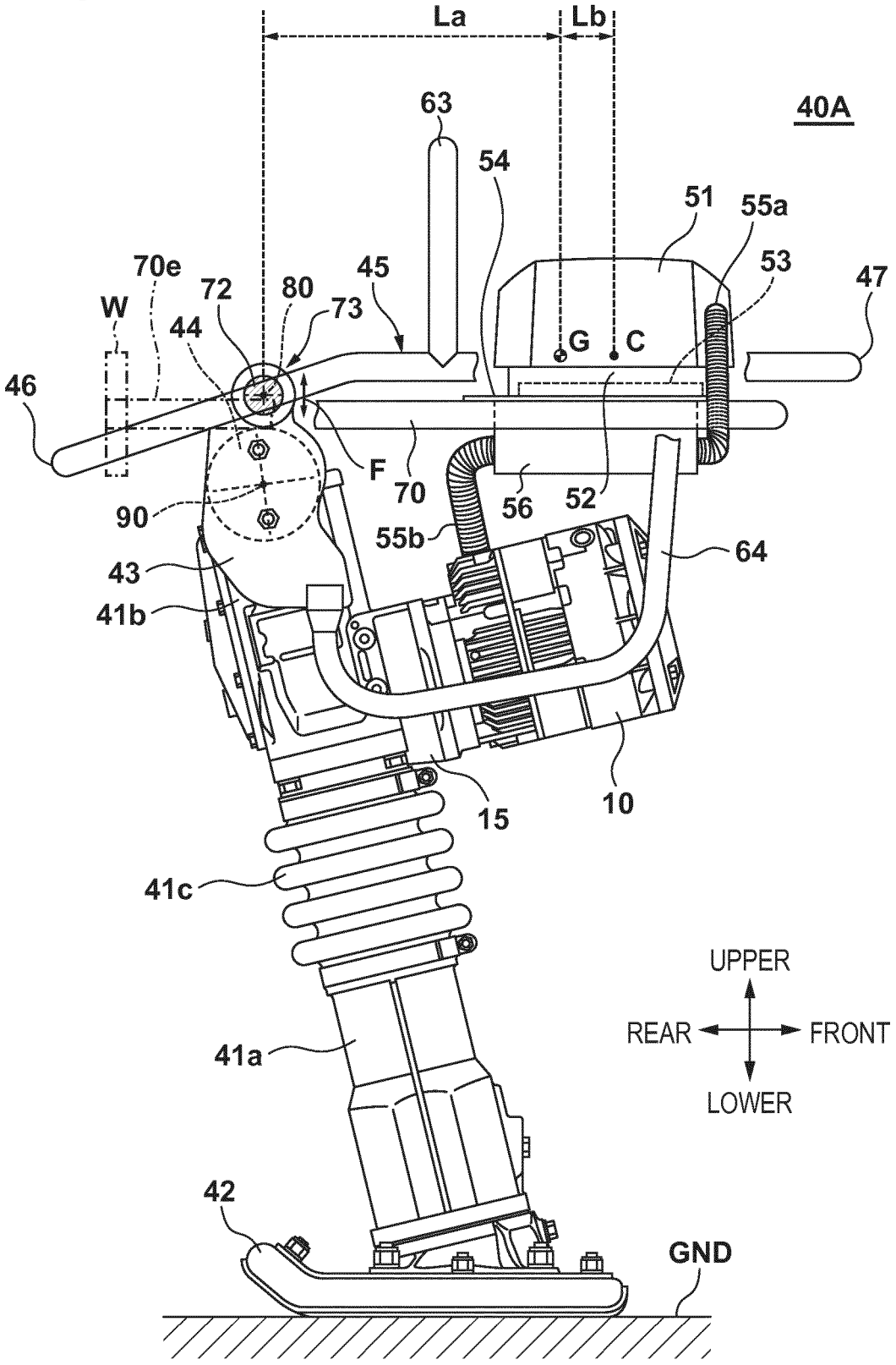

La
Lb
63
40A
54
51
55a
53
47
70e
72
80
45
W
44
73
G
C
46
F
70
56
52
90
55b
64
43
41b
15
10
41c
UPPER
REAR
FRONT
LOWER
41a
42
GND

FIG. 2

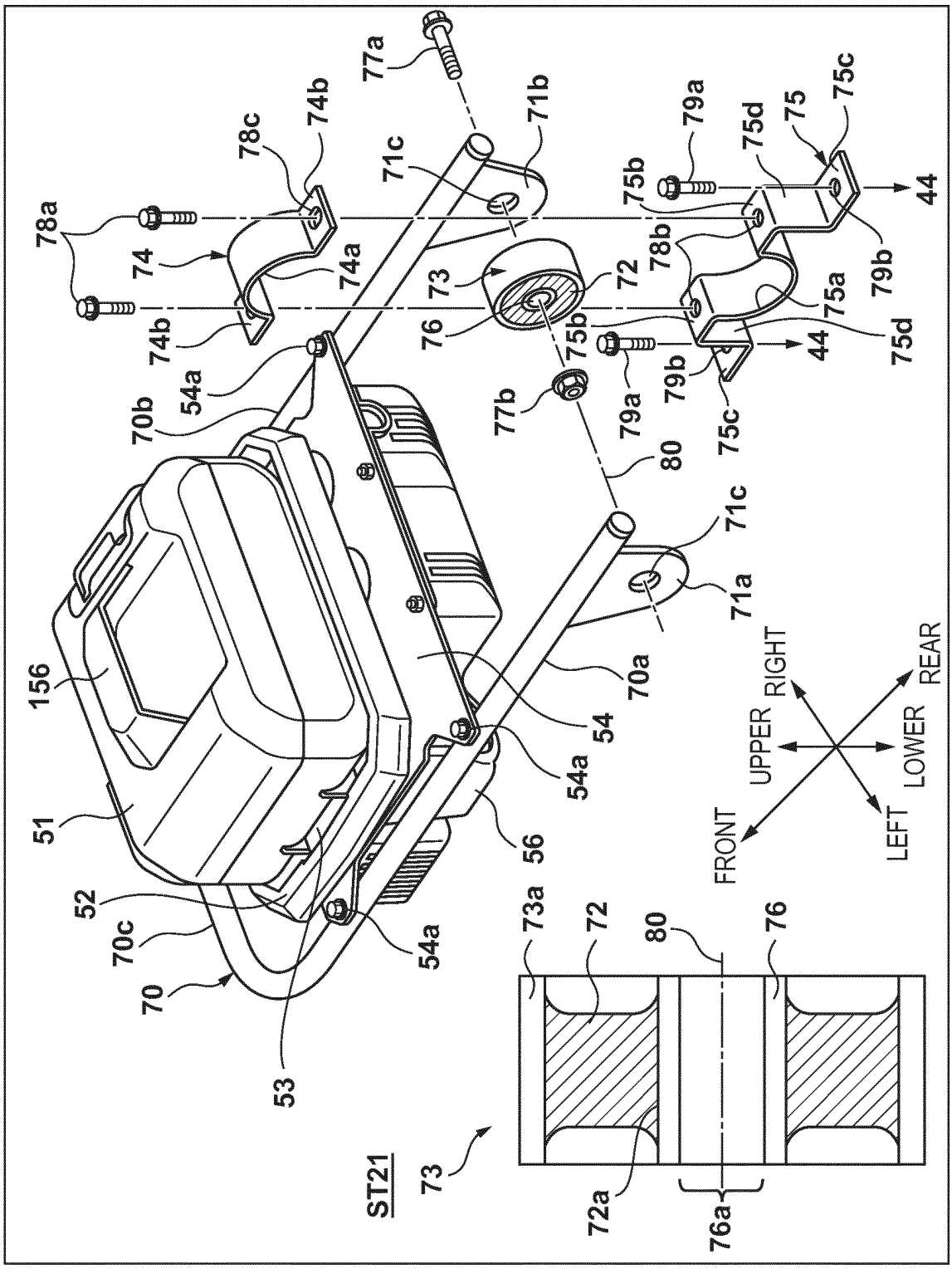

77a
71b
74b
78c
71c
79a
75d
75
75c
75b
44
78a
74
74a
73
72
78b
75a
79b
74b
76
75b
44
75d
54a
77b
79a
79b
75c
70b
80
71c
71a
70a
156
54
54a
51
56
52
73a
72
80
76
70c
54a
70
FRONT
UPPER
RIGHT
LEFT
LOWER
REAR
53
ST21
73
72a
76a

FIG. 3

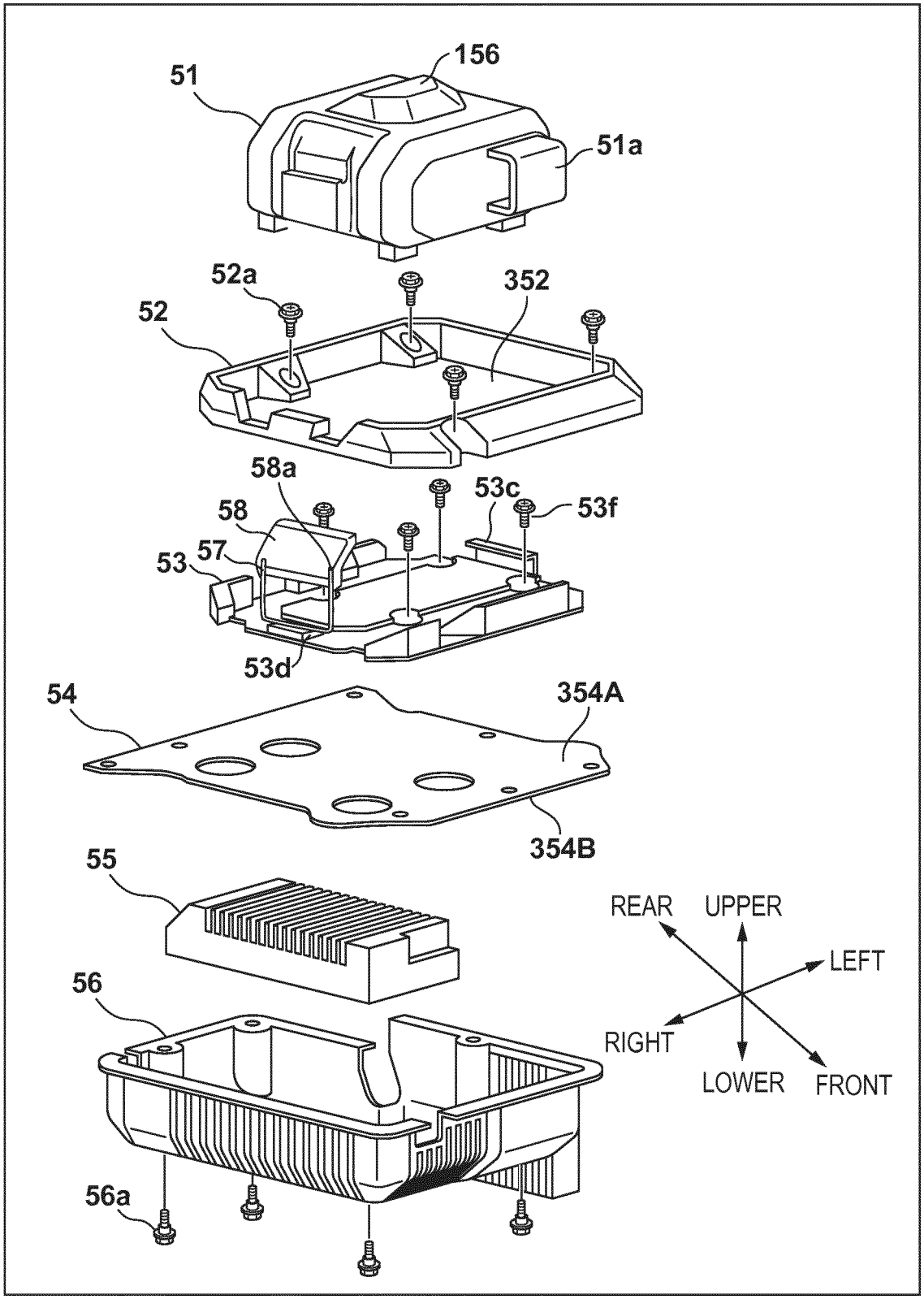

156
51
51a
52a
352
52
58a
53c
53f
58
57
53
53d
54
354A
354B
55
56
56a
REAR
UPPER
LEFT
RIGHT
LOWER
FRONT

FIG. 4

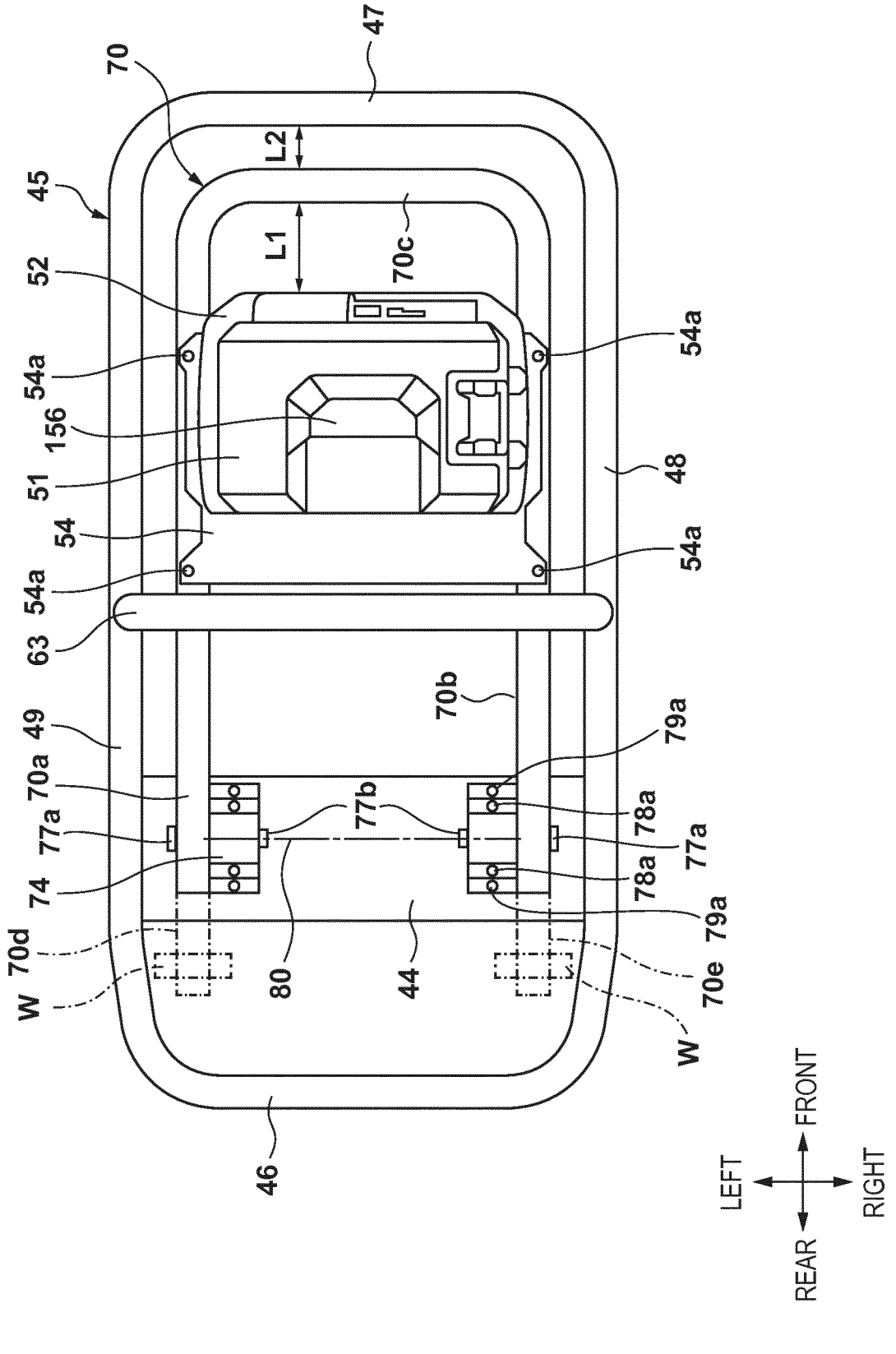

47
70
L2
45
L1
70c
52
54a
54a
156
51
48
54
54a
54a
63
70b
49
79a
70a
77b
78a
77a
77a
74
78a
79a
70d
80
44
70e
W
W
46
LEFT
FRONT
REAR
RIGHT

FIG. 5

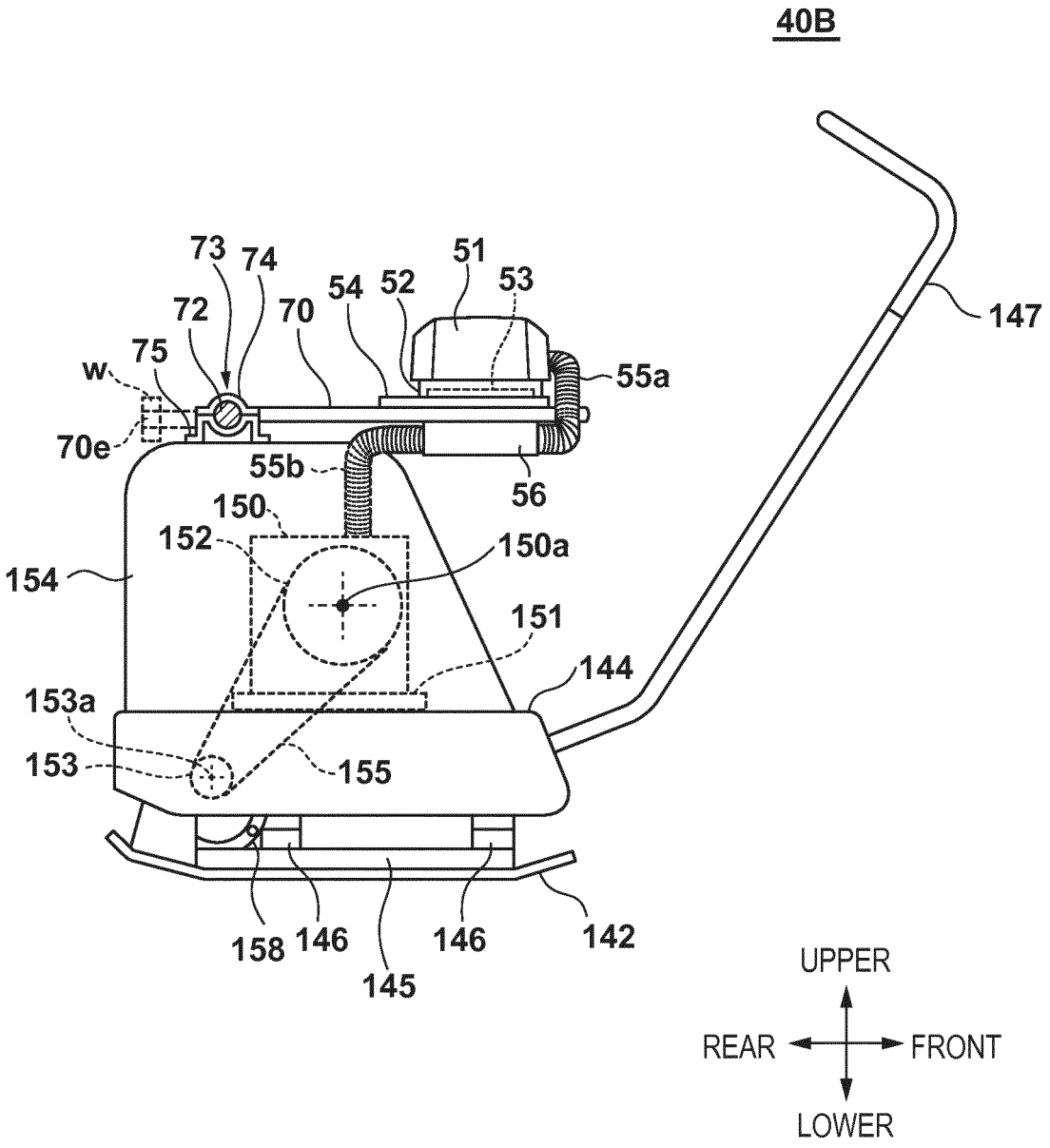

40B
147
73
74
72
70
54
52
51
53
75
w
55a
70e
55b
56
150
152
150a
154
151
144
153a
153
155
158
146
145
146
142
UPPER
REAR
FRONT
LOWER

FIG. 6

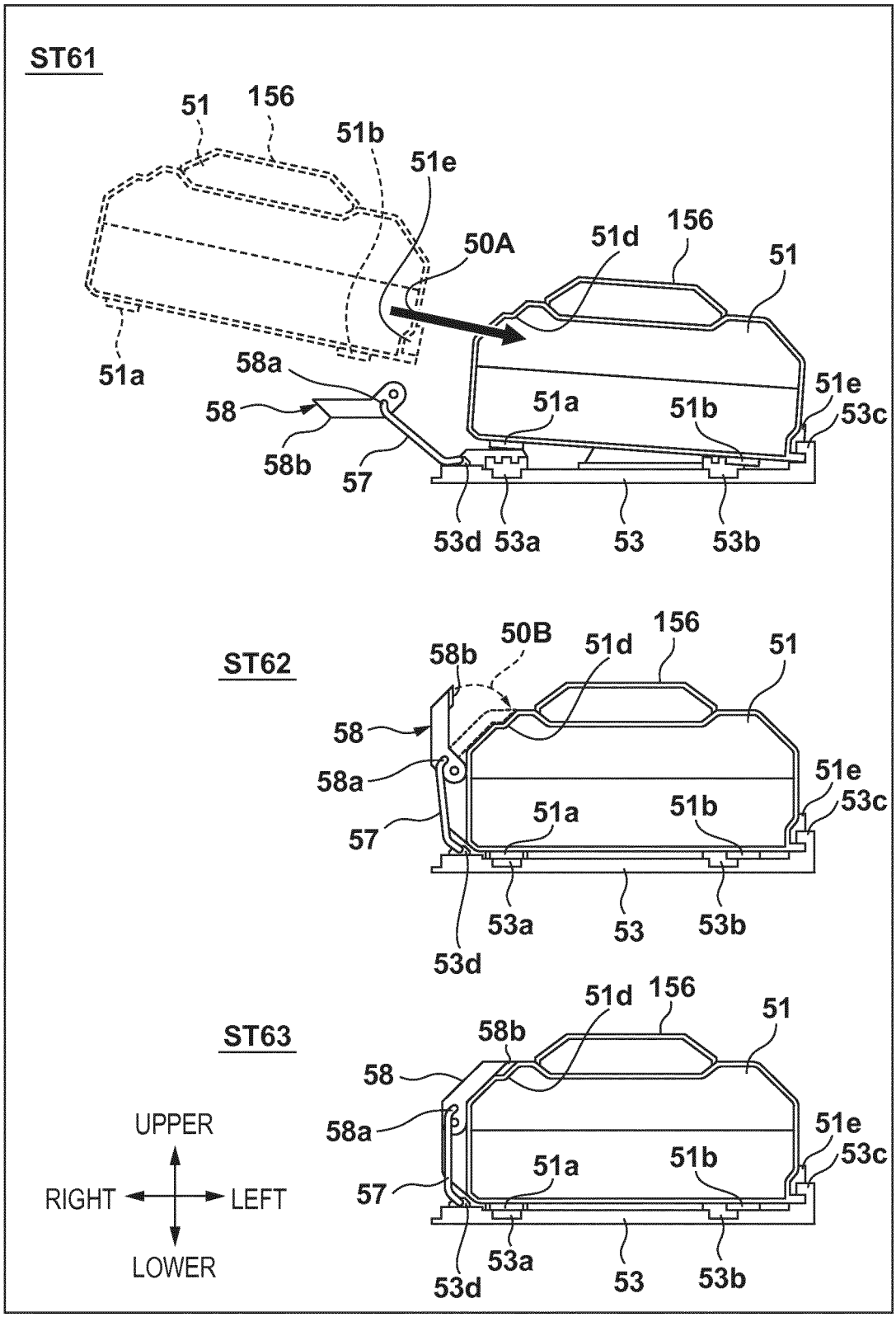

ST61
51
156
51b
51e
50A
51d
156
51
51a
58a
58
58b
57
51a
51b
51e
53c
53d
53a
53
53b
ST62
50B
58b
51d
156
51
58
58a
57
51a
51b
51e
53c
53a
53
53b
53d
ST63
51d
156
51
58b
58
58a
57
51a
51b
51e
53c
53a
53
53b
53d
UPPER
RIGHT
LEFT
LOWER

FIG. 7

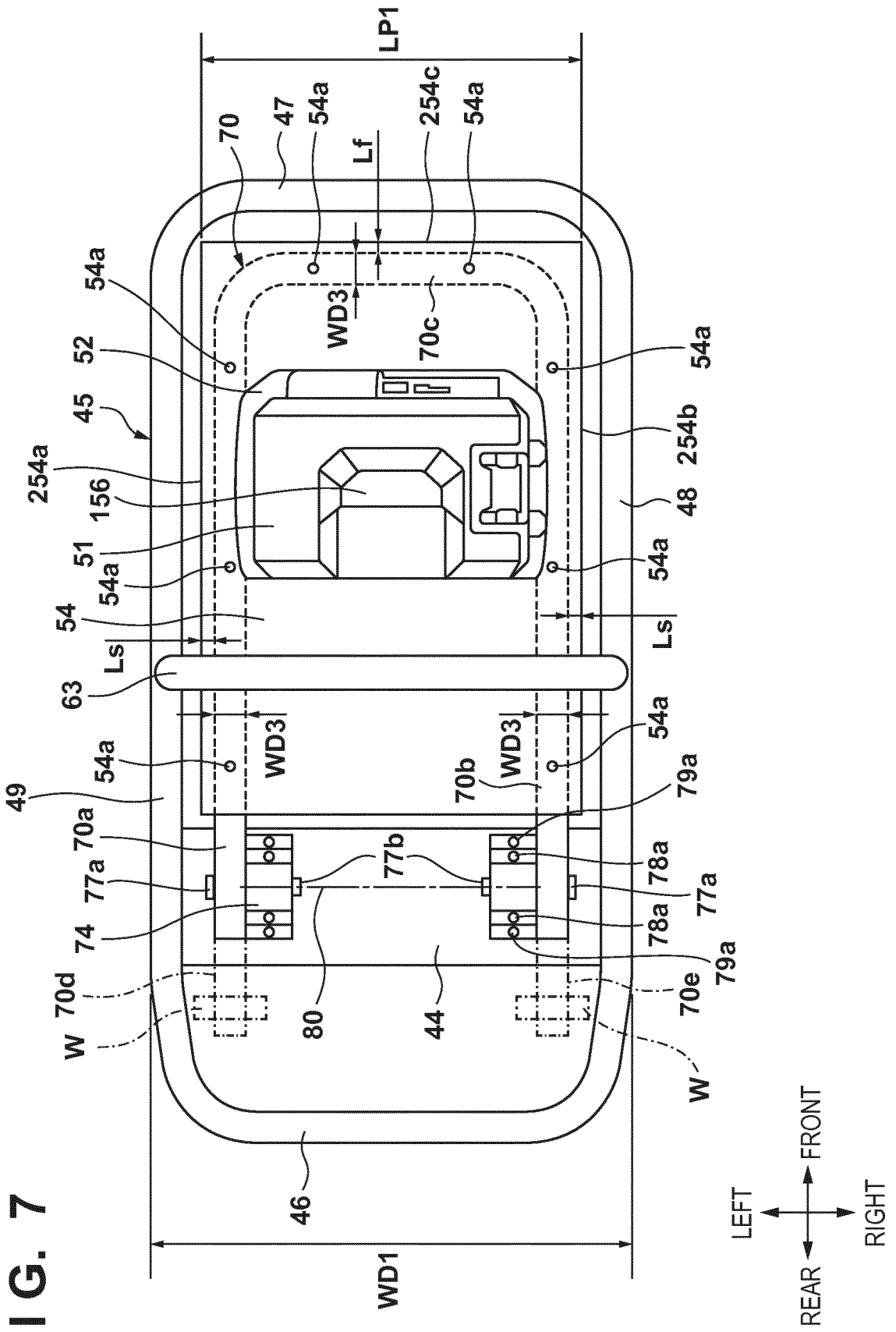

LP1
70
47
54a
Lf
254c
54a
WD3
70c
54a
52
54a
45
254b
254a
156
48
51
54a
54a
54
Ls
Ls
63
WD3
WD3
54a
54a
49
70b
79a
70a
77b
78a
77a
74
77a
78a
79a
70d
70e
W
80
44
W
46
WD1
LEFT
FRONT
REAR
RIGHT

FIG. 8

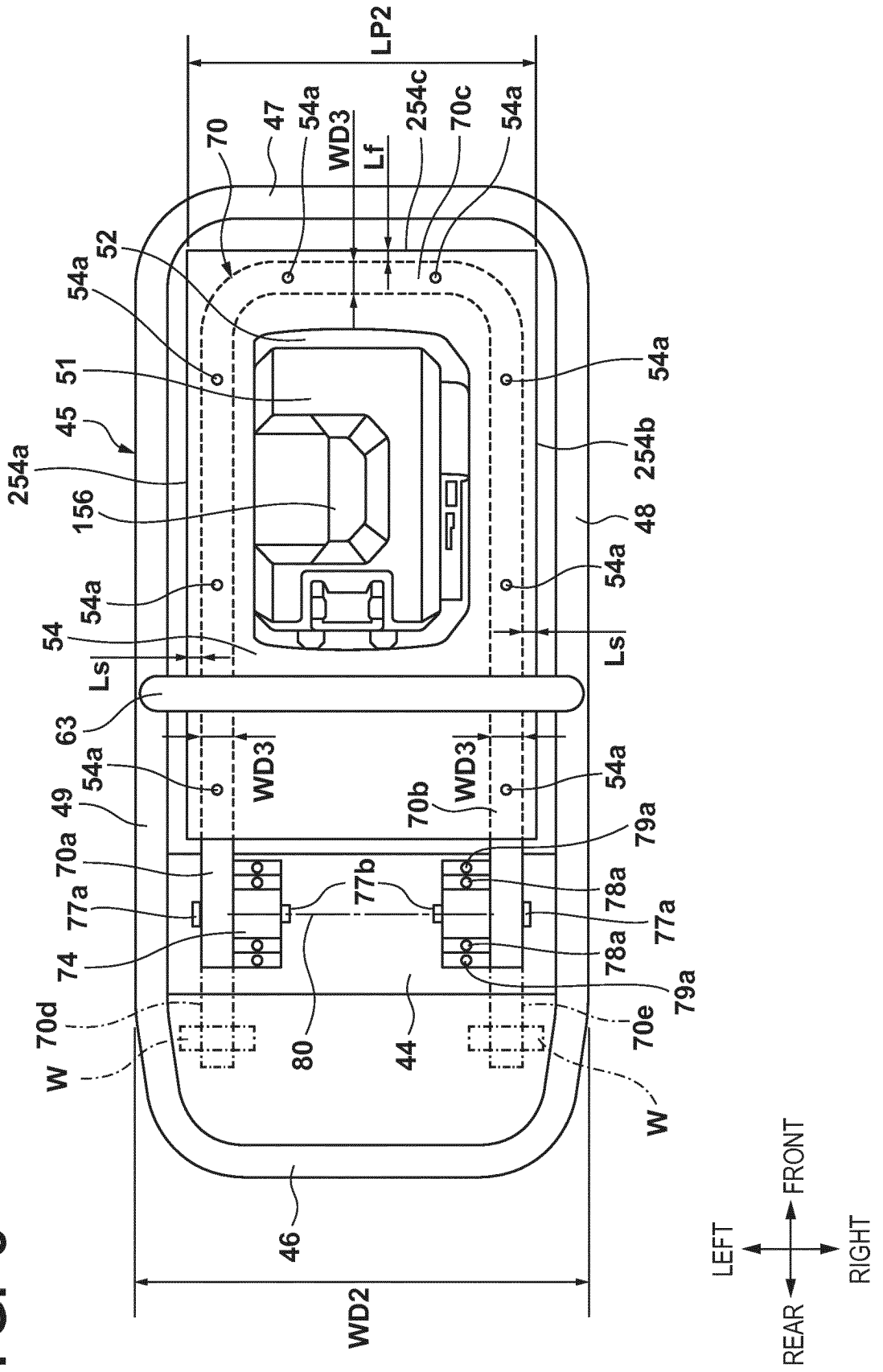

LP2
70
47
54a
WD3
Lf
254c
70c
54a
52
54a
51
45
254a
156
54a
254b
48
54a
54a
54
Ls
Ls
63
54a
WD3
WD3
54a
49
70b
79a
70a
77b
78a
77a
74
78a
77a
79a
W
70d
80
44
70e
W
46
WD2
LEFT
FRONT
REAR
RIGHT

FIG. 9

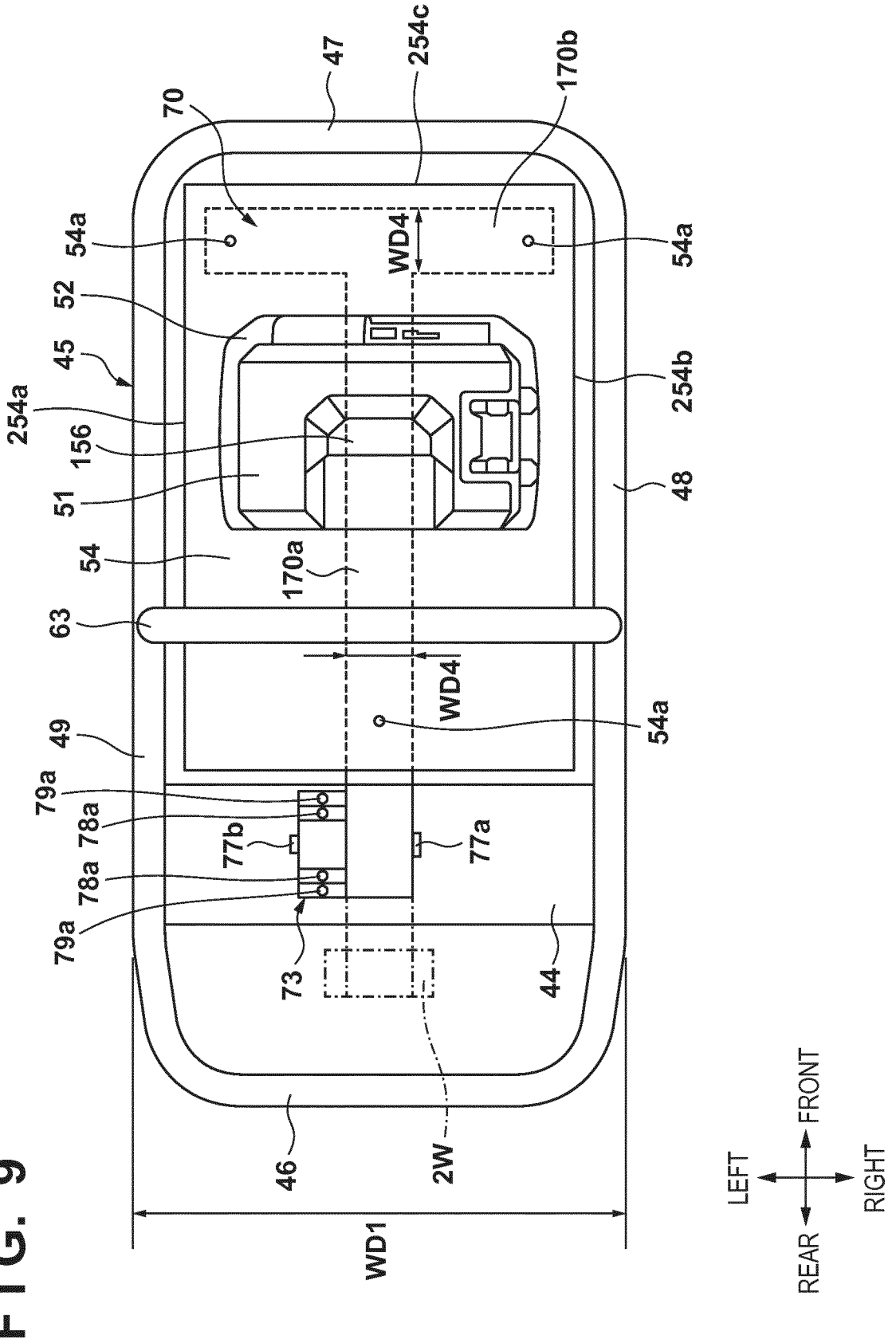
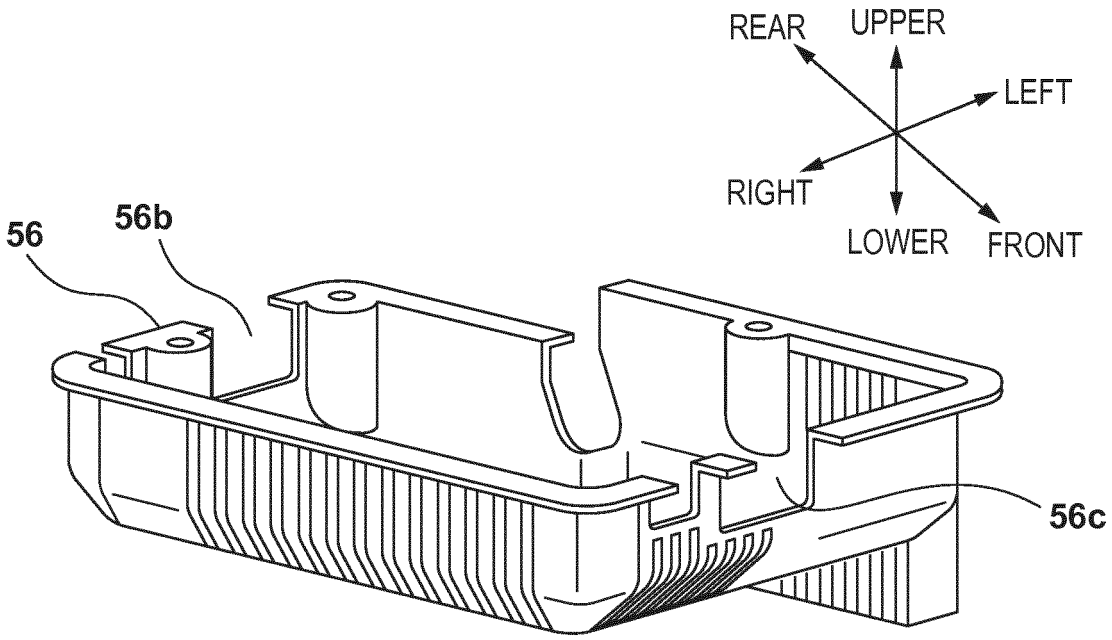

70
47
254c
170b
54a
WD4
54a
52
45
254a
156
51
254b
48
54
170a
63
WD4
54a
49
79a
78a
77b
77a
78a
79a
73
44
46
2W
WD1
LEFT
FRONT
REAR
RIGHT

FIG. 10



INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2019/018906

A. CLASSIFICATION OF SUBJECT MATTER
Int.Cl. E01C19/34(2006.01)i

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
Int.Cl. E01C19/34

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Published examined utility model applications of Japan	1922-1996
Published unexamined utility model applications of Japan	1971-2019
Registered utility model specifications of Japan	1996-2019
Published registered utility model applications of Japan	1994-2019

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	JP 9-264003 A (EKUSEN KK) 07 October 1997, entire text, all drawings (Family: none)	1-9
A	JP 2016-216939 A (HITACHI CONSTRUCTION MACHINERY CAMINO CO., LTD.) 22 December 2016, entire text, all drawings (Family: none)	1-9
A	JP 2014-173283 A (FUJI HEAVY IND LTD.) 22 September 2014, entire text, all drawings (Family: none)	1-9

☒ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"E" earlier application or patent but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
18.06.2019	09.07.2019

Name and mailing address of the ISA/	Authorized officer
Japan Patent Office 3-4-3, Kasumigaseki, Chiyoda-ku, Tokyo 100-8915, Japan	Telephone No.

Form PCT/ISA/210 (second sheet) (January 2015)

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2019/018906

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	Microfilm of the specification and drawings annexed to the request of Japanese Utility Model Application No. 171984/1982 (Laid-open No. 76604/1984) (HOKKAIDO KIDO SHISETSU KOGYO) 24 May 1984, entire text, all drawings (Family: none)	1-9
A	US 2006/0291958 A1 (PIRANDELLO INDUSTRIES LTD.) 28 December 2006, entire text, all drawings & US 2011/0211910 A1 & US 2011/0217121 A1 & WO 2012/058760 A1 & CA 2551264 A1	1-9
A	US 2014/0161541 A1 (BOMAG GMBH) 12 June 2014, entire text, all drawings & EP 2743400 A2 & DE 102012024222 A1	1-9

Form PCT/ISA/210 (continuation of second sheet) (January 2015)

REFERENCES CITED IN THE DESCRIPTION

This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.

Patent documents cited in the description

- JP 2002363915 A **[0004]**
- JP 2019015211 W **[0076]**