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(54) **Power supply apparatus and crane system**

opening formed in an insulation cover (42) which covers the power supply section, with a power supply section (43) which is provided on a side section on a traveling pathway of the self-traveling crane, and supplies electric power to the self-traveling crane. The opening is formed in a region including a bottom section of the insulation cover facing a pathway surface where the self-traveling crane travels, and opposite end sections (44,45) of the insulation cover in the traveling direction of the self-traveling crane.

Description

BACKGROUND OF THE INVENTION

Field of the Invention

[0001] The present invention relates to a power supply apparatus and a crane system.

Background Art

[0002] Conventionally, as a crane for transporting containers stored at a container yard, there has been known a self-traveling crane which self-travels along a lane at a container yard.

[0003] As an example of this type of self-traveling crane, Japanese Unexamined Patent Application, First Publication No. 2009-242101 discloses a self-traveling crane (yard crane) which is provided with a power supply apparatus and a rechargeable battery and which self-travels using electric power stored in the rechargeable battery. In the self-traveling crane disclosed in Japanese Unexamined Patent Application, First Publication No. 2009-242101 there is provided in the vicinity of a lane where containers are stored, a power supply rail which is formed in the lengthwise direction of the lane, and in the self-traveling crane there is provided a power receiving apparatus which extends and contracts or rotates so as to come in contact with this rail. According to the self-traveling crane disclosed in this Patent Document, by pressing a power collector against the rail in the extension/contraction direction of the power receiving apparatus, electric power can be received from the rail through the power collector.

[0004] However, in the power supply apparatus of the self-traveling crane disclosed in Japanese Unexamined Patent Application, First Publication No. 2009-242101, although the power supply rail is installed at a location higher than the height of an operator, there is still a possibility that the operator may come in contact with the rail.

[0005] The present invention takes the above circumstances into consideration, with an object of providing a power supply apparatus and a crane system that can further reduce the possibility of an operator coming in contact with power supply equipment, and can also facilitate the supply of electric power to a self-traveling crane.

SUMMARY OF THE INVENTION

[0006] A power supply apparatus of the present invention is provided with: at least one power collector which supplies electric power to a rechargeable battery equipped on a self-traveling crane; and a position adjusting section which is provided between a crane main body of the self-traveling crane and the power collector, and which adjusts a position in a widthwise direction orthogonal to a traveling direction of the self-traveling crane, of

the power collector with respect to the self-traveling crane. The power collector comes in contact, through an opening formed in an insulation cover which covers the power supply section, with a power supply section which is provided on a side section on a traveling pathway of the self-traveling crane, and supplies electric power to the self-traveling crane. The opening is formed in a region including a bottom section of the insulation cover facing a pathway surface where the self-traveling crane travels, and opposite end sections of the insulation cover in the traveling direction of the self-traveling crane.

[0007] The insulation cover may have; a widthwise guiding section which inclines in the widthwise direction of the self-traveling crane as it advances in the traveling direction of the self-traveling crane, and a heightwise guiding section which inclines in a projecting direction of the power collector as it advances in the traveling direction of the self-traveling crane.

[0008] The insulation cover may be formed so as to extend in the traveling direction from the end sections of the power supply section, by at least a length within which the power collector can be housed inside.

[0009] The power supply apparatus may have a plurality of the power collectors, and the position adjusting section may respectively support the power collectors at a plurality of locations along the traveling direction.

[0010] The power supply apparatus may have a magnetic guide line arranged so as to extend along an extending direction of a pathway surface where the self-traveling crane travels, and the power supply section may be arranged parallel with the magnetic guide line.

[0011] The position adjusting section may adjust a position of the power collector so that the power collector aligns with the power supply section in the widthwise direction, and the power collector may be pressed against the power supply section while the position thereof is adjusted by the position adjusting section.

[0012] The crane system of the present invention is provided with: a container yard where containers are stored; a self-traveling crane which transports the containers; the above mentioned power supply apparatus which is provided in the self-traveling crane; and a plurality of power supply sections which supply driving electric power to the self-traveling crane via the power collector of the power supply apparatus. The container yard has a plurality of lanes where a plurality of the containers are arranged in line, and along which the self-traveling crane travels, and the power supply section is provided in each of the lanes.

[0013] According to the power supply apparatus and the crane system of the present invention, the insulation cover is provided on the power supply section, and electricity being supplied to the power supply section will not flow to the body of an operator even if the operator comes in contact with the insulation cover. Therefore, supply of electric power to the self-traveling crane can be facilitated, and the possibility of electricity flowing to the body of an operator can be reduced.

BRIEF DESCRIPTION OF THE DRAWINGS

[0014] FIG. 1 is an overall view showing a crane system of one embodiment of the present invention.

FIG. 2 is an enlarged view showing a self-traveling crane and a traveling lane in the crane system.

FIG. 3 is a front view showing a configuration of a part of the self-traveling crane.

FIG. 4 is a perspective view showing a configuration of a power supply apparatus of the self-traveling crane.

FIG. 5A is a perspective view showing a configuration of a part of the power supply apparatus.

FIG. 5B is a side view showing a configuration of a part of the power supply apparatus.

FIG. 6A and FIG. 6B are perspective views showing a configuration of a recharging terminal section in the crane system.

FIG. 7 is a cross-sectional view along the line Z-Z in FIG. 6A.

FIG. 8 is a drawing for describing an operation during use of the self-traveling crane provided with the crane system and the power supply apparatus.

FIG. 9 is a drawing for describing an operation during use of the self-traveling crane provided with the crane system and the power supply apparatus.

PREFERRED EMBODIMENT

[0015] Hereunder is a description of a power supply apparatus 30, a self-traveling crane 10 equipped with the power supply apparatus 30, and a crane system 1 provided with a plurality of the self-traveling cranes 10, according to an embodiment of the present invention.

FIG. 1 is an overall view showing the crane system 1 provided with a plurality of the self-traveling cranes 10. As shown in FIG. 1, the crane system 1 of the present embodiment is provided with; a plurality of traveling lanes L respectively installed on a pathway surface R within a container yard Y, a plurality of the self-traveling cranes 10 which travel within the respective traveling lanes L, and a plurality of external power supplies 2. The external power supplies 2 are provided as external equipment corresponding respectively to the traveling lanes L, and supply electric power to the self-traveling cranes 10.

[0016] In the crane system 1 of the present embodiment, a ground guide line 3 is provided on the pathway surface R in the extending direction A-B of each of the traveling lanes L. The ground guide line 3 corresponds to a position sensor 21 of the self-traveling crane 10 described later, and is provided within the traveling lane L so as to extend on the side where the recharging terminal section 40 is grounded, on the widthwise direction C-D orthogonal to the extending direction A-B side (the C side according to FIG. 1). The ground guide line 3 of the present embodiment is a magnetic guide line which contains a magnetized magnetic material.

[0017] In the crane system 1 of the present embodiment, the self-traveling crane 10 can travel in the extending direction A-B of the traveling lane L. Furthermore, the self-traveling crane 10 can travel so as to move from one traveling lane L to another traveling lane L. FIG. 1 illustrates three of the traveling lanes L and three of the self-traveling cranes 10 arranged on these respective traveling lanes L. However, the number of the traveling lanes L and the number of the self-traveling cranes 10 are not limited to the numbers illustrated in FIG. 1.

[0018] Next, the self-traveling crane 10 is described in detail.

[0019] The self-traveling crane 10 is a crane which travels within each of the traveling lanes L within the container yard Y to thereby transport containers 100 stored at the container yard Y, and which loads and unloads the containers 100 carried in and out by a trailer, transporting truck, or the like (not shown in the drawing), which transports the containers 100. The self-traveling crane 10 of the present embodiment is a tired type gantry crane (rubber tired gantry crane) which self-travels in the extending direction A-B of the traveling lane L using tires.

[0020] Moreover, the self-traveling crane 10 of the present embodiment is a battery-operated type crane which stores electric power supplied from the external power supply 2 in a rechargeable battery B1 provided in the self-traveling crane 10, and which uses the electric power stored in the rechargeable battery B1 to thereby self-travel and lift or lower the container 100.

[0021] FIG. 2 is an enlarged view showing the self-traveling crane 10 and the traveling lane L in the crane system 1. Moreover, FIG. 3 is a front view showing a configuration of a part of the self-traveling crane 10.

As shown in FIG. 2 and FIG. 3, the self-traveling crane 10 is provided with a gantry type crane main body 11 which straddles over the storage region for storing containers 100, and a power supply apparatus 30 which supplies electric power for operating the self-traveling crane 10.

The crane main body 11 has tired type traveling units 14, gantry type frames 17, each of which includes leg sections 15 with the traveling device 14 provided at the bottom end thereof and a beam section 16 extending between the top ends of the leg sections 15, and a suspension mechanism 18 suspended from the beam section 16.

[0022] A pair of the traveling units 14 are provided on each pair of the leg sections 15 on opposite sides of the beam section 16 in the direction orthogonal to the extending direction E-F, that is, in the direction substantially matching the extending direction A-B of the traveling lane L. Each of the traveling units 14 has traveling wheels 14a made from resin materials such as rubber. Four of the traveling wheels 14 are provided on each leg of the leg section 15, and sixteen in total of the traveling wheels 14a are provided in a single self-traveling crane 10.

[0023] The traveling units 14 are controlled by a remote operating device (not shown in the drawing), and the ori-

entation thereof on the pathway surface R is rotated about a rotation shaft 14b, thus being capable of changing the traveling direction of the self-traveling crane 10. In the present embodiment, the traveling units 14 are controlled based on automatic operation command signals in the remote operating device, and the self-traveling crane 10 can travel automatically within a traveling lane L, and travel back and forth between traveling lanes L. In the remote operating device, the self-traveling crane 10 can also be operated remotely by hand by switching from automatic operation to manual operation.

[0024] As shown in FIG. 3, in the crane main body 11, at the bottom end section of the leg section 15 on one side E of the extending direction E-F of the beam section 16, there is installed a position detection section 22 for detecting the position of the crane main body 11 with respect to the ground guide line 3. On the position detection section 22 there is provided a position sensor 21 with a detection region facing the ground guide line 3. The position sensor 21 detects the relative position between the ground guide line 3 and the position sensor 21, and detects the C-D direction position of the self-traveling crane 10 on the pathway surface R with respect to the ground guide line 3.

In the present embodiment, the position sensor 21 is a magnetic sensor which detects magnetism.

[0025] An appropriate sensor may be employed for the position sensor 21 according to the configuration of the ground guide line 3, and it is not limited to a magnetic sensor. For example, in those cases where the ground guide line 3 is a marking or the like drawn on the pathway surface R, the position sensor 21 may be a CCD camera configured to detect positions relative to the ground guide line 3 using image processing.

[0026] As shown in FIG. 2, the beam sections 16 are supporting members for supporting the suspension mechanism 18 and suspending a container 100. On each of the beam sections 16 there is provided a guide rail 16a on which the suspension mechanism 18 can travel in the extending direction E-F of the beam section 16. The suspension mechanism 18 receives electric power from the rechargeable battery B1 and thereby operates on electric power as a power source to perform loading and unloading of the container 100. The suspension mechanism 18 has; a trolley 18a which travels along the guide rails 16a of the beam sections 16, a spreader 18b which holds the container 100, suspending ropes 18c which suspend the spreader 18b from the trolley 18a, a winch 18d which reels and unreels the suspending rope 18c, and a suspension mechanism control section (not shown in the drawing) which controls operations of the trolley 18a, the spreader 18b, and the winch 18d.

[0027] FIG. 4 is a perspective view showing a configuration of the power supply apparatus 30 of the self-traveling crane 10.

As shown in FIG. 4, the power supply apparatus 30 has: strut members 31; a first supporting section 32 fixed on the strut members 31; links 33 (link 33a and link 33b) and

links 34 (link 34a and link 34b) connected to opposite ends of the first supporting section 32; a second supporting section 35 connected to the links 33 and the links 34; a strut member 36 fixed on the second supporting section 35; connecting members 37 (connecting member 37a and connecting member 37b), with one end connected to the strut member 36 and which extend in the traveling direction of the self-traveling crane 10; strut members 38 (strut member 38a and strut member 38b) which are connected to the other ends of the connecting members 37 and extend in the height direction of the self-traveling crane 10; and power collectors 39 (power collector 39a and power collector 39b) respectively fixed on the upper side end sections of the strut members 38.

[0028] FIG. 5A is a perspective view showing a configuration of a part of the power supply apparatus 30.

As shown in FIG. 5A, between the first supporting member 32 and the second supporting member 35 there is provided an extension/contraction operation section S which operates to extend and contract in the widthwise direction of the self-traveling crane 10. In the present embodiment, the extension/contraction operation section S is an air cylinder which uses air pressure to perform extension/contraction operations. On the first supporting section 32 there is fixed a cylinder S1, and on the second supporting section 35 there is fixed a piston rod S2.

[0029] As shown in FIG. 4 and FIG. 5A, the strut members 31 project from the leg section 15 of the crane main body 11 towards the widthwise outer side of the self-traveling crane 10, which is orthogonal to the traveling direction of the self-traveling crane 10 (the A-B direction illustrated in FIG. 2). In the present embodiment, the strut members 31 have one end thereof fixed at two locations distanced from each other in the traveling direction of the self-traveling crane 10, on the outer surface on the widthwise outer side of the leg section 15. The strut members 31 are formed for example from a rectangular column-shaped metallic material. The power supply apparatus 30 is supported, via the strut members 31, on the leg section 15 of the self-traveling crane 10.

[0030] The first supporting section 32 is formed from a rod-shaped metallic material with a lengthwise direction corresponding to the traveling direction of the self-traveling crane 10 (the extending direction A-B of the traveling lane L). On lengthwise opposite end sections of the first supporting section 32, there are provided concavities 32a into which one end of the links 33 is inserted, and rotation shaft members 32b which extend in the height direction of the self-traveling crane 10 and connect the links 33 and the first supporting member 32. Moreover, the cylinder S1 of the extension/contraction operation section S mentioned above is fixed on the outer surface of the lengthwise intermediate section of the first supporting section 32.

[0031] Each of the links 33 is a rod-shaped member which is capable of rotating about the rotation shaft member 32b with respect to the first supporting section 32 in a plane parallel with the pathway surface R of the con-

tainer yard Y (refer to FIG. 1). The links 33 are formed for example from a rectangular column-shaped metallic material with one end thereof connected to the lengthwise end section of the first supporting section 32 and the other end thereof connected to the end section of the link 34. Moreover, the links 34 are formed for example from a rectangular column-shaped metallic material as with the links 33. The one ends of the links 34 are connected, via rotation shafts which extends in the height direction of the self-traveling crane 10, to the links 33. The other ends of the links 34 are connected, via rotation shafts which extend in the height direction of the self-traveling crane 10, to the opposite end sections of the second supporting section 35.

[0032] The second supporting section 35 is formed for example from a metallic material which extends in the traveling direction of the self-traveling crane 10. To the second supporting section 35 there is connected the other ends of the links 34. On the lengthwise intermediate section of the second supporting section 35, there is fixed the piston rod S2 of the extension/contraction operation section S. Thus, the extension/contraction operation section S performs an extending/contracting operation, and thereby, the second supporting section 35 performs an advancing/retracting operation in the widthwise direction of the self-traveling crane 10 with respect to the self-traveling crane 10, while maintaining its parallel positional relationship with the first supporting section 32.

[0033] The first supporting section 32, the links 33 and 34, the second supporting section 35, and the extension/contraction operation section S are included in a position adjusting section 30A. The position adjusting section 30A adjusts the position of the power collectors 39 in the widthwise direction of the self-traveling crane 10.

[0034] FIG. 5B is a side view showing a configuration of a part of the power supply apparatus 30.

As shown in FIG. 4 and FIG. 5B, the strut member 36 is fixed on the side surface of the second supporting section 35, and is formed so as to extend upward in the height direction of the self-traveling crane 10. The strut member 36 is fixed on the second supporting section 35 at two locations distanced from each other in the traveling direction of the self-traveling crane 10.

[0035] The connecting members 37 are connected to the strut member 36 so as to be able to rotate about rotation shafts with center axial directions facing the widthwise direction of the self-traveling crane 10. Moreover, between the connecting members 37 and the strut member 36, there is provided a biasing device (not shown in the drawing) which presses the connecting members 37 upward when the connecting members 37 on the end connected to the strut members 38 are pressed downward in the height direction of the self-traveling crane 10. Moreover, the connecting members 37 themselves may be formed with a material having elasticity.

In the present embodiment, two connecting members 37 are provided between the strut member 36 and the strut member 38a, and two are provided between the strut

member 36 and the strut member 38b. The connecting members 37 are of a parallel link structure respectively between the strut member 36 and the strut member 38a, and between the strut member 36 and the strut member 38b.

[0036] The strut member 38 extends in the height direction of the self-traveling crane 10, and is formed for example from a rectangular column-shaped metallic material.

[0037] Each of the power collectors 39 is formed in a rod shape with the lengthwise direction corresponding to the traveling direction of the self-traveling crane 10. Moreover, as for the outer surface of the power collector 39, the upper surface in the height direction of the self-traveling crane 10 is bent, and the contour shape of the upper side thereof is of a substantially arc shape when seen on the vertical cross-section along the widthwise direction of the self-traveling crane 10. Furthermore, the lengthwise opposite end sections of the power collector 39 are formed in a tapered shape which inclines downward as it advances towards the opposite ends of the self-traveling crane 10 in the traveling direction of the self-traveling crane 10.

The width of the power collector 39 measured in the widthwise direction of the self-traveling crane 10 is a size such that it can be inserted in a clearance gap of opening width w3 of a power supply section 43 of the recharging terminal section 40 described later. Moreover, it is preferable that the dimension of the power collector 39 be appropriately set corresponding to the shape of the power supply section 43.

The strut member 36 fixed on the second supporting section 35, the connecting members 37, and the strut members 38, are included in a height adjusting section 30B. The height adjusting section 30B moves the power collector 39 in the height direction in order to press the power collector 39 against the power supply section 43 described later.

[0038] Hereunder is a description of the recharging terminal section 40 which is an ancillary facility connected to the external power supplies 2 arranged in the container yard Y.

As shown in FIG. 1, the external power supplies 2 are arranged on one end (A side shown in FIG. 1) in the extending direction of the traveling lane L at the container yard Y, and are respectively arranged for each of the traveling lanes L. One external power supply 2 may be provided for a plurality of traveling lanes L.

[0039] For the external power supplies 2, there is provided a supply wiring path 4 for supplying driving electric power to the self-traveling crane 10. The supply wiring path 4 is provided on each of the traveling lanes L along the extending direction A-B of the traveling lane L. The supply wiring path 4 may be buried under the ground of the traveling lane L, or may be arranged and laid along the pathway surface R of the traveling lane L. On the supply wiring path 4 there is provided the recharging terminal section 40 (recharging terminal section 40a and

recharging terminal section 40b) which is arranged extending in the height direction from the pathway surface R.

[0040] The recharging terminal sections 40 are provided in each of the traveling lanes L. Moreover, each of the recharging terminal sections 40 is provided in two locations which are distanced from each other in the extending direction A-B of the traveling lane L so as to be on both sides of the storage region where the containers 100 are stored. In the present embodiment, the recharging terminal section 40 may be provided in one location for each of the traveling lanes L, or it may be provided in more than two locations for each of the traveling lanes L.

[0041] FIG. 6A and FIG. 6B are perspective views showing a configuration of the recharging terminal section 40.

As shown in FIG. 2, FIG. 6A, and FIG. 6B, the recharging terminal section 40 has a strut 41, an insulation cover 42, the power supply section 43, and guiding members 44 and 45. The strut 41 is fixed on the pathway surface R on the side section of the traveling lane L. The insulation cover 42 is fixed on the strut 41, and extends along the extending direction A-B of the traveling lane L. The power supply section 43 is arranged on the inner side of the insulation cover 42, and is connected electrically to the supply wiring path 4. The guiding members 44 and 45 are respectively attached to the opposite ends of the insulation cover 42, and extend along the extending direction of the traveling lane L.

[0042] The strut 41 is formed standing vertically from the pathway surface R at its end closer to the pathway surface R. The upper end of the strut 41 is formed in a L shape which bends inward in the widthwise direction of the traveling lane L.

[0043] The insulation cover 42 is a cover which is provided to prevent an operator from coming in contact with the power supply section 43 and being exposed to electrification within the container yard Y. The insulation cover 42 is open at opposite lengthwise end sections thereof and at the bottom section facing the pathway surface R. That is to say, an opening O of the insulation cover 42 is formed in a region including a bottom section of the insulation cover 42 facing the pathway surface R where the self-traveling crane 10 travels, and the opposite end sections of the insulation cover 42 in the traveling lane L of the self-traveling crane 10.

The cross-sectional shape of the insulation cover 42 orthogonal to the lengthwise axis thereof is of an arch shape. The upper side of the insulation cover 42 covers the power supply section 43 arranged thereinside so that it will not be exposed to rain and so forth. As the material of the insulation cover 42, there may be employed materials having insulating properties such as resin and ceramic.

[0044] The power supply section 43 is used to supply electric power supplied from the external power supplies 2 through the supply wiring path 4 (refer to FIG. 1) to the power collectors 39 of the self-traveling crane 10. The

power supply section 43 is fixed on the insulation cover 42 along the inner circumferential surface of the insulation cover 42. The power supply section 43 is formed in an arch shape such that the lengthwise opposite end sections thereof and the bottom section facing the pathway surface R are open. That is to say, the opening of the power supply section 43 is formed in a region including a bottom section of the power supply section 43 facing the pathway surface R, and the opposite lengthwise end sections. The power collectors 39 are inserted into and pressed against the power supply section 43 from the lower side to the upper side in the height direction of the self-traveling crane 10.

[0045] FIG. 7 is a cross-sectional view along the line Z-Z in FIG. 6A.

As shown in FIG. 7, the length L3 of the power supply section 43 is preferably a length which allows the power collectors 39a and 39b provided on the self-traveling crane 10 to simultaneously come in contact with the power supply section 43.

[0046] As the material of the power supply section 43, a material having electrical conducting properties and a low level of electrical resistance is preferable. Specifically, as the material of the power supply section 43, iron, copper, aluminum, and so forth may be employed. Moreover, as the material of the power supply section 43, a material having a high level of corrosion resistance against rain and so forth may be employed.

[0047] As shown in FIG. 6A and FIG. 6B, the guiding member 44 and the guiding member 45 are fixed on the lengthwise end sections of the insulation cover 42. The shape of the guiding member 44 and the guiding member 45 is an arch shape which opens at the lengthwise opposite end sections and the bottom section facing the pathway surface R, as with the insulation cover 42 and the power supply section 43. Moreover, the end sections of the guiding member 44 and the guiding member 45 on the side where they are connected to the insulation cover 42 are continuous with the inner side of the arch of the insulation cover 42.

[0048] In the guiding member 44 and the guiding member 45, the width w1 of the opening on the side further from the insulation cover 42 is greater than the width w2 of the opening on the side closer to the insulation cover 42. That is to say, in the guiding member 44 and the guiding member 45, inner wall surfaces 45a and 45b which face each other on opposite sides of the opening facing the pathway surface R side, are formed in a tapered shape so that the width therebetween gradually becomes narrower from the width w1 to the width w2, and this portion forms a widthwise guiding section G1 which guides the power collectors 39 to the power supply section 43. That is to say, the inner wall surfaces 45a and 45b which form the widthwise guiding section G1 incline so as to become closer to each other in the widthwise direction of the self-traveling crane 10 as they advance in the traveling direction of the self-traveling crane 10.

[0049] Moreover, as shown in FIG. 7, the edge lines of the arch-shaped inner surfaces of the guiding member 44 and the guiding member 45 incline upward as they advance away from the insulation cover 42 in the traveling direction of the self-traveling crane 10. Therefore, in the guiding member 44 and the guiding member 45, the height h1 of the opening on the side further from the insulation cover 42 is greater than the height h2 of the opening on the side closer to the insulation cover 42. That is to say, in the guiding member 44 and the guiding member 45, each of inner wall surfaces 44c and 45c which face the pathway surface R forms a heightwise guiding section G2 which guides the power collectors 39 to the power supply section 43. That is to say, each of the inner wall surfaces 44c and 45c which form the heightwise guiding section G2 inclines diagonally downward as it advances in the traveling direction of the self-traveling crane 10.

[0050] Moreover, as shown in FIG. 7, it is preferable that the length L2 of the guiding members 44 and 45 in the traveling direction of the self-traveling crane 10 (A-B direction shown in FIG. 2), is a length such that the power collectors 39a and 39b provided in the self-traveling crane 10 are both positioned inside of the guiding members 44 and 45. In a case where two of the power collectors 39a and 39b are both positioned inside of the guiding member 44, or where two of the power collectors 39a and 39b are both positioned inside of the guiding member 45, if one of the two power collectors 39a and 39b is in contact with the power supply section 43, the other one of the two power collectors 39a and 39b is either in contact with the power supply section 43, or positioned inside of the arch of the guiding member 44 or the guiding member 45. That is to say, the power collectors 39a and 39b are not exposed to the outside. Therefore, it is possible to reduce the possibility of an operator, who performs operations within the container yard Y, from coming in contact with the power collectors 39 when power supply is being performed from the power supply section 43 via the power collectors 39.

[0051] As the material of the guiding member 44 and the guiding member 45, there may be employed a material having insulating properties as with the insulation cover 42.

[0052] Hereunder, there are described operations during use of the crane system 1, and the self-traveling crane 10 provided with the power supply apparatus 30 of the embodiment with the configuration described above.

As shown in FIG. 1 to FIG. 3, when the self-traveling crane 10 travels on the traveling lane L, the position sensor 21 detects its position relative to the ground guide line 3. The traveling units 14 of the self-traveling crane 10 are controlled based on the relative position information detected by the position sensor 21, using an automatic operating device for example, so that the position sensor 21 is positioned on the ground guide line 3.

[0053] The self-traveling crane 10 travels with electric power stored in the rechargeable battery B1 as a power

source. If the electric power stored in the rechargeable battery B1 decreases, the self-traveling crane 10 travels along the traveling lane L to a position where there is a recharging terminal section 40, in order to supply electric power to the rechargeable battery B1. In the present embodiment, the self-traveling crane 10 may travel to either one of the recharging terminal section 40a and the recharging terminal section 40b. For example, the self-traveling crane 10 may travel to either one of the recharging terminal sections 40a and 40b closer thereto, or the self-traveling crane 10 may travel toward the recharging terminal section which results in a shorter traveling distance for the self-traveling crane 10, based on loading/unloading schedules of the containers 100.

[0054] FIG. 8 and FIG. 9 are drawings for describing operations during use of the crane system 1, and the self-traveling crane 10 provided with the power supply apparatus 30.

As shown in FIG. 8, in the power supply apparatus 30, a control section (not shown in the drawing) controls the extension/contraction operation section S of the power supply apparatus 30 to perform an extending/contracting operation, based on the result of the position of the crane main body 11 with respect to the ground guide line 3 detected by the position sensor 21. Consequently, the amount that the power collectors 39 move away from the leg section 15 of the crane main body 11 in the widthwise direction is adjusted. A control target value of the amount that the power collectors 39 are to be moved away from the leg section 15 of the crane main body 11 in the widthwise direction, is based on the distance between the ground guide line 3 and the center axial line of the power supply section 43 when measured from the ground guide line 3 in the direction orthogonal to the ground guide line 3. The extension/contraction operation section S controls the power collectors 39 so as to follow along the center axial line of the power supply section 43. That is to say, the position adjusting section 30A adjusts the position of the power collectors 39 so that the power collectors 39 align with the power supply section 43 in the widthwise direction of the self-traveling crane 10. Thus, the self-traveling crane 10 approaches the recharging terminal section 40 with the position of the power collectors 39 is always being controlled with respect to the power supply section 43.

[0055] Moreover, the control section (not shown in the drawing) which controls the traveling units 14, corrects the amount of meander of the crane main body 11 with respect to the extending direction A-B of the traveling lane L, and controls the widthwise direction of the self-traveling crane 10 so as to be orthogonal to the ground guide line 3.

[0056] As the self-traveling crane 10 further approaches the recharging terminal section 40, one of the power collectors 39 of the power supply apparatus 30 provided on the leg section 15 enters the inner side of the guiding member 44 of the recharging terminal section 40. In the guiding member 44, the width w1 of the opening of the

end section on the side further from the insulation cover 42 is greater than the width w_3 of the opening of the power supply section 43. Therefore, even if the position of the power collector 39 is displaced from the center axial line of the power supply section 43, the power collector 39 is guided into the power supply section 43 by the widthwise guiding section G1 as long as the power collector 39 enters the inside of the guiding member 44.

[0057] Moreover, as shown in FIG. 9, as the power collector 39 comes in contact with the inner wall surface 44c (heightwise guiding section G2) of the guiding member 44, and moves so as to approach the power supply section 43, the power collector 39 is pressed downward by the guiding member 44. At this time, the power collector 39 is moved downward by means of the strut member 38 connected to the power collector 39, the connecting members 37, and the strut member 36. Furthermore, the power collector 39 is pushed back by an urging force towards the inner wall section 44c of the guiding member 44.

[0058] When the power collector 39 is in contact with the power supply section 43, the power collector 39 is pressed upward from the lower side against the power supply section 43. Thereby, the power collector 39 and the power supply section 43 are electrically connected, and electric power is supplied from the power supply section 43 to the rechargeable battery B1 (refer to FIG. 2) via the power collector 39. The self-traveling crane 10 stops traveling at a position where the two power collectors 39a and 39b both come in contact with the power supply section 43 for just a period of time until the rechargeable battery B1 (refer to FIG. 2) is sufficiently recharged.

[0059] Once the rechargeable battery B1 has been sufficiently recharged, the self-traveling crane 10 again travels within the traveling lane L. The traveling direction of the self-traveling crane 10 at this time may be an appropriate direction according to the state of loading/unloading the containers 100. For example, if the self-traveling crane 10 travels from the power supply section 43 toward the guiding member 44 side, the power collector 39 exits to the outside of the recharging terminal section 40 through the inside of the guiding member 44. In contrast, if the self-traveling crane 10 travels from the power supply section 43 toward the guiding member 45 side, the power collector 39 exits to the outside of the recharging terminal section 40 through the inside of the guiding member 45. Thus, the self-traveling crane 10 travels within the traveling lane L and transports the container 100 again, using the electric energy stored in the rechargeable battery B1 as a power source.

[0060] As described in detail above, in the crane system 1 and the self-traveling crane 10 of the present embodiment, electric power can be supplied to the rechargeable battery B1 of the self-traveling crane 10 by bringing the power collector 39 provided on the leg section 15 of the self-traveling crane 10 into contact with the power supply section 43 covered by the insulation cover 42.

Consequently, the power supply section 43 is not exposed to the outside, and the possibility of an operator or the like accidentally coming in contact with the power supply section 43 can be reduced.

5 As a result, in the crane system 1 and the self-traveling crane 10 of the present embodiment, the supply of electric power to the self-traveling crane 10 can be facilitated, and the possibility of electricity flowing to the body of an operator can be further reduced.

10 **[0061]** Moreover, since the lower side of the insulation cover 42 which faces the pathway surface R is open, ingress of rain and so forth into the inside of the insulation cover 42 can be reduced.

[0062] Furthermore, the insulation cover 42 of the power supply section 43 has the widthwise guiding section G1 which inclines in the widthwise direction of the self-traveling crane 10 as it advances in the traveling direction of the self-traveling crane 10, and the heightwise guiding section G2 which inclines in the height direction of the self-traveling crane 10 as it advances in the traveling direction of the self-traveling crane 10. Therefore, the power collector 39 can be contacted with the power supply section 43 even if there is an error in the distance between the power collector 39 and the power supply section 43 when positioning the power collector 39 with respect to the power supply section 43 and bringing it into contact.

[0063] Moreover, the guiding member 44 and the guiding member 45 fixed on the insulation cover 42 are formed so as to extend in the traveling direction of the self-traveling crane 10 from the end sections of the power supply section 43, by at least a length within which the power collectors 39a and 39b can be simultaneously housed inside. Therefore, the possibility of an operator coming in contact with the power collector 39 in a state where the power collector 39 is in contact with the power supply section 43 can be reduced. Accordingly, electric power can be supplied to the self-traveling crane 10 more safely.

[0064] Furthermore, the power supply apparatus 30 has a plurality of the power collectors 39, and the power collector 39a and the power collector 39b are respectively supported at two locations separated from each other in the traveling direction of the self-traveling crane 10. Therefore, the power collectors 39a and 39b can be brought into contact with the power supply section 43 at two different locations.

[0065] Moreover, the ground guide line 3 is provided in the container yard Y, and the power supply section 43 is arranged parallel with the ground guide line 3. Therefore, power can be supplied to the rechargeable battery B1 without changing the orientation of the self-traveling crane 10 from the state of the self-traveling crane 10 traveling along the ground guide line 3.

[0066] The preferred embodiment of the present invention has been described above. However, the present invention is not limited to the above embodiment, and additions, omissions, replacement of the configuration, and other modifications may be made without departing

from the scope of the invention. The present invention is not limited by the description above, and is only limited by accompanying claims.

[0067] For example, in the above embodiment, the position detection section 22 is set on the lower surface of one of the leg sections 15, and has the position sensor 21 capable of detecting its position relative to the ground guide line 3 provided therein. However, it is not limited to this. For example, a member on which the position sensor 21 is attached, may protrude from one of the leg sections 15, and the position sensor 21 may be provided in an arbitrary position on this member.

[0068] Moreover, the type of the position sensor is not limited to one that detects its position relative to the ground guide line 3 as described above. For example, instead of the ground guide line 3, a laser light source which irradiates laser beams along the extending direction A-B of the traveling lane L may be provided on the traveling lane L, and the self-traveling crane may be provided with a sensor which detects the laser beams. Alternatively, the position of the self-traveling crane 10 may be detected using a GPS. In this case, the position sensor may be provided on the upper end section of the beam section 16.

[0069] Furthermore, an example of employing an air cylinder for the extension/contraction operation section S was illustrated in the embodiment described above. However, the configuration of the extension/contraction operation section is not limited to an air cylinder. For example, a linear movement mechanism which combines ball screws and nuts, or a linear movement mechanism having a rack-and-pinion structure may be employed. Moreover, a hydraulic cylinder or an electric cylinder may be employed for the extension/contraction operation section S.

[0070] Furthermore, in the above embodiment, a configuration was described where the power collector 39 is of two units namely the power collector 39a and the power collector 39b. However, the power collector is not limited to this configuration, and three or more power collectors may be provided. Moreover, only a single power collector may be provided for a single self-traveling crane.

[0071] Furthermore, in the above embodiment, an example was described in which the insulation cover 42 and the guiding members 44 and 45 are separate bodies. However, the insulation cover 42 and the guiding members 44 and 45 may be formed as one body.

Moreover, the shape of the insulation cover 42 may have a deep arch shape so that for example even if the finger of an operator is inserted from the opening into the inside, the finger will not come in contact with the power supply section. In this case, even if an operator at the container yard accidentally grasps the insulation cover, there is an increased possibility of preventing the finger of the operator from coming in contact with the power supply section.

DESCRIPTION OF THE REFERENCE SYMBOLS

[0072]

5	1	Crane system
	2	External power supply
	3	Ground guide line (magnetic guide line)
10	4	Supply wiring path
	L	Traveling lane
15	R	Pathway surface
	Y	Container yard
	10	Self-traveling crane
20	30	Power supply apparatus
	30A	Position adjusting section
25	39, 39a, 39b	Power collector
	40, 40a, 40b	Recharging terminal section
	42	Insulation cover
30	43	Power supply section
	44	Guiding member
35	45	Guiding member
	100	Container

40 Claims

1. A power supply apparatus, comprising:

at least one power collector (39) which supplies electric power to a rechargeable battery equipped on a self-traveling crane (10); and a position adjusting section (30A) which is provided between a crane main body of the self-traveling crane and the power collector, and which adjusts a position in a widthwise direction orthogonal to a traveling direction of the self-traveling crane, of the power collector with respect to the self-traveling crane, wherein the power collector comes in contact, through an opening formed in an insulation cover (42) which covers the power supply section, with a power supply section (43) which is provided on a side section on a traveling pathway of the self-

- traveling crane, and supplies electric power to the self-traveling crane, and
the opening is formed in a region including a bottom section of the insulation cover facing a pathway surface where the self-traveling crane travels, and opposite end sections of the insulation cover in the traveling direction of the self-traveling crane. 5
2. The power supply apparatus according to claim 1, wherein the insulation cover (42) has a widthwise guiding section (45a, 45b) which inclines in the widthwise direction of the self-traveling crane (10) as it advances in the traveling direction of the self-traveling crane, and
a heightwise guiding section (45c) which inclines in a projecting direction of the power collector (39) as it advances in the traveling direction of the self-traveling crane. 10 15 20
3. The power supply apparatus according to either one of claim 1 and claim 2, wherein the insulation cover (42) is formed so as to extend in the traveling direction from end sections of the power supply section (43), by at least a length within which the power collector (39) can be housed inside. 25
4. The power supply apparatus according to any one of claim 1 through claim 3, wherein the power supply apparatus (30) has a plurality of the power collectors (39a, 39b), and
the position adjusting section (30A) respectively supports the power collectors at a plurality of locations along the traveling direction. 30 35
5. The power supply apparatus according to any one of claim 1 through claim 4, wherein the power supply apparatus (30) has a magnetic guide line (3) arranged so as to extend along an extending direction of a pathway surface (R) where the self-traveling crane (10) travels, and
the power supply section (43) is arranged parallel with the magnetic guide line. 40
6. The power supply apparatus according to any one of claim 1 through claim 5, wherein the position adjusting section (30A) adjusts a position of the power collector (39) so that the power collector aligns with the power supply section (43) in the widthwise direction, and
the power collector is pressed against the power supply section while the position thereof is adjusted by the position adjusting section. 45 50
7. A crane system (1) comprising: 55
- a container yard (Y) where containers are stored;

a self-traveling crane (10) which transports the containers;
a power supply apparatus (30) according to any one of claim 1 through claim 6, which is provided in the self-traveling crane; and
a plurality of power supply sections (43) which supply driving electric power to the self-traveling crane via the power collector (39, 39a, 39b) of the power supply apparatus, wherein
the container yard has a plurality of lanes (L) where a plurality of the containers are arranged in line, and along which the self-traveling crane travels, and
the power supply section is provided in each of the lanes.

FIG. 1

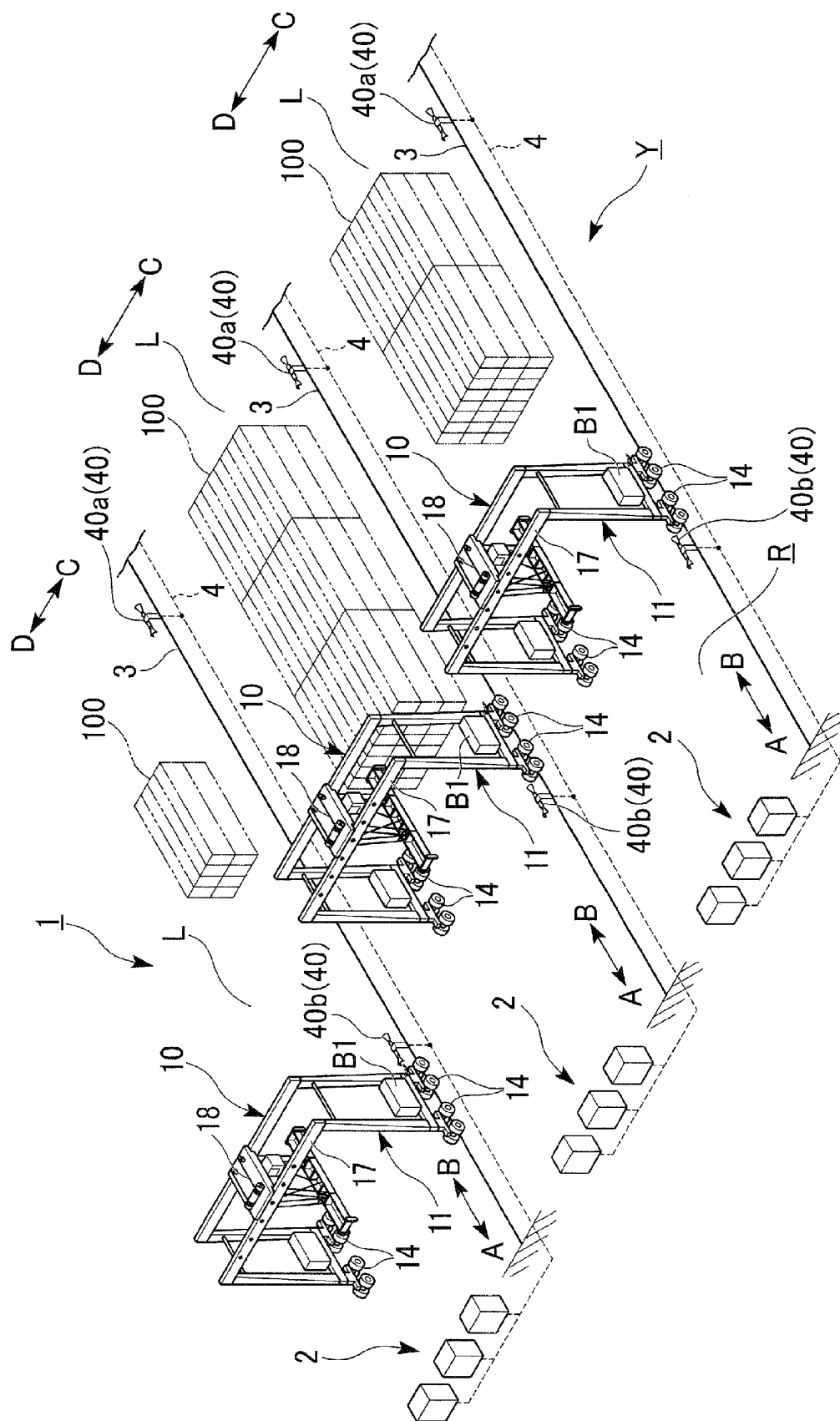


FIG. 2

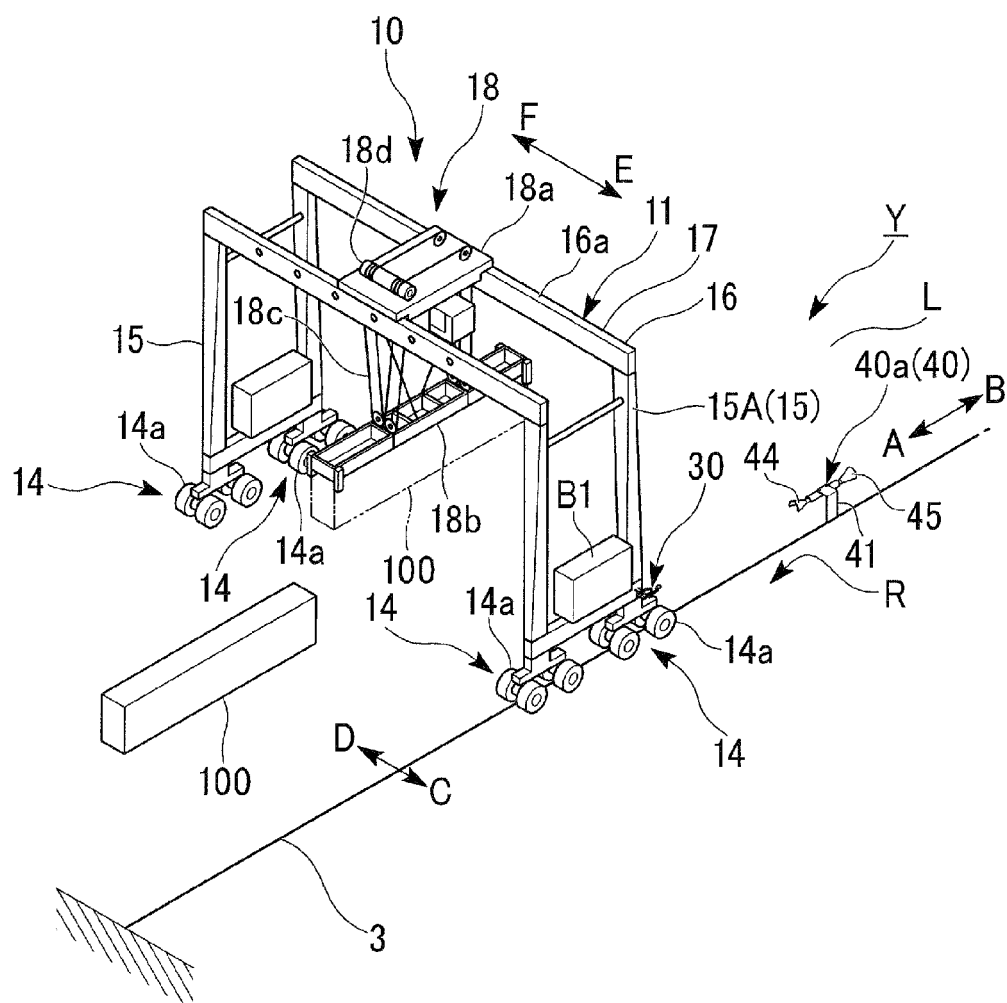


FIG. 3

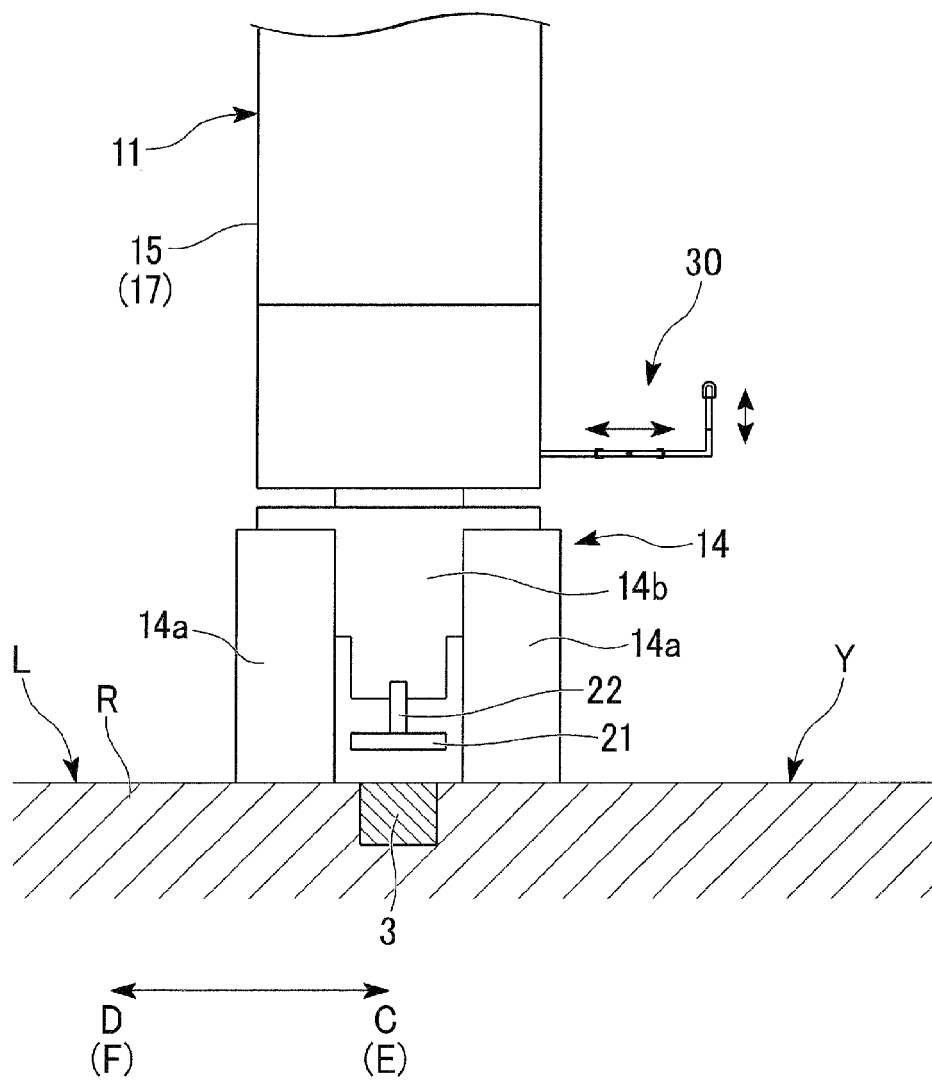


FIG. 4

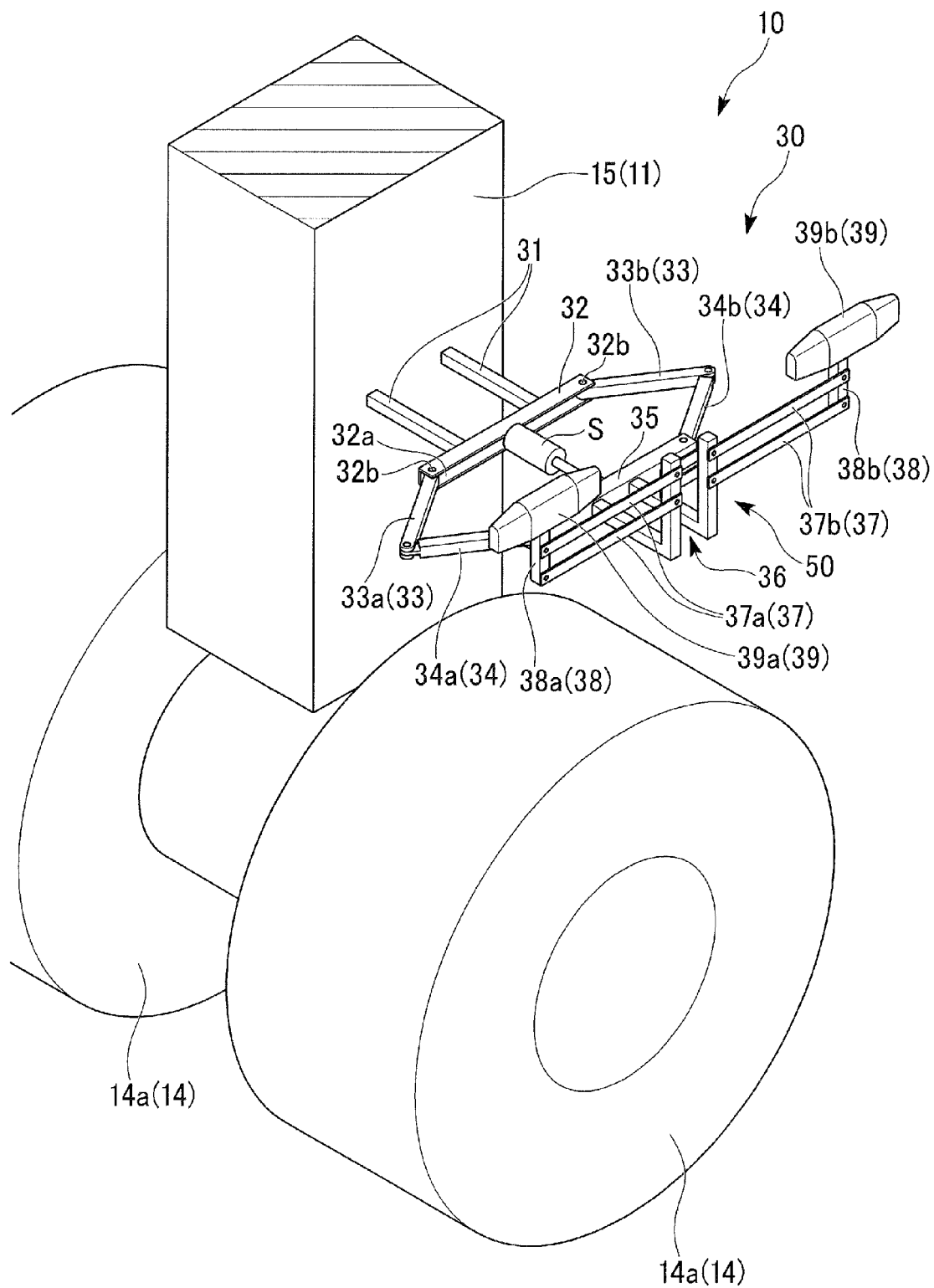


FIG. 5A

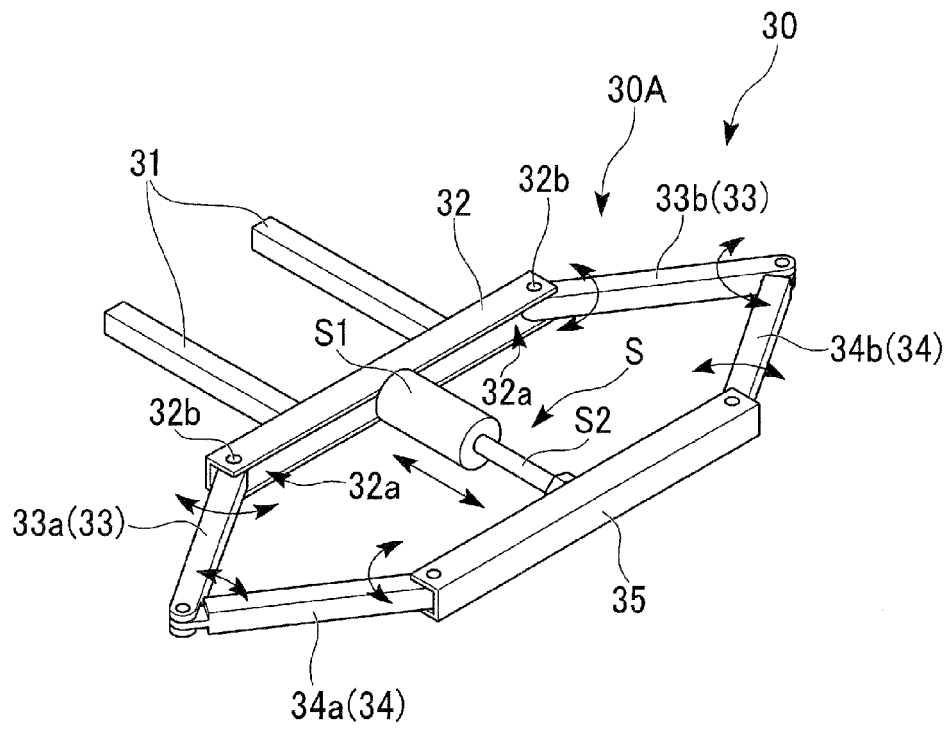


FIG. 5B

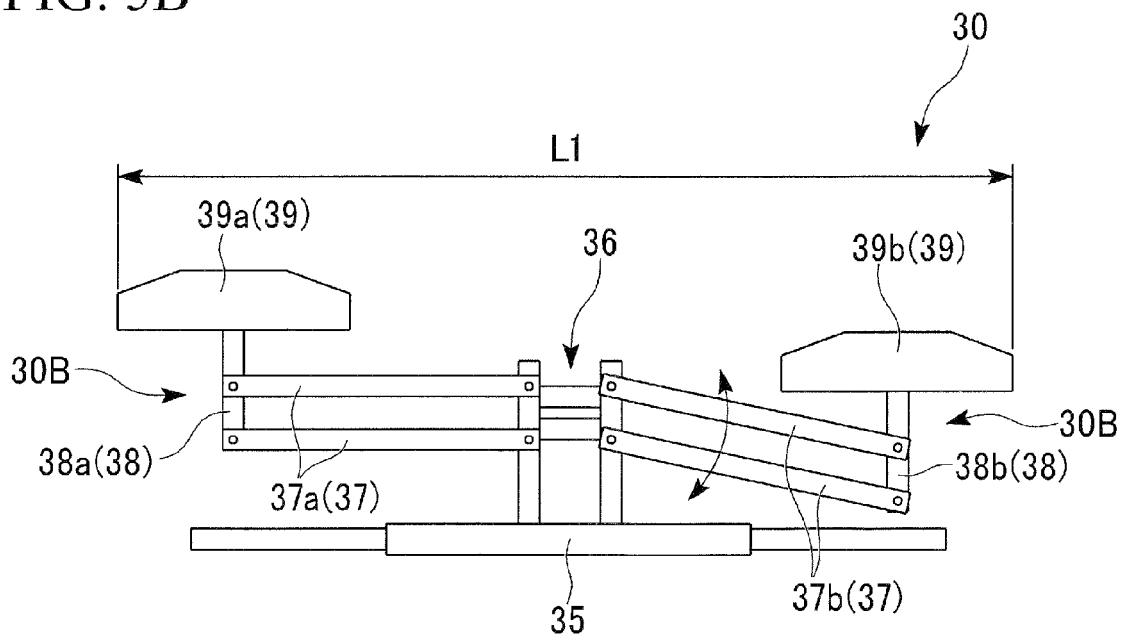


FIG. 6A

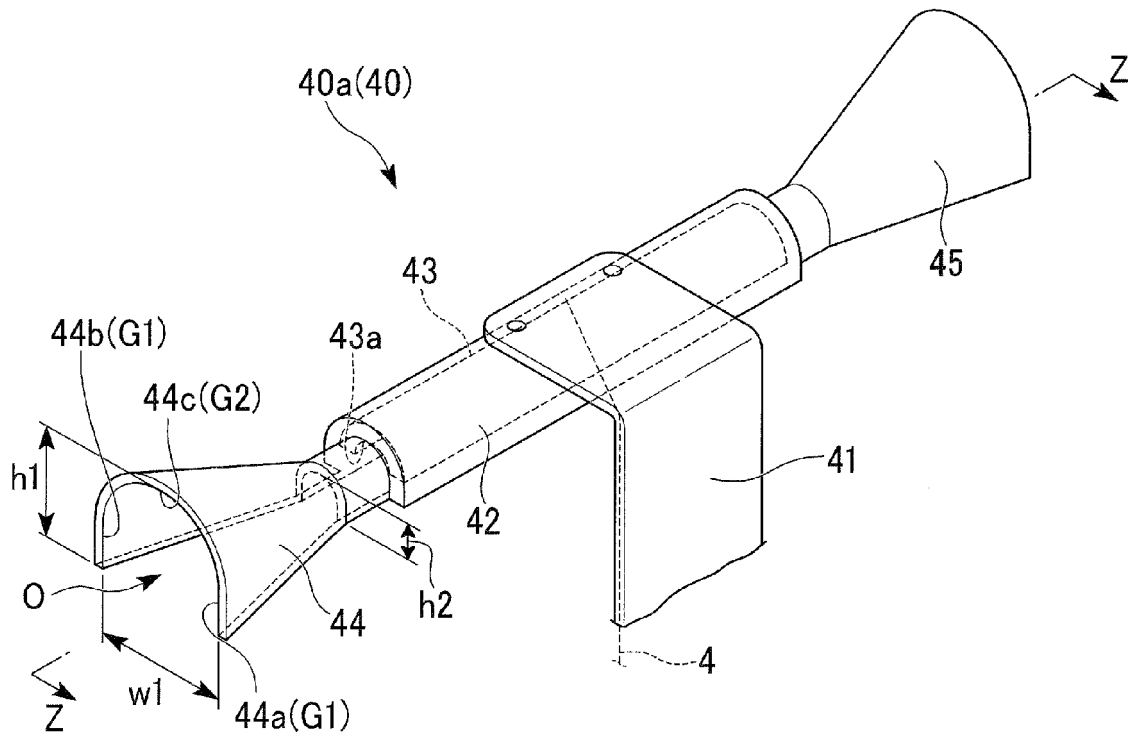


FIG. 6B

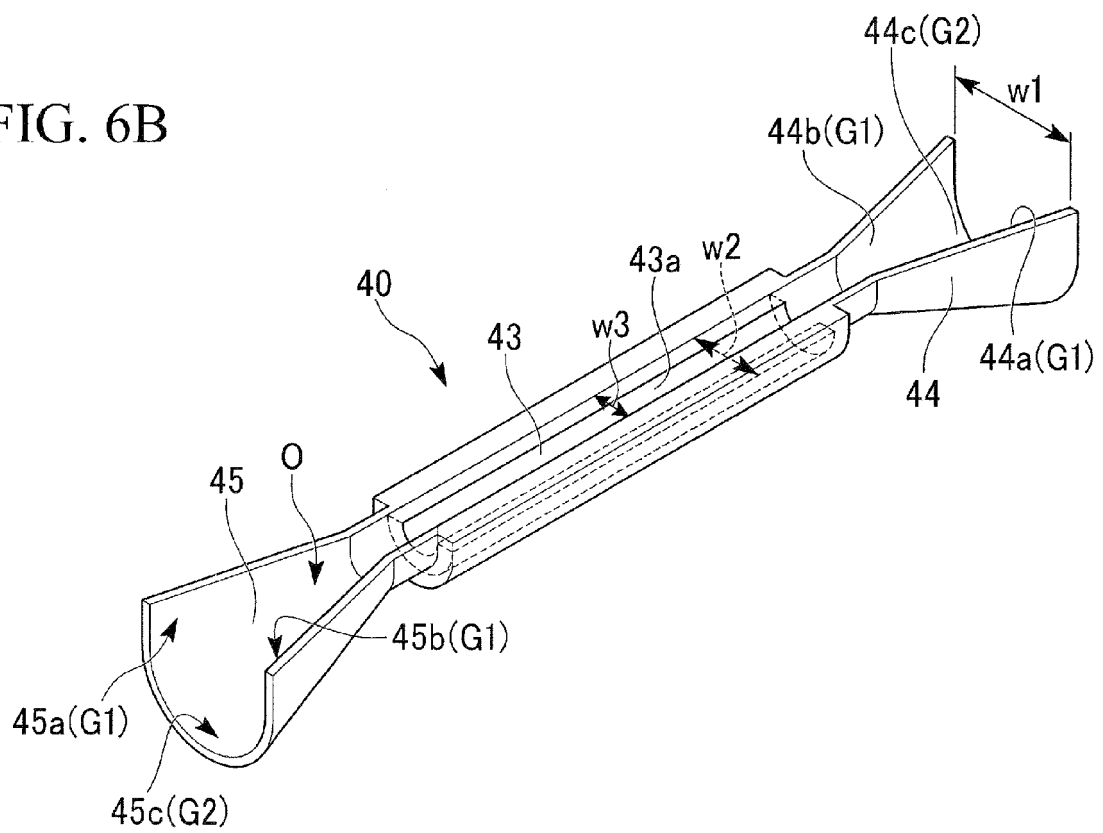


FIG. 7

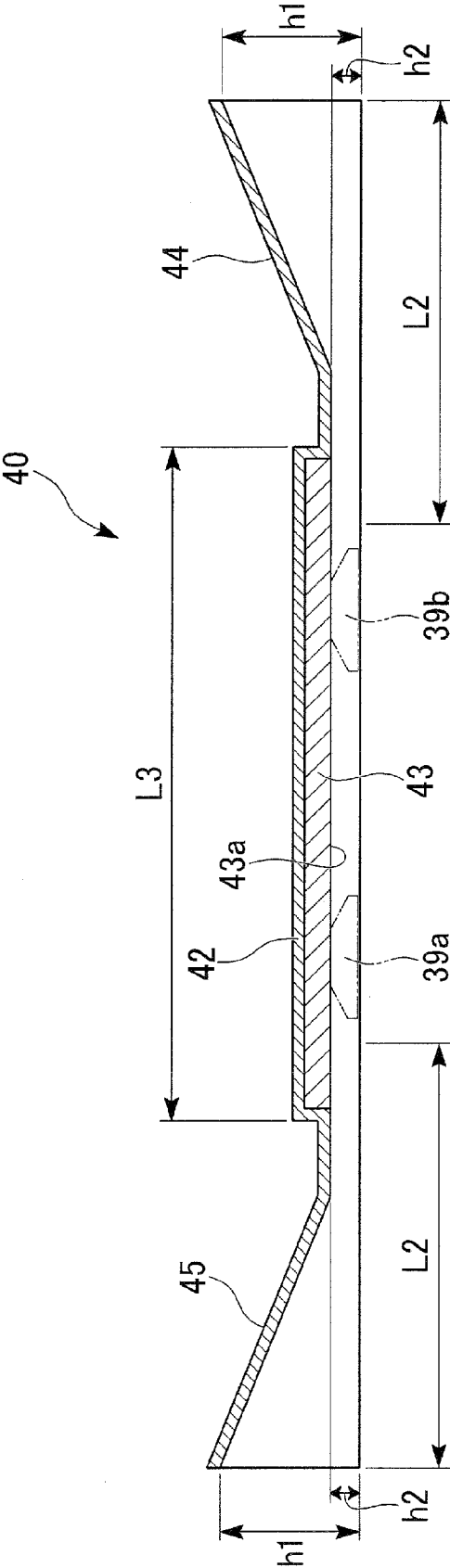


FIG. 8

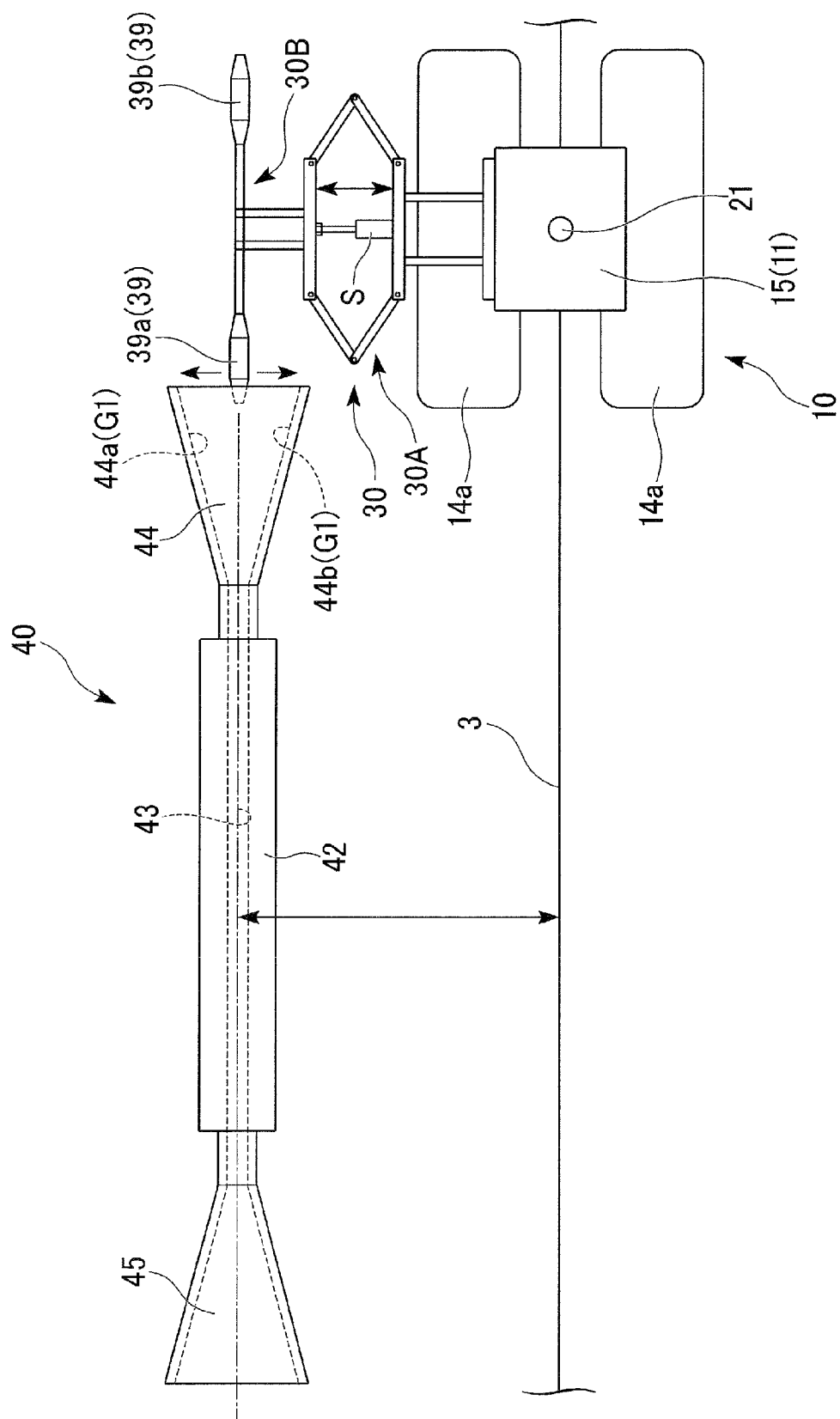
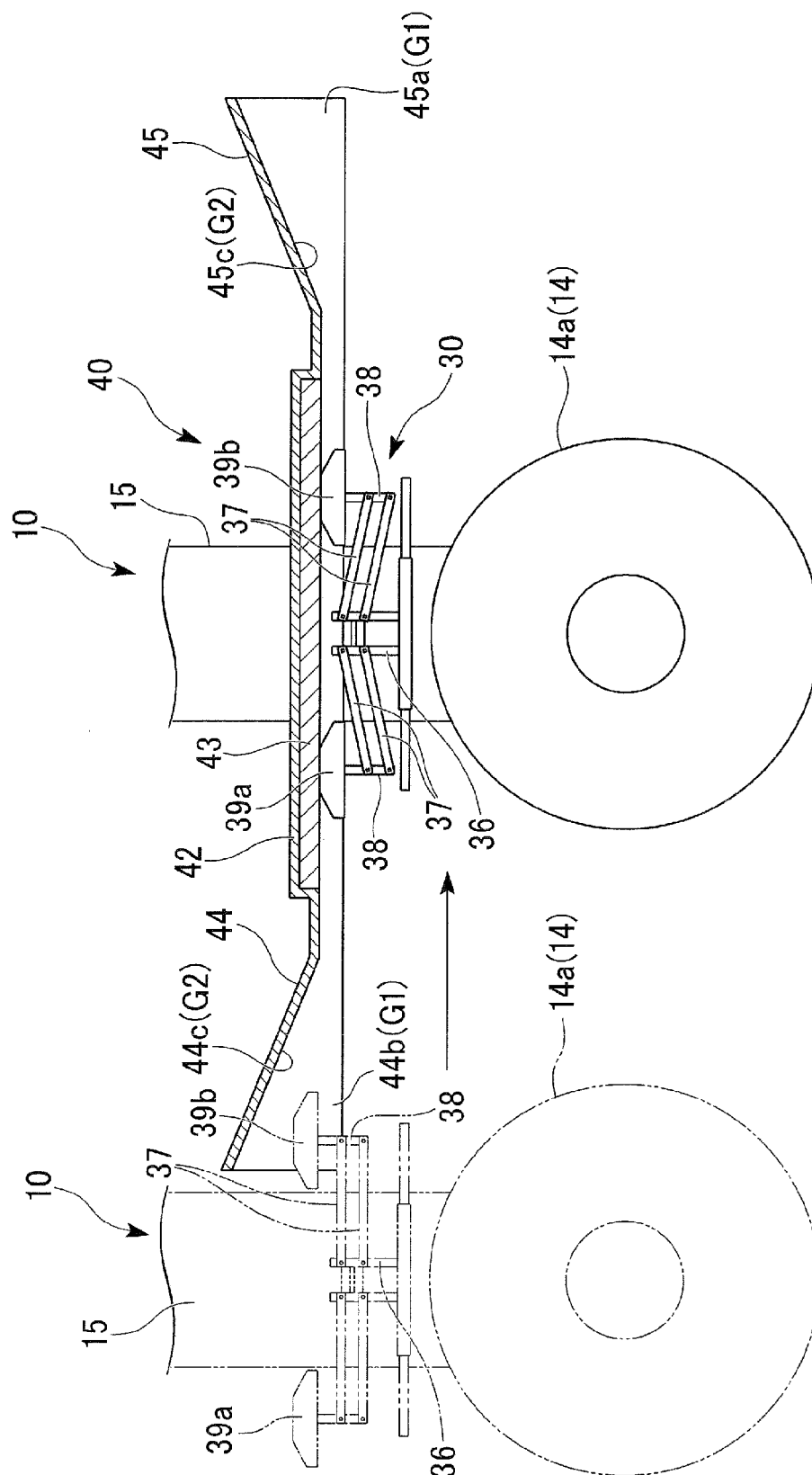


FIG. 9





EUROPEAN SEARCH REPORT

Application Number
EP 10 17 0774

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Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
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			B66C
Place of search		Date of completion of the search	Examiner
The Hague		8 April 2011	Sheppard, Bruce
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

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EP 10 17 0774

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08-04-2011

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JP 2007204203	A	16-08-2007	NONE	

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