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(54) ASPHALT FINISHER

(57) An asphalt finisher (100) includes a tractor (1), a screed (3), a screw (SC) arranged in front of the screed (3), a retaining plate (41) arranged in front of the screw (SC) and mounted on the tractor (1), a support rod (B1) arranged in front of the retaining plate (41) between the tractor (1) and the retaining plate (41), an extension retaining plate (42) pivotably mounted on the retaining plate (41), and an extension support rod (B2) arranged in front of the extension retaining plate (42) between the tractor (1) and the extension retaining plate (42).

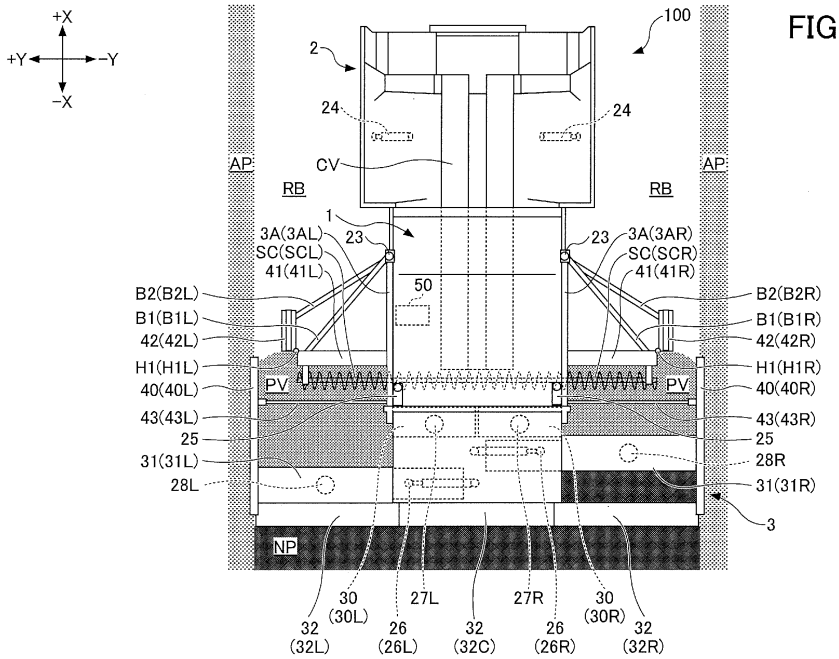

FIG.1B

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Description

TECHNICAL FIELD

[0001] The present disclosure relates to asphalt finishers.

BACKGROUND ART

[0002] A conventional asphalt finisher provided with a retaining plate arranged in front of a screw is known (refer to Patent Document 1).

PRIOR ART DOCUMENTS

PATENT DOCUMENT

[0003] Japanese Unexamined Patent Publication No. 2016-108879

DISCLOSURE OF THE INVENTION

PROBLEM TO BE SOLVED BY THE INVENTION

[0004] The retaining plate described above has a fixed length structure, and cannot cope with a case where the screw is extended in a vehicle width direction. For this reason, when the screw is extended in the vehicle width direction, an extension retaining plate may be added in the vehicle width direction. However, adding the extension retaining plate requires complicated operations.

[0005] Accordingly, it is desirable to provide an asphalt finisher that can more easily extend the retaining plate.

MEANS OF SOLVING THE PROBLEM

[0006] An asphalt finisher according to an embodiment of the present invention includes a tractor; a screed; a screw arranged in front of the screed; a machine-side retaining plate arranged in front of the screw and mounted on the tractor; a machine-side support rod arranged in front of the machine-side retaining plate between the tractor and the machine-side retaining plate; an extension retaining plate pivotably mounted on the machine-side retaining plate; and an extension support rod arranged in front of the extension retaining plate between the tractor and the extension retaining plate.

EFFECTS OF THE INVENTION

[0007] The means described above can provide an asphalt finisher that can more easily extend the retaining plate.

BRIEF DESCRIPTION OF THE DRAWINGS

[0008]

FIG. 1A is a side view of an asphalt finisher according to an embodiment of the present invention.

FIG. 1B is a top view of the asphalt finisher according to the embodiment of the present invention.

FIG. 2 is a top view of rear part of the asphalt finisher illustrating three states of an extension retaining plate.

FIG. 3A is a perspective view of a proximity a right screw illustrating a folded state of the extension retaining plate.

FIG. 3B is a perspective view of the proximity of the right screw illustrating a first extended state of the extension retaining plate.

FIG. 3C is a perspective view of the proximity of the right screw illustrating a second extended state of the extension retaining plate.

FIG. 4 is a perspective view of the proximity of the right screw illustrating another configuration of an extension support rod.

FIG. 5 is a top view of the asphalt finisher according to another embodiment of the present invention.

MODE OF CARRYING OUT THE INVENTION

[0009] FIG. 1A and FIG. 1B illustrate an asphalt finisher 100, which is an example of a road construction machine, according to an embodiment of the present invention. More particularly, FIG. 1A is a side view of the asphalt finisher 100, and FIG. 1B is a top view of the asphalt finisher 100. A coarsest dot pattern AP in FIG. 1B indicates a surface of an existing pavement or curb, and a finest dot pattern NP indicates a new pavement.

[0010] The asphalt finisher 100 is mainly formed of a tractor 1, a hopper 2, and a screed 3. Hereinafter, a direction (+X direction) of the hopper 2 viewed from the tractor 1 will be referred to as the front, and a direction (-X direction) of the screed 3 viewed from the tractor 1 will be referred to as the rear.

[0011] The tractor 1 is a mechanism for driving the asphalt finisher 100. In this embodiment, the tractor 1 rotates a rear wheel 5 using a rear wheel driving motor, and rotates a front wheel 6 using a front wheel driving motor, to move the asphalt finisher 100. The rear wheel driving motor and the front-wheel driving motor rotate in response to receiving hydraulic oil from a hydraulic pump. The rear wheel 5 and the front wheel 16 may be replaced by crawlers.

[0012] A controller 50 is a control device that controls the asphalt finisher 100. In this embodiment, the controller 50 is formed of a processor including a CPU, a volatile storage device, and a non-volatile storage device, and is mounted on the tractor 1. Various functions of the controller 50 are realized by executing a program stored in the non-volatile storage device by the CPU.

[0013] The hopper 2 is a mechanism for receiving a pavement material. In this embodiment, the hopper 2 is provided on the front side of the tractor 1, and is configured to be able to open and close in a Y-axis direction

(vehicle width direction) by a hopper cylinder 24. The asphalt finisher 100 typically receives the pavement material (for example, an asphalt mixture) from a dump truck bed with the hopper 2 in a fully open state. FIG. 1A and FIG. 1B illustrate the fully open state of the hopper 2. As the pavement material in the hopper 2 decreases, the hopper 2 is closed, and the pavement material near an inner wall of the hopper 2 is collected to a center portion of the hopper 2, so as to enable a conveyor CV at the center portion of the hopper 2 to supply the pavement material to the rear side of the tractor 1. In addition, the pavement material supplied to the rear side of the tractor 1 is spread on a roadbed RB, which is on the rear side of the tractor 1 and on the front side of the screed 3. A screw SC spreads the pavement material on the roadbed RB in the vehicle width direction. In this embodiment, the screw SC includes a right screw SCR and a left screw SCL. The screw SC is configured so that an extension screw is connectable thereto.

[0014] The screed 3 is a mechanism for placing and spreading the pavement material. In this embodiment, the screed 3 mainly includes a front fixed screed 30 and a rear extension screed 31. The rear extension screed 31 is caused to extend and contract in the vehicle width direction by a screed extension cylinder 26. The screed 3 is a floating screed towed by the tractor 1, and is connected to the tractor 1 via a leveling arm 3A. The screed 3 is moved up and down together with the leveling arm 3A by extension and contraction of a screed drift cylinder 25.

[0015] The front fixed screed 30 includes a left front fixed screed 30L and a right front fixed screed 30R, and the rear extension screed 31 includes a left rear extension screed 31L and a right rear extension screed 31R. The screed extension cylinder 26 includes a left screed extension cylinder 26L and a right screed extension cylinder 26R. The left rear extension screed 31L is caused to extend and contract in the vehicle width direction by the left screed extension cylinder 26L, and the right rear extension screed 31R is caused to extend and contract in the vehicle width direction by the right screed extension cylinder 26R.

[0016] In order to compact the pavement surface, the left front fixed screed 30L is vibrated by a left front vibrator 27L, and the right front fixed screed 30R is vibrated by a right front vibrator 27R. The left rear extension screed 31L is vibrated by a left rear vibrator 28L, and the right rear extension screed 31R is vibrated by a right rear vibrator 28R.

[0017] A leveling cylinder 23 is a hydraulic cylinder that moves a front end portion of a leveling arm 3A up and down to adjust a thickness of the asphalt mixture that is placed and spread.

[0018] A side plate 40 is attached to an end portion of the screed 3. The side plate 40 restricts excessive spreading of a pavement material PV in the vehicle width direction by screw SC which places and spreads the pavement material PV. FIG. 1A and FIG. 1B illustrate the pavement material PV, that is placed and spread by the screw SC, by a dot pattern. In this embodiment, the side plate 40 includes a right side plate 40R extending frontward from the right rear extension screed 31R, and a left side plate 40L extending frontward from the left rear extension screed 31L.

[0019] A retaining plate 41 is attached to a side portion of the tractor 1, as a machine-side retaining plate. The retaining plate 41 prevents the pavement material PV from propelling to the front near the tractor 1 (particularly the rear wheel 5) due to rotation of the screw SC. In this embodiment, the retaining plate 41 includes a right retaining plate 41R attached to a right side portion of the tractor 1, and a left retaining plate 41L attached to a left side portion of the tractor 1.

[0020] The left retaining plate 41L is detachably fastened to the left side portion of the tractor 1 by fastening members such as bolts, screws, or the like. However, the left retaining plate 41L may be pivotably (foldably) mounted to the left side portion of the tractor 1 via a hinge or the like. In addition, the left retaining plate 41L may have a sliding type extension structure. The same applies to the right retaining plate 41R.

[0021] A support rod B1 is arranged between the retaining plate 41 and the tractor 1, as a machine-side support rod. The support rod B1 is configured to be able to maintain an extended state where the retaining plate 41 extends in the vehicle width direction along the screw SC. In particular, the support rod B1 is configured to prevent the retaining plate 41 from being folded toward the tractor 1 by being pushed by the pavement material PV in the extended state.

[0022] In this embodiment, the support rod B1 includes a left support rod B1L and a right support rod B1R. One end of the left support rod B1L is attached to the tractor 1, and the other end of the left support rod B1L is attached to the left retaining plate 41L. The left support rod B1L is formed of a pair of support rods, but may be formed solely of a single support rod, or may be formed of three or more support rods. The same applies to the right support rod B1R.

[0023] An extension retaining plate 42 is attached to an end portion of the retaining plate 41. In this embodiment, the extension retaining plate 42 is mounted to the end portion of the retaining plate 41 via a hinge H1, in a manner pivotable in a traveling direction. More particularly, the extension retaining plate 42 includes a left extension retaining plate 42L and a right extension retaining plate 42R. The left extension retaining plate 42L is pivotably mounted to an end portion on the left side (+Y-side) of the left retaining plate 41L via a hinge H1L. The right extension retaining plate 42R is pivotally mounted to an end portion on the right side (-Y-side) of the right retaining plate 41R via a hinge H1R.

[0024] A support rod B2 is arranged between the extension retaining plate 42 and the tractor 1, as an extension support rod. The support rod B2 is configured to be able to maintain an extended state where the extension

retaining plate 42 extends in the vehicle width direction along the screw SC, or a folded state where the extension retaining plate 42 is folded so as to be approximately perpendicular to the screw SC. In particular, the support rod B2 is configured to prevent the extension retaining plate 42 from being folded toward the tractor 1 by being pushed by the pavement material PV in the extended state. FIG. 1A and FIG. 1B illustrate the folded state of the extension retaining plate 42.

[0025] In this embodiment, the support rod B2 includes a left support rod B2L and a right support rod B2R. When the left extension retaining plate 42L is in the folded state, one end of the left support rod B2L is attached to the tractor 1, and the other end of the left support rod B2L is attached to the left extension retaining plate 42L. In addition, when the left extension retaining plate 42L is in the extended state, one end of the left support rod B2L is attached to the left support rod B1L, and the other end of the left support rod B2L is attached to the left extension retaining plate 42L. The left support rod B2L is formed solely of a single support rod, but may be formed of two support rods, or may be formed of three or more support rods. The same applies to the right support rod B2R.

[0026] A moldboard 43 is attached to a front portion of the screed 3. The moldboard 43 is configured to be able to adjust the amount of pavement material PV stagnant in front of the screed 3. The pavement material PV passes through a gap between a lower end of the moldboard 43 and the roadbed RB, and reaches under the screed 3. In this embodiment, the moldboard 43 is configured to extend and contract together with the rear extension screed 31. The moldboard 43 includes a right extension moldboard 43R attached to the front of the right rear extension screed 31R, and a left extension moldboard 43L attached to the front of the left rear extension screed 31L. The left extension moldboard 43L is configured to be able to adjust a height in a Z-axis direction, independent of the left side plate 40L and the left rear extension screed 31L, so that it is possible to adjust the amount of the pavement material stagnant in front of the left rear extension screed 31L by moving the left extension moldboard 43L up and down. The same applies to the right extension moldboard 43R.

[0027] A step 32 is attached to a rear portion of the screed 3. The step 32 is a footboard that may be used by an operator. In this embodiment, the step 32 includes a center step 32C attached to the rear of the front fixed screed 30, a right step 32R attached to the rear of the right rear extension screed 31R, and a left step 32L attached to the rear of the left rear extension screed 31L.

[0028] Next, three states of the extension retaining plate 42 extending in response to the expansion of the road width during construction will be described, by referring to FIG. 2 and FIG. 3A through FIG. 3C. Each of three figures illustrated separately in FIG. 2 indicates a state where the rear portion of the asphalt finisher 100 is viewed from the top, by omitting the illustration of the front portion of the asphalt finisher 100. FIG. 2 illustrates a state where the right rear extension screed 31R is extended to the right in steps according to the road width expansion, when the asphalt finisher 100 moves toward the top from the bottom in FIG. 2. The bottom figure illustrates the folded state of the right extension retaining plate 42R, the middle figure illustrates a first extended state which is one of the extended states of the right extension retaining plate 42R, and the top figure illustrates a second extended state which is another of the extended states of the right extension retaining plate 42R. The left extension retaining plate 42L is in the folded state in all of the three figures.

[0029] FIG. 3A through FIG. 3C are perspective views in a proximity a right screw SCR, illustrating each of the three states of the right extension retaining plate 42R, respectively. More particularly, FIG. 3A illustrates the folded state of the right extension retaining plate 42R, and corresponds to the bottom figure of FIG. 2. FIG. 3B illustrates the first extended state of the right extension retaining plate 42R, and corresponds to the middle figure of FIG. 2. FIG. 3C illustrates the second extended state of the right extension retaining plate 42R, and corresponds to the top figure of FIG. 2. Because the structure associated with the right extension retaining plate 42R and the structure associated with the left extension retaining plate 42L are symmetrical, the following description applies similarly to the structure associated with the left extension retaining plate 42L.

[0030] The operator connects an extension screw ESC1 to the right screw SCR when the right rear extension screed 31R and the right extension moldboard 43R are extended to the right from the state illustrated in the bottom figure to the state illustrated in the middle figure in FIG. 2. Then, the operator switches the state of the right extension retaining plate 42R from the folded state illustrated in FIG. 3A to the first extended state illustrated in FIG. 3B.

[0031] More particularly, the operator removes one end of the right support rod B2R, fixed to the right side portion of tractor 1, from tractor 1. Then, the operator turns the right extension retaining plate 42R at the hinge H1R in a direction indicated by an arrow AR1 in FIG. 3A. Thereafter, the operator fixes one end of the right support rod B2R to a right support rod B1Rb, as illustrated in FIG. 3B. The operator may fix one end of the right support rod B2R to a right support rod B1Ra. The right support rod B1Ra is a support rod positioned on the upper side of the two support rods forming the right support rod B1R, and the right support rod B1Rb is a support rod positioned on the lower side of the two support rods forming the right support rod B1R. In this embodiment, one end of the right support rod B1R is pivotally mounted on the right side portion of the tractor 1 via a fixture C1R as illustrated in FIG. 3B, and the other end of the right support rod B1R is pivotally mounted via a fixture C2R on a reinforcing column section CM, which is a portion of a screw retainer SH (to be described later) of the right retaining plate 41R. More particularly, one end of the right support rod B1Ra

is mounted on the right side portion of the tractor 1 via a fixture C1Ra so as to be pivotable around the axis, and the other end of the right support rod B1Ra is mounted on the reinforcing column section CM via a fixture C2Ra so as to be pivotable around the vertical axis. In addition, one end of the right support rod B1Rb is mounted on the right side portion of the tractor 1 via a fixture C1Rb so as to be pivotable around the vertical axis, and the other end of the right support rod B1Rb is mounted on the reinforcing column section CM via a fixture C2Rb so as to be pivotable around the vertical axis. The connecting member FE is attached to one end of the right support rod B2R. The connecting member FE is configured to be connectable to each of the right side portion of the tractor 1 and the right support rod B1R. More particularly, the connecting member FE is configured to be connectable to the right side portion of the tractor 1 and the right support rod B1R, respectively, via a clamping mechanism. However, connecting mechanisms other than the clamping mechanism may be used. Moreover, the connecting member FE is connected to the right support rod B2R via a universal joint, such as a ball joint or the like. However, the connecting member FE may be connected to the right support rod B2R via a pin joint, or may be connected to the right support rod B2R via a rigid joint. The other end of the right support rod B2R is mounted on a distal plate 42D (to be described later) of the right extension retaining plate 42R via a fixture C3R so as to be pivotable around the vertical axis.

[0032] The right retaining plate 41R has a reinforced rib RF1 on a surface on an opposite side (+X side) of a surface opposing the right screw SCR, as illustrated in FIG. 3A. In addition, the right retaining plate 41R is detachably mounted on the right side portion of the tractor 1 by bolts serving as fastening members BT1. A guard rail GR1 is detachably mounted on the right retaining plate 41R. The guard rail GR1 prevents objects from getting caught into the right screw SCR.

[0033] A rotating shaft of the right screw SCR is rotatably supported by the screw retainer SH of the right retaining plate 41R. The screw retainer SH is reinforced by the reinforcing column section CM to enable supporting the rotating shaft of the right screw SCR which is a heavy object. In this embodiment, the reinforcing column section CM is formed of a metal plate that is formed to a rectangular tube shape. Because the right screw SCR is supported by the screw retainer SH near the distal end, the right screw SCR will not bend at an intermediate portion thereof even if the extension screw ESC1 is connected thereto.

[0034] The right extension retaining plate 42R is pivotally mounted on the end portion of the right retaining plate 41R via a hinge H1R, as illustrated in FIG. 3B. More particularly, the right extension retaining plate 42R is detachably mounted on to the end portion of the right retaining plate 41R by bolts serving as fastening members BT2. In addition, the right extension retaining plate 42R has a reinforced rib RF2 on a surface on an opposite side (+X side) of a surface opposing the right screw SCR, as illustrated in FIG. 3C.

[0035] The operator connects the extension screw ESC2 to the extension screw ESC1 when the right rear extension screed 31R and the right extension moldboard 43R are further extended to the right from the state illustrated in the middle figure to the state illustrated in the top figure in FIG. 2. The length of the extension screw ESC2 is the same as the length of the extension screw ESC1. After removing the extension screw ESC1, the operator may connect another extension screw longer than the extension screw ESC1 to the right screw SCR.

[0036] Then, the operator switches the state of the right extension retaining plate 42R from the first extended state illustrated in FIG. 3B to the second extended state illustrated in FIG. 3C.

[0037] More particularly, the operator loosens the tightening by the connecting member FE at one end of the right support rod B2R fixed to the right support rod B1Rb, in order to slide the connecting member FE along the right support rod B1Rb in a direction indicated by an arrow AR2 in FIG. 3B. The distal plate 42D is then slid in a direction indicated by an arrow AR3 in FIG. 3B, with respect to a proximal plate 42P.

[0038] In this embodiment, the right extension retaining plate 42R has a sliding extension structure. The proximal plate 42P and the distal plate 42D are constituent elements forming the sliding extension structure. In this embodiment, the distal plate 42D is slidably arranged on the front side (+X-side) of the proximal plate 42P. The other end of the right support rod B2R is pivotally mounted on the distal plate 42D via the fixture C3R. The right extension retaining plate 42R may have other extension structures, such as a telescopic extension structure or a folding extension structure.

[0039] FIG. 3B illustrates a contracted state where the distal plate 42D is retracted to the inner side of the proximal plate 42P, and FIG. 3C illustrates an extended state where the distal plate 42D is pushed out to the outer side of the proximal plate 42P. In addition, FIG. 3B illustrates a state where the guard rail GR2 is attached to the right extension retaining plate 42R, and FIG. 3C illustrates a state where the guard rail GR2 and the guard rail GR3 are attached to the right extension retaining plate 42R. More particularly, FIG. 3C illustrates the state where the guard rail GR2 is attached to the proximal plate 42P, and the guard rail GR3 is attached to the distal plate 42D.

[0040] Thereafter, as illustrated in FIG. 3C, the operator fixes one end of the right support rod B2R to the right support rod B1Rb at a position closer to the right retaining plate 41R than in FIG. 3B. However, the operator may attach one end of the right support rod B2R to the right support rod B1Ra.

[0041] According to this configuration, the operator can use the right support rod B2R as an extension support rod even when switching the state of the right extension retaining plate 42R from the folded state to the extended state. In other words, the right support rod B2R can be

used, as it is, as the extension support rod, by simply changing the fixing position of one end of the right support rod B2R. For this reason, the operator can easily switch the state of the right extension retaining plate 42R between the folded state and the extended state.

[0042] Next, another configuration example of the support rod B2 will be described with reference to FIG. 4. FIG. 4 is a perspective view of the proximity of the right screw SCR, illustrating the second extended state of the right extension retaining plate 42R corresponding to FIG. 3C. Because the structure associated with the right extension retaining plate 42R and the structure associated with the left extension retaining plate 42L are symmetrical, the following description applies similarly to the structure associated with the left extension retaining plate 42L.

[0043] A right support rod B2AR of FIG. 4 differs from the right support rod B2R of FIG. 3A through FIG. 3C having the fixed length structure, in that the right support rod B2AR has a variable length structure, but is otherwise similar to the right support rod B2R. For this reason, a description of the similar portions will be omitted, and a description will be given of the portions that differ.

[0044] The right support rod B2AR is mainly formed of an outer cylinder member EC, an inner cylinder member UC, a locking pin LP, and a retaining pin RP.

[0045] One end E1 of the outer cylinder member EC is pivotally mounted on the right support rod B1R via the connecting member FE, and the other end E2 of the outer cylinder member EC is configured to receive the inner cylinder member UC. One end of the outer cylinder member EC may be pivotally mounted on the right side portion of the tractor 1. A plurality of radial through-holes EH are formed in the outer cylinder member EC, penetrating the outer cylinder member EC in a radial direction.

[0046] One end E3 of the inner cylinder member UC is received within the outer cylinder member EC, and the other end E4 of the inner cylinder member UC is pivotally mounted on the right extension retaining plate 42R. A plurality of radial through-holes UH are formed in the inner cylinder member UC, penetrating the inner cylinder member UC in the radial direction. In the example illustrated in FIG. 4, the plurality of radial through-holes UH are formed at intervals identical to the intervals of the plurality of radial through-holes EH formed in the outer cylinder member EC.

[0047] The locking pin LP fixes the outer cylinder member EC and the inner cylinder member UC, so that the cylinder members EC and UC cannot move relative to each other. In the example illustrated in FIG. 4, the locking pin LP is configured to have an L-shape. In addition, a through-hole is formed at a tip end of the locking pin LP for receiving the retaining pin RP.

[0048] The retaining pin RP prevents the locking pin LP inserted into the radial through-hole EH and the radial through-hole UH from slipping out of the radial through-hole EH and the radial through-hole UH.

[0049] The operator inserts the inner cylinder member UC into the outer cylinder member EC, and aligns the position of the radial through-hole EH and the position of the radial through-hole UH at a position where the right support rod B2AR becomes a desired length. The length of the right support rod B2AR corresponds to a distance between the one end E1 of the outer cylinder member EC and the other end E4 of the inner cylinder member UC. Further, the operator inserts the locking pin LP so as to penetrate the radial through-hole EH and the radial through-hole UH, which are aligned, and attaches the retaining pin RP to the tip end of the locking pin LP. FIG. 4 illustrates a state where the outer cylinder member EC and the inner cylinder member UC are fixed by two locking pins LP.

[0050] According to this configuration, the operator can use the right support rod B2AR, as it is, as the extension support rod, without removing the one end of the right support rod B2AR from the right support rod B1Rb, even when switching the state of the right extension retaining plate 42R from the folded state to the extended state. In other words, the operator can use the right support rod B2AR, as it is, as the extension support rod, by simply changing the length of the right support rod B2AR.

[0051] More particularly, the operator can extend or contract the length of the right support rod B2AR, in a state where the one end E1 of the right support rod B2AR is mounted on the right support rod B1Rb, and the other end E4 of the right support rod B2AR is mounted on the right extension retaining plate 42R. For this reason, the operator can easily switch the state of the right extension retaining plate 42R between the folded state and extended state.

[0052] In the example illustrated in FIG. 4, the asphalt finisher 100 includes the right support rod B2AR having the length that is manually adjustable, however, the asphalt finisher 100 may include a right support rod having a length that is automatically adjustable by an actuator. In other words, the asphalt finisher 100 may include the actuator for pivoting the extension retaining plate 42. For example, the support rod B2 may be formed of a hydraulic cylinder.

[0053] Next, the asphalt finisher 100 according to another embodiment of the present invention will be described with reference to FIG. 5. FIG. 5 is a top view of the asphalt finisher 100 according to another embodiment of the present invention. The asphalt finisher 100 of FIG. 5 differs from the asphalt finisher 100 of FIG. 1 in that the asphalt finisher 100 of FIG. 5 includes a mechanism for extending and contracting each of the screw SC and the extension retaining plate 42, but is otherwise similar to the asphalt finisher 100 of FIG. 1. For this reason, a description of the similar portions will be omitted, and a description will be given of the portions that differ.

[0054] In the example illustrated in FIG. 5, the screw SC includes a center fixed screw SCC and an extension screw ESC. The extension screw ESC is caused to extend and contract in the vehicle width direction by a screw extension cylinder 29. The extension screw ESC includes a left extension screw ESCL and a right extension screw

ESCR, and the screw extension cylinder 29 includes a left screw extension cylinder 29L and a right screw extension cylinder 29R. The left extension screw ESCL is caused to extend and contract in the vehicle width direction by the left screw extension cylinder 29L, and the right extension screw ESCR is caused to extend and contract in the vehicle width direction by the right screw extension cylinder 29R.

[0055] The extension retaining plate 42 is caused to extend and contract in the vehicle width direction by a plate extension cylinder 45 which also functions as an extension support rod. For this reason, in the example illustrated in FIG. 5, the support rod B2 is omitted. More particularly, the plate extension cylinder 45 includes a left plate extension cylinder 45L and a right plate extension cylinder 45R. The left extension retaining plate 42L is caused to pivot by the left plate extension cylinder 45L which also functions as an extension support rod, to switch between the folded state and the extended state. The right extension retaining plate 42R is caused to pivot by the right plate extension cylinder 45R, which also functions as an extension support rod, to switch between the folded state and the extended state.

[0056] In the example illustrated in FIG. 5, the controller 50 is configured to synchronize the movements of the screed extension cylinder 26, the screw extension cylinder 29, and the plate extension cylinder 45, respectively. More particularly, the controller 50 causes the right screw extension cylinder 29R and the right plate extension cylinder 45R to extend, respectively, when extending the right screed extension cylinder 26R to extend the right rear extension screed 31R. The controller 50 also causes the right screw extension cylinder 29R and the right plate extension cylinder 45R to contract, respectively, when contracting the right screed extension cylinder 26R to contract the right rear extension screed 31R. The same applies to the extension and contraction of the left rear extension screed 31L.

[0057] The controller 50 may be configured to autonomously control each of the screed extension cylinder 26, the screw extension cylinder 29, and the plate extension cylinder 45 according to a change in the width of the roadbed RB detected based on an output of an imaging device or the like.

[0058] According to this configuration, the asphalt finisher 100 can automatically extend and contract the extension screw ESC in synchronization with the extension and contraction of the rear extension screed 31, and automatically pivot the extension retaining plate 42.

[0059] As described above, the asphalt finisher 100 according to the embodiments of the present application includes the tractor 1, the screed 3, the screw SC arranged in front of the screed 3, the retaining plate 41 arranged in front of the screw SC and mounted on the tractor 1 as the machine-side retaining plate, the support rod B1 arranged in front of the retaining plate 41 between the tractor 1 and the retaining plate 41 as the machine-side support rod, the extension retaining plate 42 pivotally mounted on the retaining plate 41, and the support rod B2 arranged in front of the extension retaining plate 42 between the tractor 1 and the extension retaining plate 42 as the extension support rod. This configuration makes it easier to extend the retaining plate 41. Hence, the asphalt finisher 100 can improve the workability at the work site.

[0060] In addition, the asphalt finisher 100 can facilitate the extension of the extension retaining plate 42, to prevent paving from being performed without additionally providing the extension retaining plate even though the rear extension screed 31 is extended, for example. Because the operator does not need to perform the complicated operations that are conventionally required, the extension retaining plate 42 can be extended without hesitation. As a result, the asphalt finisher 100 can increase the work efficiency of the paving construction. If the extension retaining plate were not additionally provided, the pavement material PV would spread frontward rather than in the vehicle width direction, which would consequently require the pavement material PV to be spread manually in the vehicle width direction.

[0061] Moreover, by utilizing the asphalt finisher 100, it is possible to eliminate the need for the operator to perform the operation such as mounting or removing the heavy extension retaining plate 42 every time the width of the roadbed RB to be paved changes. The operator need only mount the extension retaining plate 42 to the retaining plate 41 once at the start of the paving construction. For this reason, the asphalt finisher 100 can increase the safety of the operator associated with the paving construction.

[0062] Typically, one end of support rod B2 is fixed to tractor 1 or the support rod B1, and the other end of support rod B2 is fixed to the extension retaining plate 42. The position where the one end of the support rod B2 is fixed is set to be different between the state where the extension retaining plate 42 is folded and the state where the extension retaining plate 42 is extended. For example, one end of the right support rod B2R in the folded state of the right extension retaining plate 42R, may be fixed to the right side portion of the tractor 1, as illustrated in FIG. 3A. On the other hand, one end of the right support rod B2R in the first extended state of the right extension retaining plate 42R, may be fixed to a portion close to the right end of the right support rod B1Rb, as illustrated in FIG. 3B. Further, one end of the right support rod B2R in the second extended state of the right extension retaining plate 42R, may be fixed to a portion close to the center of the right support rod B1Rb, as illustrated in FIG. 3C. According to this configuration, the right support rod B2R having the fixed length structure can function suitably function as the support rod, regardless of whether the right extension retaining plate 42R is in the folded state, the first extended state, or the second extended state.

[0063] The support rod B2 may have the variable length structure. The support rod B2 may have the tele-

scopic extension structure, as illustrated in FIG. 4, for example. According to this configuration, even in the case where the operator switches the state of the extension retaining plate 42 from the folded state to the extended state, the support rod B2 can be utilized, as it is, as the extension support rod without having to remove one end of the support rod B2 from the support rod B1. In other words, the operator can utilize the support rod B2, as it is, as the extension support rod, by simply changing the length of the support rod B2.

[0064] The extension retaining plate 42 may have the sliding extension structure. More particularly, the extension retaining plate 42 may be configured to push out the distal plate 42D, telescopically provided inside the proximal plate 42P, our from the proximal plate 42P, as illustrated in FIG. 3C. According to this configuration, the operator can further extend the extension retaining plate 42, as appropriate.

[0065] The asphalt finisher 100 may include an actuator for pivoting the extension retaining plate 42. In this case, the actuator may be a hydraulic cylinder, such as the plate extension cylinder 45 illustrated in FIG. 5, or may be an electric cylinder. Alternatively, a hydraulic or electric motor or the like may be utilized as the actuator.

[0066] The asphalt finisher 100 may include an actuator that causes the screed 3 to extend and contract. In this case, the actuator may be a hydraulic cylinder such as the screed extension cylinder 26 illustrated in FIG. 1B or may be an electric cylinder. Alternatively, a hydraulic motor, an electric motor, or the like may be utilized as the actuator.

[0067] The controller 50 may be configured to be able to control a first actuator which pivots the extension retaining plate 42, and a second actuator which causes the screed 3 to extend and contract. In this case, the controller 50 may be configured to synchronize the movement of the first actuator and the movement of the second actuator. More particularly, the controller 50 may be configured to synchronize the movement of the screed extension cylinder 26 with the movement of the plate extension cylinder 45.

[0068] The right support rod B1R, as the machine-side support rod, includes the right support rod B1Ra as the first machine-side support rod, and the right support rod B1Rb as the second machine- side support rod, as illustrated in FIG. 3B. The asphalt finisher 100 is configured so that the distance between one end of the right support rod B1Ra (fixture C2Ra) fixed to the right retaining plate 41R as the machine-side retaining plate, and the tractor 1, is equal to the distance between one end of the right support rod B1Rb (fixture C2Rb) fixed to the right retaining plate 14R, and the tractor 1. The same applies to the left support rod B1L. According to this configuration, the support rod B1 can support the retaining plate 41 with an excellent balance.

[0069] The support rod B2, as the extension support rod, is desirably arranged to have the same height as the support rod B1, as the machine-side support rod. For example, the right support rod B2R, as the extension support rod, is desirably arranged in the vertical direction to have the same height as either the right support rod B1Ra or the right support rod B1Rb. The same applies to the left support rod B2L. In the example illustrated in FIG. 3, the right support rod B2R is arranged to have the same height as the right support rod B1Rb. In other words, the fixture C3R is arranged on the surface on the front side (+X-side) of the distal plate 42D to have the same height as the fixture C1Rb and the fixture C2Rb, respectively. This means that both the support rod B1 and the support rod B2 extend horizontally in a case where the asphalt finisher 100 is positioned on a horizontal plane. According to this configuration, the support rod B1 can support the support rod B2 with an excellent balance, and can thus support the extension retaining plate 42 with an excellent balanced. However, the present invention does not exclude a configuration in which the height of one end of the extension support rod is different from the height of the other end of the extension support rod.

[0070] Preferred embodiments of the present invention are described heretofore. However, the present invention is not limited to the embodiments described above. Various modifications, substitutions, or the like may be applied to the embodiments described above, without departing from the scope of the present invention. In addition, each of the features described above with reference to the embodiments described above may also be suitably combined, unless technically contradictory.

[0071] For example, in the embodiments described above, the extension retaining plate 42 includes the distal plate 42D and the proximal plate 42P which form the sliding extension structure. However, the distal plate 42D may be omitted.

[0072] In addition, the retaining plate 41 may have a sliding extension structure similar to the extension retaining plate 42. In this case, the support rod B1 may have a variable length structure.

[0073] This application claims priority to Japanese Patent Application No. 2018-126910, filed on July 3, 2018, the entire contents of which are hereby incorporated by reference.

DESCRIPTION OF THE REFERENCE NUMERALS

[0074] 1: Tractor, 2: Hopper, 3: Screed, 3A: Leveling arm, 5: Rear wheel, 6: Front wheel, 23: Leveling cylinder, 24: Hopper cylinder, 25: Screed extension cylinder, 26: Screed extension cylinder, 27L: Left front vibrator, 27R: Right front vibrator, 28L: Left rear vibrator, 28R: Right rear vibrator, 29: Screw extension cylinder, 30: Front fixed screed, 31: Rear extension screed, 32: Step, 40: Side plate, 41: Retaining plate, 42: Extension retaining plate, 42D: Distal plate, 42P: Proximal plate, 43: Moldboard, 45: Plate extension cylinder, 50: Controller, 100: Asphalt finisher, B1 & B2: Support rod, BT1 & BT2: Fastening member, C1R, C2R & C3R: Fixture, CM: Rein-

forcing column section, CV: Conveyor, EC: Outer cylinder member, EH: Radial through-hole, ESC1 & ESC2: Extension screw, FE: Connecting member, GR1 through GR3: Guard rail, H1: Hinge, LP: Locking pin, PV: Pavement material, RB: Roadbed, RF: Reinforcement rib. RP: Retaining pin, SC: Screw, SH: Screw retainer, UC: Inner cylinder member, UH: Radial through-hole.

Claims

1. An asphalt finisher comprising:

a tractor;
a screed;
a screw arranged in front of the screed;
a machine-side retaining plate arranged in front of the screw and mounted on the tractor;
a machine-side support rod arranged in front of the machine-side retaining plate between the tractor and the machine-side retaining plate;
an extension retaining plate pivotably mounted on the machine-side retaining plate; and
an extension support rod arranged in front of the extension retaining plate between the tractor and the extension retaining plate.

2. The asphalt finisher as claimed in claim 1, wherein
one end of the extension support rod is fixed to the tractor or the machine-side support rod,
the other end of the extension support rod is fixed to the extension retaining plate, and
a position where the one end of the extension support rod is fixed differs between a state where the extension retaining plate is folded and a stage where the extension retaining plate is extended.

3. The asphalt finisher as claimed in claim 1, wherein the extension support rod has a variable length structure.

4. The asphalt finisher as claimed in claim 1, wherein the extension retaining plate has a sliding extension structure.

5. The asphalt finisher as claimed in claim 1, comprising:
a first actuator configured to pivot the extension retaining plate.

6. The asphalt finisher as claimed in claim 5, comprising:

a second actuator configured to cause the screed to extend and contract; and
a controller configured to control the first actuator and the second actuator,
wherein the controller is configured to synchronize a movement of the first actuator with a movement of the second actuator.

7. The asphalt finisher as claimed in claim 1, wherein the machine-side support rod includes a first machine-side support rod and a second machine-side support rod, and
a distance between one end of the first machine-side support rod fixed to the machine-side retaining plate and the tractor is equal to a distance between one end of the second machine-side support rod fixed to the machine-side retaining plate and the tractor.

8. The asphalt finisher as claimed in claim 7, wherein the extension support rod is arranged to have the same height as the first machine-side support rod or the second machine-side support rod.

FIG.1A

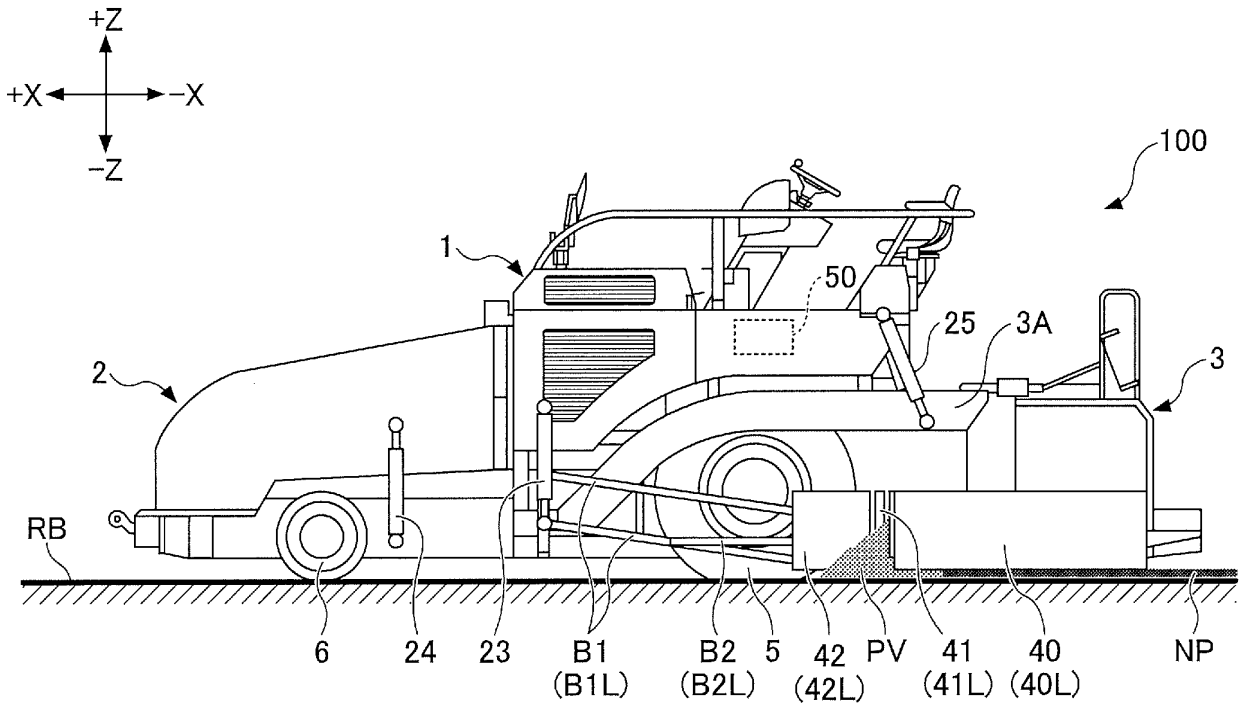
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FIG.1B

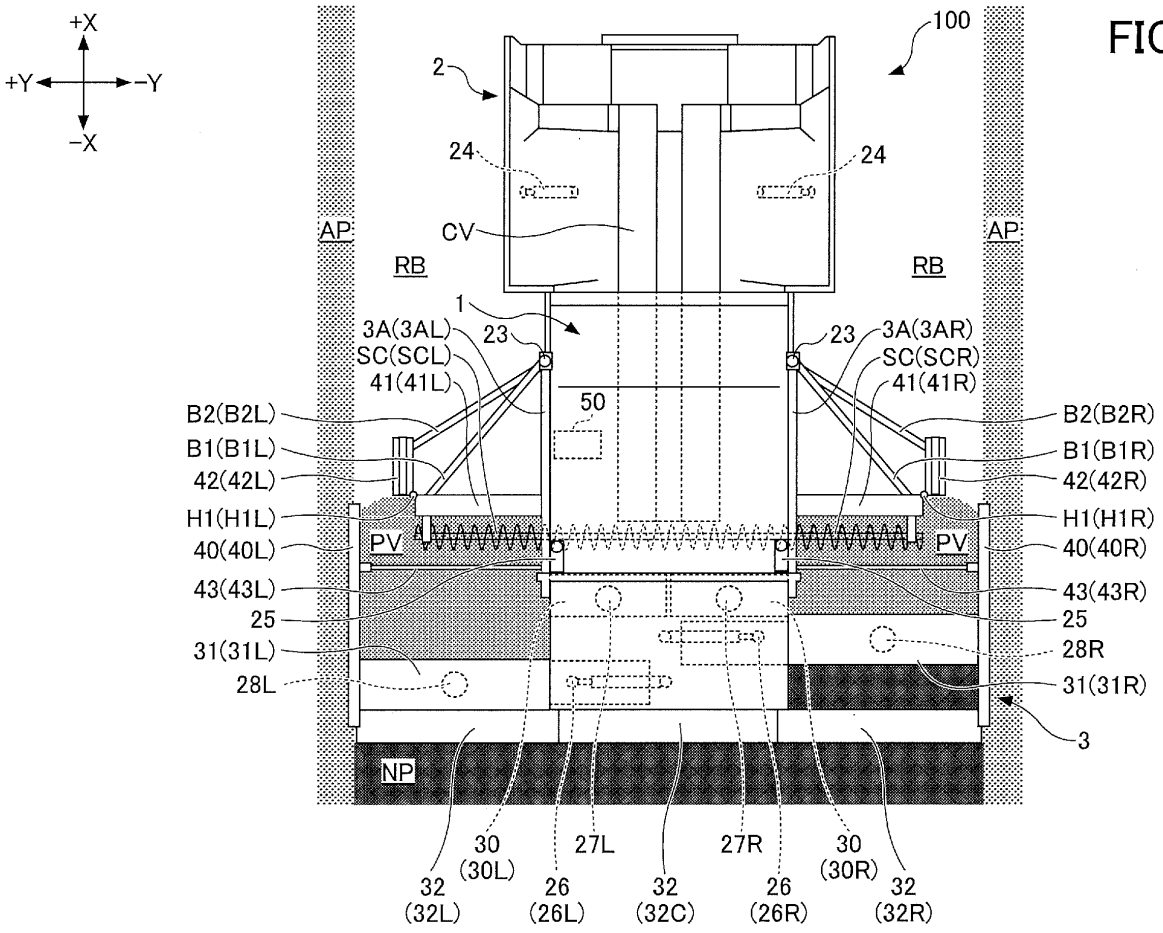
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FIG.2

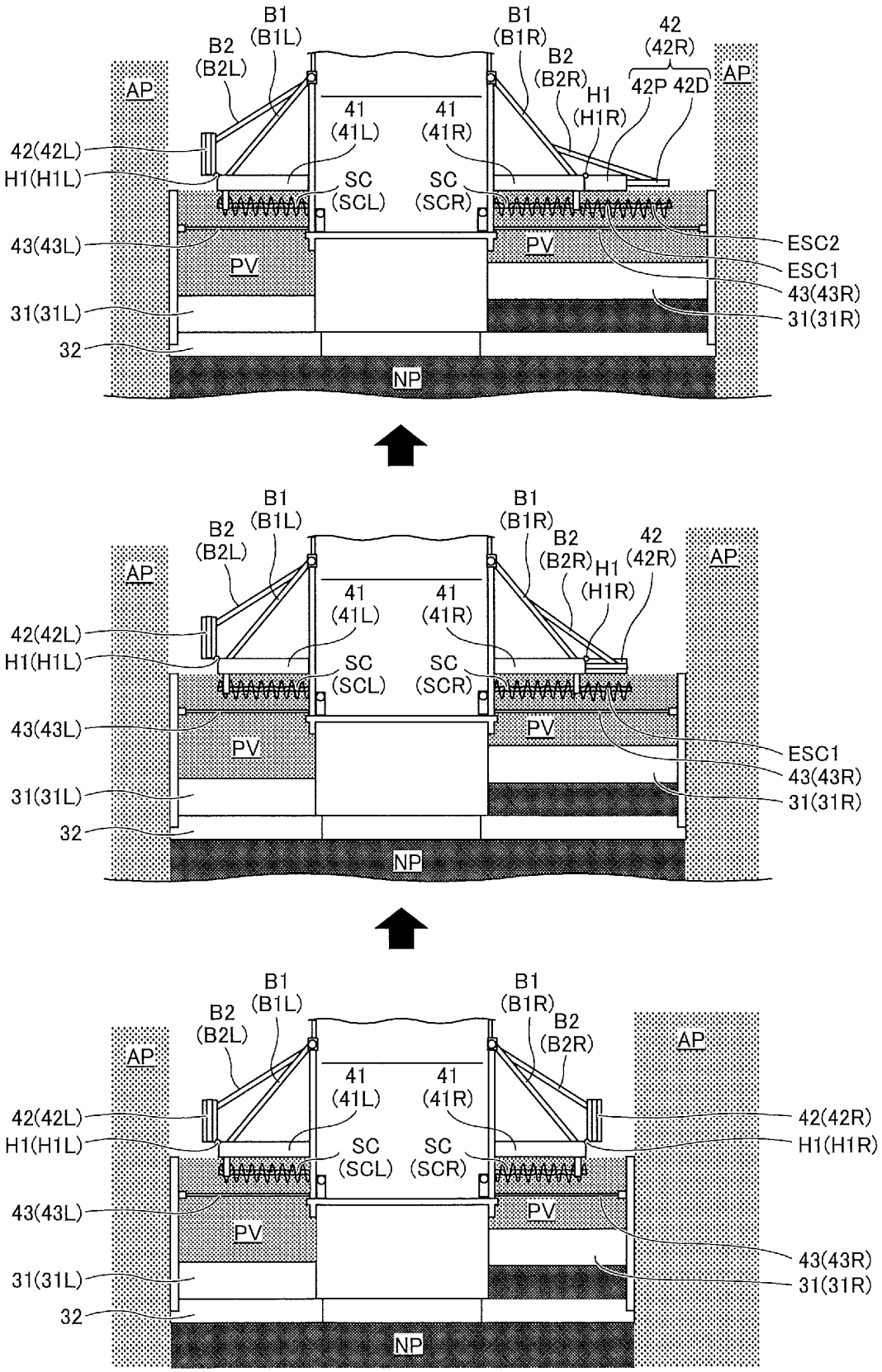
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FIG.3A

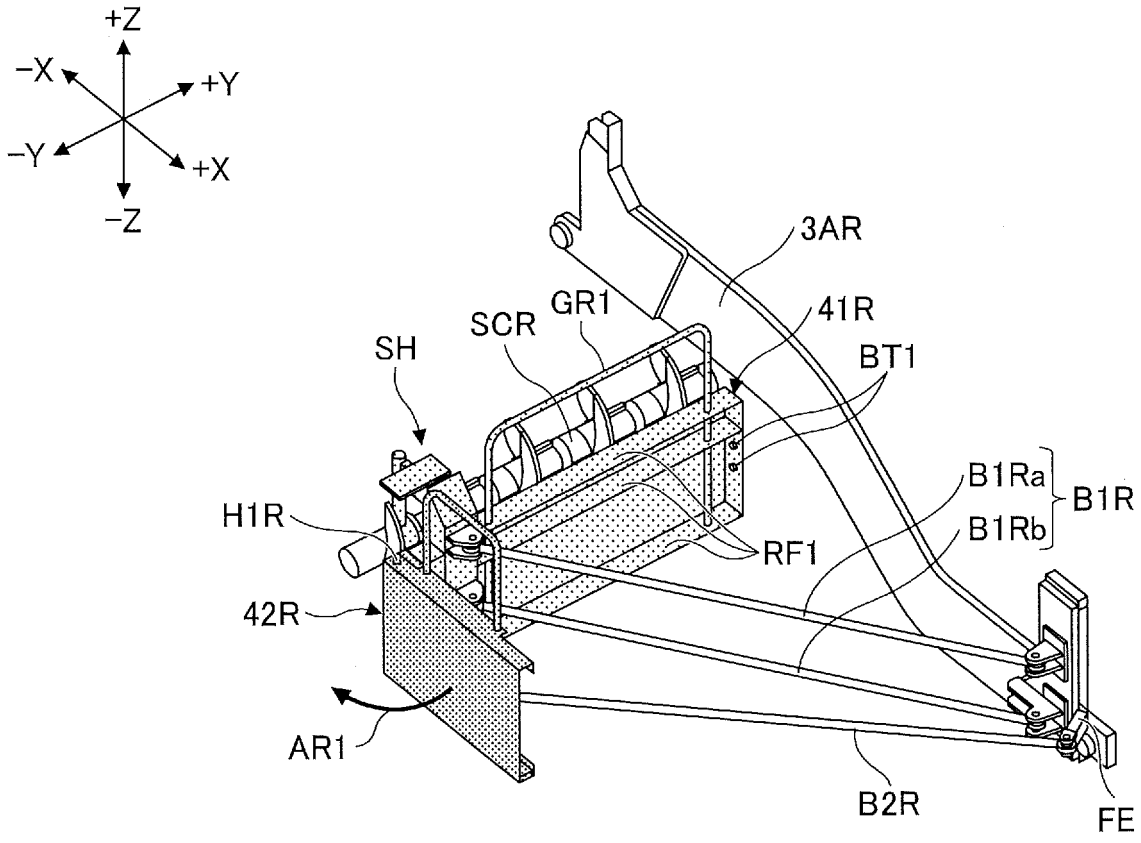
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FIG.3B

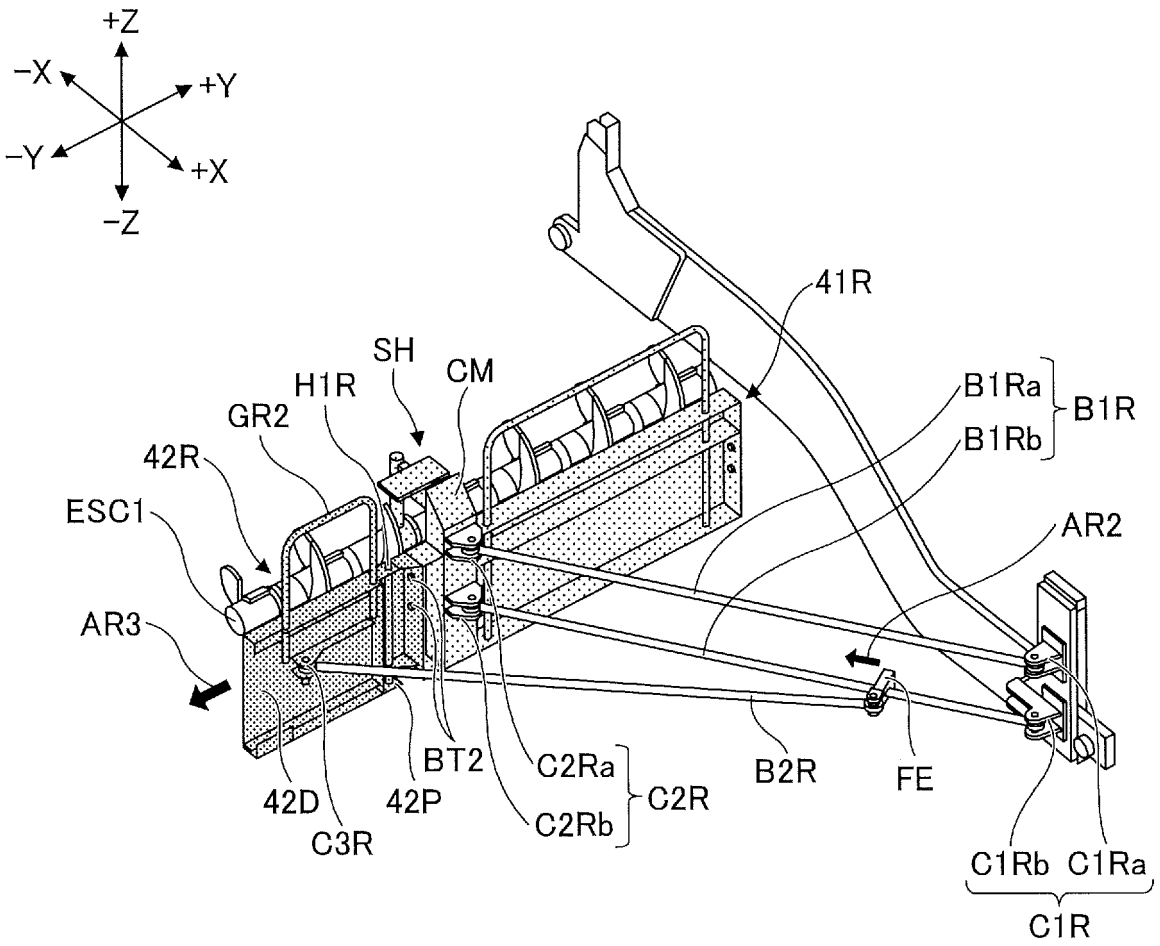
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FIG.3C

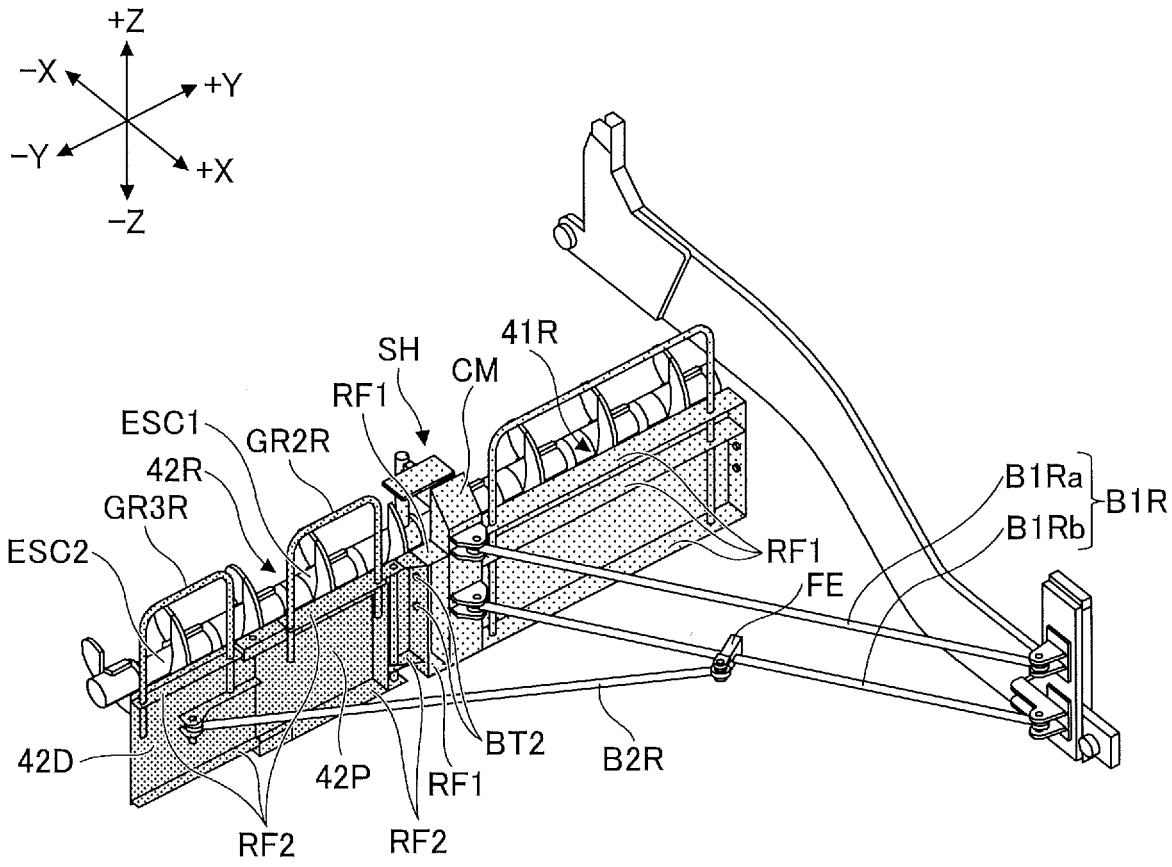
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FIG.4

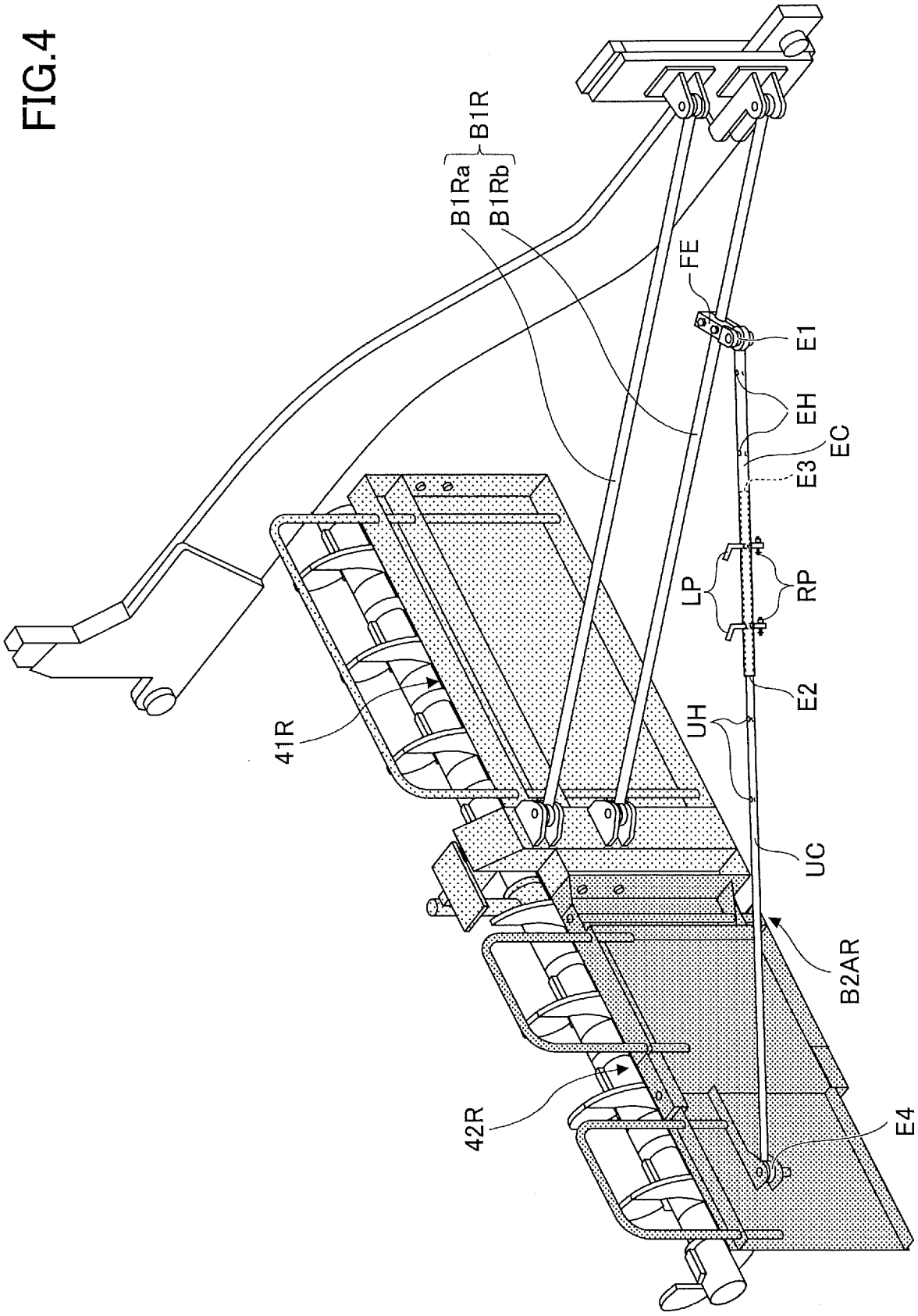
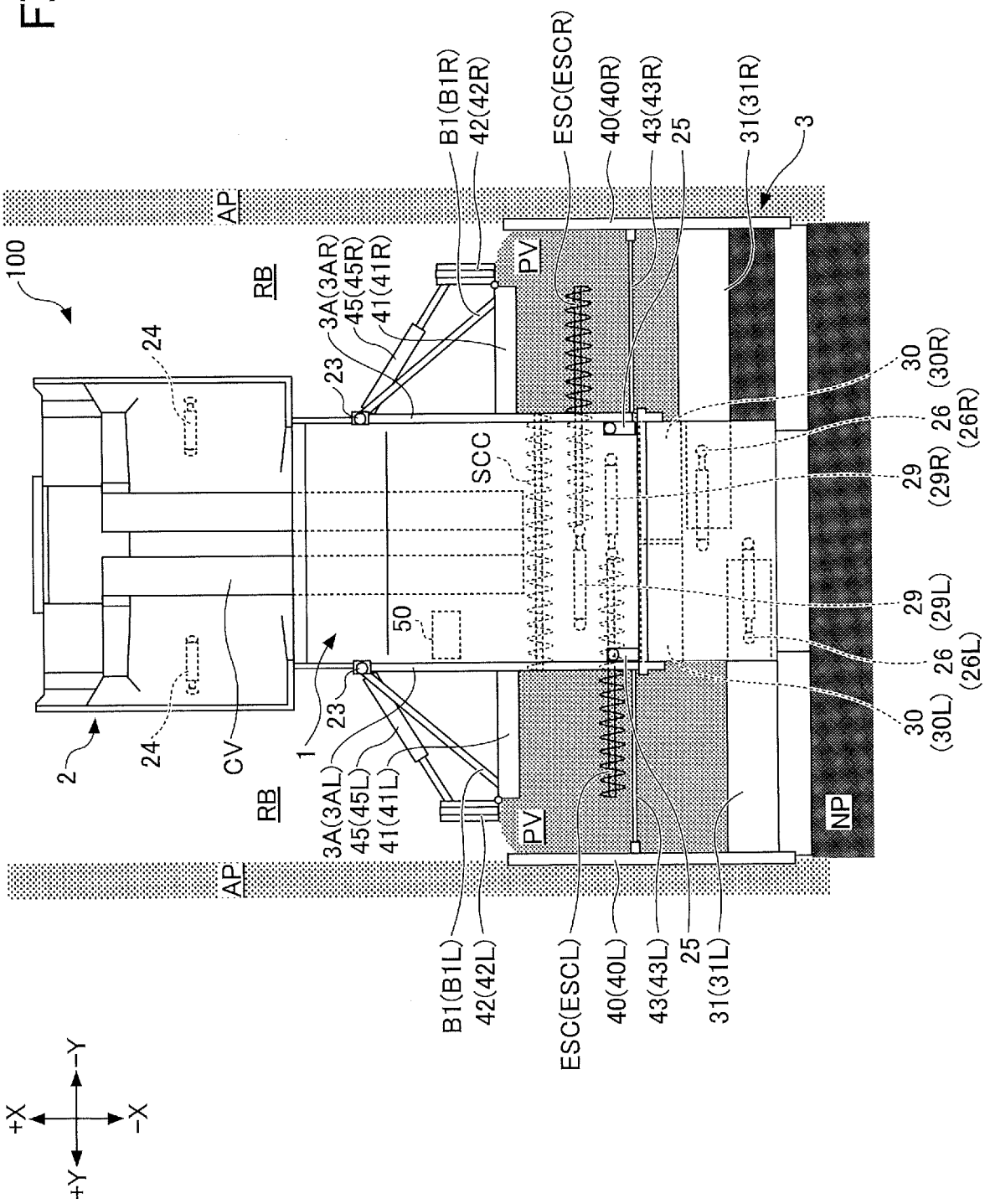


FIG.5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INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2019/026362

A. CLASSIFICATION OF SUBJECT MATTER
Int.Cl. E01C19/48(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. E01C19/48

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.
Y A	JP 10-88515 A (SHIN CATERPILLAR MITSUBISHI LTD.) 07 April 1998, paragraphs [0001], [0005]-[0013], fig. 1-3 (Family: none)	1, 3-8 2
Y	JP 2004-300855 A (SUMITOMO (S.H.I.) CONSTRUCTION MACHINERY MANUFACTURING CO., LTD.) 28 October 2004, paragraphs [0016], [0017], [0020]-[0022], fig. 1-5 (Family: none)	1, 3-8
Y	JP 2010-77799 A (JOSEPH VOEGELE AG) 08 April 2010, paragraph [0023], fig. 1, 2 & US 2010/0080655 A1, paragraph [0029], fig. 1, 2	7-8

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

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"P" document published prior to the international filing date but later than the priority date claimed
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"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
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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
05.08.2019	20.08.2019

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/JP2019/026362

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	JP 2016-108879 A (SUMITOMO(S.H.I.) CONSTRUCTION MACHINERY CO., LTD.) 20 June 2016, entire text, all drawings (Family: none)	1-8
A	EP 1120495 A1 (JOSEPH VOEGELE AG) 01 August 2001, entire text, all drawings & DE 20001246 U	1-8

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REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- JP 2016108879 A **[0003]**
- JP 2018126910 A **[0073]**