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(54) **ASPHALT FINISHER AND MACHINE LEARNING DEVICE**

ASPHALTFERTIGER UND MASCHINENLERNVORRICHTUNG

ÉPANDEUSE AUTOMATIQUE D'ENROBÉ ET DISPOSITIF D'APPRENTISSAGE MACHINE

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Description

TECHNICAL FIELD

[0001] The present disclosure relates to asphalt finishers.

BACKGROUND ART

[0002] An asphalt finisher including a conveyor to convey paving material accumulated in a hopper to the rear side of a tractor, a screw to lay and spread the paving material conveyed by the conveyor behind the tractor, and a screed to lay and level the paving material laid and spread by the screw behind the screw is known (see Patent Document 1). According to this asphalt finisher, the conveyor is so disposed as to be partly exposed at the center of the bottom surface of the hopper. Therefore, the conveyor can convey paving material at the center of the hopper to the rear side of the tractor. When the amount of paving material in the hopper decreases, an operator of the asphalt finisher manually closes the hopper to gather paving material at end portions of the bottom surface of the hopper to the center of the bottom surface so that the paving material at the end portions of the bottom surface is conveyed to the rear side of the tractor by the conveyor.

[0003] Furthermore, Patent Document 2 discloses an asphalt finisher with a sensor for determining the filling state of the hopper. Based on the sensor output, the operator shall be enabled to more reliably control the refilling of the hopper by a truck.

PRIOR ART DOCUMENT

PATENT DOCUMENT

[0004]

Patent Document 1: Japanese Unexamined Patent Publication No. 2017-160636
Patent Document 2: German Utility Model No. DE 94 02 324

SUMMARY OF THE INVENTION

PROBLEMS TO BE SOLVED BY THE INVENTION

[0005] If the operator of the asphalt finisher fails to manually operate the hopper, however, the paving material at the end portions of the bottom surface of the hopper remains at the end portions of the bottom surface of the hopper without being conveyed to the rear side of the tractor by the conveyor. Although the paving material remains in the hopper, the conveyor cannot convey the paving material to the rear side of the tractor. In this case, because of a deficiency of paving material supplied to the screed, depressions may be formed in a road to be newly constructed.

[0006] Therefore, it is desired to move the hopper with more reliability when the amount of paving material in the hopper decreases.

MEANS FOR SOLVING THE PROBLEMS

[0007] The aforementioned objective is achieved by an asphalt finisher according to claim 1.

[0008] An asphalt finisher according to an embodiment of the present invention, which includes a tractor, a hopper installed in front of the tractor to receive paving material, a conveyor configured to convey the paving material in the hopper to the rear side of the tractor, a screw configured to lay and spread the paving material conveyed by the conveyor behind the tractor, and a screed configured to lay and level the paving material laid and spread by the screw behind the screw, further includes a space recognition device configured to monitor a state in the hopper and a controller configured to move the hopper based on the output of the space recognition device, the controller being configured to close the hopper in response to determining that an amount of the paving material in the hopper is less than a predetermined amount.

EFFECTS OF THE INVENTION

[0009] The above-described asphalt finisher can move the hopper with more reliability when the amount of paving material in the hopper decreases.

BRIEF DESCRIPTION OF THE DRAWINGS

[0010]

FIG. 1A is a left side view of an asphalt finisher.
FIG. 1B is a top plan view of the asphalt finisher.
FIG. 2 is a functional block diagram of a controller.
FIG. 3A is a left side view of the asphalt finisher and a dump truck.
FIG. 3B is a left side view of the asphalt finisher and the dump truck.
FIG. 3C is a left side view of the asphalt finisher and the dump truck.
FIG. 4A is a front elevational view of the asphalt finisher.
FIG. 4B is a front elevational view of the asphalt finisher.
FIG. 4C is a front elevational view of the asphalt finisher.
FIG. 4D is a front elevational view of the asphalt finisher.
FIG. 4E is a front elevational view of the asphalt finisher.
FIG. 5 is a concept diagram illustrating an example of a determination process executed by a space recognition part.

EMBODIMENT OF THE INVENTION

[0011] FIGS. 1A and 1B are schematic diagrams of an asphalt finisher 100 according to an embodiment of the present invention. Specifically, FIG. 1A is a left side view of the asphalt finisher 100, and FIG. 1B is a top plan view of the asphalt finisher 100.

[0012] The asphalt finisher 100 is composed mainly of a tractor 1, a hopper 2, and a screed 3. According to the example illustrated in FIGS. 1A and 1B, the asphalt finisher 100 is positioned such that the vehicle length directions correspond to the X-axis directions and the vehicle width directions correspond to the Y-axis directions. The Z-axis is oriented to be perpendicular to each of the X-axis and the Y-axis. Specifically, the front side in the vehicle length directions corresponds to the +X side, the rear side in the vehicle length directions corresponds to the -X side, the left side in the vehicle width directions corresponds to the +Y side, the right side in the vehicle width directions corresponds to the -Y side, the upper side in the vertical directions corresponds to the +Z side, and the lower side in the vertical directions corresponds to the -Z side.

[0013] The tractor 1 is a mechanism for causing the asphalt finisher 100 to travel. According to the example illustrated in FIGS. 1A and 1B, the tractor 1 moves the asphalt finisher 100 by rotating rear wheels 5 using a rear wheel travel motor and rotating front wheels 6 using a front wheel travel motor. Each of the rear wheel travel motor and the front wheel travel motor is a hydraulic motor that receives hydraulic oil supplied from a hydraulic pump to rotate. The tractor 1, however, may have crawlers instead of wheels.

[0014] A controller 50 is a control device that controls the asphalt finisher 100. According to the example illustrated in FIGS. 1A and 1B, the controller 50 is a computer including a CPU, a volatile storage, and a nonvolatile storage, and is mounted on the tractor 1. For example, the CPU executes programs stored in the nonvolatile storage to implement various functions of the controller 50. The various functions implemented by the controller 50 include, for example, a function to control the discharge quantity of a hydraulic pump that discharges hydraulic oil for driving hydraulic actuators and a function to control the flow of hydraulic oil between the hydraulic actuators and the hydraulic pump. The hydraulic actuators include hydraulic cylinders and hydraulic motors.

[0015] The hopper 2 is a mechanism for receiving paving material. The paving material is, for example, an asphalt mixture or the like. According to the example illustrated in FIGS. 1A and 1B, the hopper 2 is installed on the front side (+X side) of the tractor 1 and is configured to be opened and closed in the Y-axis directions (vehicle width directions) by a hopper cylinder 24. Normally, the asphalt finisher 100 fully opens the hopper 2 to receive paving material from the bed of a dump truck. Furthermore, even when receiving paving material from the bed

of a dump truck, the asphalt finisher 100 continues to travel while pushing the dump truck forward through push rollers 2b. FIGS. 1A and 1B illustrate that the hopper 2 is fully open. An operator of the asphalt finisher 100 manually closes the hopper 2 to gather paving material near the inner wall of the hopper 2 to the center of the hopper 2 when the paving material in the hopper 2 decreases. This is for enabling a conveyor CV at the center of the bottom surface of the hopper 2 to convey the paving material to the rear side of the tractor 1. The paving material conveyed to the rear side of the tractor 1 is laid and spread in the vehicle width directions behind the tractor 1 and in front of the screed 3 by a screw SC.

[0016] A space recognition device CM for monitoring a situation in an area in front of the tractor 1 is attached to the tractor 1. The space recognition device CM is, for example, a monocular camera, a stereo camera, a LIDAR, or the like. According to the example illustrated in FIGS. 1A and 1B, the space recognition device CM is a monocular camera to capture an image of a situation in an area in front of the tractor 1. In this case, the controller 50 can determine whether the amount of paving material in the hopper 2 is more than a predetermined amount or not based on the image captured by the monocular camera serving as the space recognition device CM.

[0017] The conveyor CV is driven by a hydraulic motor that receives hydraulic oil supplied from a hydraulic pump to rotate. According to the example illustrated in FIGS. 1A and 1B, the conveyor CV is configured to convey the paving material in the hopper 2 to the rear side of the tractor 1 via a conveyance path CP. The conveyance path CP is a substantially cuboid space formed in the tractor 1 and has a substantially rectangular entrance OP that is open to the inside of the hopper 2 at a front 1FW of the tractor 1.

[0018] The screw SC is driven by a hydraulic motor that receives hydraulic oil supplied from the hydraulic pump to rotate. Specifically, the screw SC includes a center screw SCM, a left screw SCL, and a right screw SCR. The center screw SCM is positioned within the width of the tractor 1. The left screw SCL is connected to the left end of the center screw SCM to be positioned to protrude leftward from the width of the tractor 1. The right screw SCR is connected to the right end of the center screw SCM to be positioned to protrude rightward from the width of the tractor 1.

[0019] The screed 3 is a mechanism for laying and leveling the paving material. According to the example illustrated in FIGS. 1A and 1B, the screed 3 mainly includes a main screed 30 and an extendable screed 31. The extendable screed 31 includes a left extendable screed 31L and a right extendable screed 31R. The main screed 30, the left extendable screed 31L, and the right extendable screed 31R are arranged with forward and backward offsets. Specifically, the left extendable screed 31L is positioned behind the main screed 30, and the right extendable screed 31R is positioned behind the left extendable screed 31L. The screed 3 is a floating screed

towed by the tractor 1, and is coupled to the tractor 1 through a leveling arm 3A. A screed lift cylinder 25 extends and retracts to move the screed 3 up and down together with the leveling arm 3A.

[0020] The extendable screed 31 is configured to be extended and retracted in the vehicle width directions by an extension and retraction cylinder 60. The extension and retraction cylinder 60 is supported by a support fixed to the rear surface of the housing of the main screed 30, and is configured to be able to extend and retract the extendable screed 31 in the vehicle width directions. Specifically, the extension and retraction cylinder 60 includes a left extension and retraction cylinder 60L and a right extension and retraction cylinder 60R. The left extension and retraction cylinder 60L extends and retracts the left extendable screed 31L leftward in the vehicle width directions relative to the main screed 30. The right extension and retraction cylinder 60R extends and retracts the right extendable screed 31R rightward in the vehicle width directions relative to the main screed 30.

[0021] The leveling arm 3A is configured to be able to couple the screed 3 to the tractor 1. Specifically, the leveling arm 3A has one end (rear end) coupled to the screed 3 and the other end (front end) pivotably coupled to the tractor 1.

[0022] A leveling cylinder 23 is a hydraulic cylinder that moves up and down the front end of the leveling arm 3A to adjust the laying and leveling thickness of paving material. According to the example illustrated in FIGS. 1A and 1B, the leveling cylinder 23 has a cylinder part coupled to the tractor 1 and a rod part coupled to the front end of the leveling arm 3A. The front end of the leveling arm 3A is so attached to the tractor 1 as to be able to slide up and down. In the case of increasing the laying and leveling thickness, the controller 50 causes hydraulic oil discharged by a hydraulic pump to flow into the rod-side oil chamber of the leveling cylinder 23 to retract the leveling cylinder 23 to raise the front end of the leveling arm 3A. In the case of decreasing the laying and leveling thickness, the controller 50 causes hydraulic oil in the rod-side oil chamber of the leveling cylinder 23 to flow out to extend the leveling cylinder 23 to lower the front end of the leveling arm 3A.

[0023] The screed lift cylinder 25 is a hydraulic cylinder for lifting the screed 3. According to the example illustrated in FIGS. 1A and 1B, the screed lift cylinder 25 has a cylinder part coupled to the tractor 1 and a rod part coupled to the rear end of the leveling arm 3A. In the case of lifting the screed 3, the controller 50 causes hydraulic oil discharged by the hydraulic pump to flow into the rod-side oil chamber of the screed lift cylinder 25. As a result, the screed lift cylinder 25 retracts to lift the rear end of the leveling arm 3A, so that the screed 3 lifts up. In the case of lowering the lifted screed 3, the controller 50 allows hydraulic oil in the rod-side oil chamber of the screed lift cylinder 25 to flow out. As a result, the screed lift cylinder 25 extends because of the weight of the screed 3, so that the rear end of the leveling arm 3A lowers to lower the

screed 3.

[0024] A side plate 40 is attached to the distal end of the extendable screed 31. The side plate 40, which is a plate-shaped member elongated in the vehicle length directions, includes a left side plate 40L and a right side plate 40R. Specifically, the left side plate 40L is attached to the distal end (left end) of the left extendable screed 31L, and the right side plate 40R is attached to the distal end (right end) of the right extendable screed 31R.

[0025] The side plate 40 is also attached to the distal end of an extendable mold board 41. The extendable mold board 41 is a member for adjusting the amount of paving material accumulated in front of the extendable screed 31, of the paving material laid and spread by the screw SC, and is configured to be able to extend and retract in the vehicle width directions together with the extendable screed 31.

[0026] Specifically, the extendable mold board 41 is a plate-shaped member elongated in the vehicle width directions, and includes a left extendable mold board 41L and a right extendable mold board 41R. The left side plate 40L is attached to the distal end (left end) of the left extendable mold board 41L, and the right side plate 40R is attached to the distal end (right end) of the right extendable mold board 41R.

[0027] The extendable mold board 41 is configured to be able to adjust the height in the Z-axis directions independent of the extendable screed 31 and the side plate 40. The asphalt finisher 100 can adjust the amount of paving material passing through the gap between the lower end of the extendable mold board 41 and a roadbed by adjusting the size of the gap by moving up or down the extendable mold board 41. Therefore, by moving up or down the extendable mold board 41, the asphalt finisher 100 can adjust the amount (height) of paving material accumulated on the rear side (-X side) of the extendable mold board 41 and on the front side (+X side) of the extendable screed 31, and further can adjust the amount of paving material fed below the extendable screed 31.

[0028] A screed step 42 is a member that constitutes a stage for a worker who works behind the screed 3. Specifically, the screed step 42 includes a left screed step 42L, a center screed step 42C, and a right screed step 42R.

[0029] A retaining plate 43 is a plate-shaped member for preventing the paving material fed in the vehicle width directions by the screw SC from being scattered in front of the screw SC, in order for the paving material to be appropriately laid and spread in the vehicle width directions by the screw SC. According to the example illustrated in FIGS. 1A and 1B, the retaining plate 43 includes a left retaining plate 43L and a right retaining plate 43R.

[0030] Next, an assist function that is one of the functions of the controller 50 is described with reference to FIG. 2. FIG. 2 is a functional block diagram of the controller 50. The assist function is a function for assisting the operator of the asphalt finisher 100 in operating the

asphalt finisher 100. The assist function is implemented mainly by the cooperation of the space recognition device CM, a screw rotational speed sensor 45, a conveyor feed rate sensor 46, a travel speed sensor 47, a secondary storage 48, the controller 50, a screw controller 51, a conveyor controller 52, a hopper controller 53, a travel controller 54, and an output device 55.

[0031] The screw rotational speed sensor 45 is configured to detect the rotational speed of the screw SC. According to the example illustrated in FIG. 2, the screw rotational speed sensor 45 is an encoder to detect the angular velocity of the rotating shaft of the hydraulic motor that drives the screw SC. The screw rotational speed sensor 45 may also be constituted of a proximity switch to detect slits formed in a rotary disk, or the like.

[0032] The conveyor feed rate sensor 46 is configured to detect the feed rate of the conveyor CV. According to the example illustrated in FIG. 2, the conveyor feed rate sensor 46 is an encoder to detect the angular velocity of the rotating shaft of the hydraulic motor that drives the conveyor CV. The conveyor feed rate sensor 46 may also be constituted of a proximity switch to detect slits formed in a rotary disk, or the like.

[0033] The travel speed sensor 47 is configured to detect the travel speed of the asphalt finisher 100. According to the example illustrated in FIG. 2, the travel speed sensor 47 is an encoder to detect the angular velocity of the rotating shaft of the rear wheel travel motor that drives the rear wheels 5. The travel speed sensor 47 may also be constituted of a proximity switch to detect slits formed in a rotary disk, or the like.

[0034] The secondary storage 48 is configured to store various kinds of information. According to the example illustrated in FIG. 2, the secondary storage 48 is a non-volatile storage mounted on the tractor 1 and stores various kinds of information.

[0035] The screw controller 51 is configured to control the rotational speed of the screw SC. According to the example illustrated in FIG. 2, the screw controller 51 is a solenoid valve to control the flow rate of hydraulic oil flowing into the hydraulic motor that drives the screw SC. Specifically, the screw controller 51 increases or decreases a flow area that is the cross-sectional area of a conduit connecting the hydraulic pump and the hydraulic motor that drives the screw SC in response to a control command from the controller 50. More specifically, the screw controller 51 increases the flow area, thereby increasing the flow rate of hydraulic oil flowing into the hydraulic motor that drives the screw SC to increase the rotational speed of the screw SC. The screw controller 51 decreases the flow area, thereby decreasing the flow rate of hydraulic oil flowing into the hydraulic motor that drives the screw SC to decrease the rotational speed of the screw SC.

[0036] The conveyor controller 52 is configured to control the feed rate of the conveyor CV. According to the example illustrated in FIG. 2, the conveyor controller 52 is a solenoid valve to control the flow rate of hydraulic

oil flowing into the hydraulic motor that drives the conveyor CV. Specifically, the conveyor controller 52 increases or decreases a flow area that is the cross-sectional area of a conduit connecting the hydraulic pump and the hydraulic motor that drives the conveyor CV in response to a control command from the controller 50. More specifically, the conveyor controller 52 increases the flow area, thereby increasing the flow rate of hydraulic oil flowing into the hydraulic motor that drives the conveyor CV to increase the feed rate of the conveyor CV. The conveyor controller 52 decreases the flow area, thereby decreasing the flow rate of hydraulic oil flowing into the hydraulic motor that drives the conveyor CV to decrease the feed rate of the conveyor CV.

[0037] The hopper controller 53 is configured to control the amount of extension and retraction of the hopper cylinder 24. According to the example illustrated in FIG. 2, the hopper controller 53 is a solenoid valve to control the flow rate of hydraulic oil flowing into the hopper cylinder 24 or flowing out of the hopper cylinder 24. Specifically, the hopper controller 53 switches the opening and the closing of each of a conduit connecting the hopper cylinder 24 and the hydraulic pump and a conduit connecting the hopper cylinder 24 and a hydraulic oil tank in response to a control command from the controller 50. More specifically, the hopper controller 53 is configured to open the conduits to cause hydraulic oil to flow into the bottom-side oil chamber of the hopper cylinder 24, thereby extending the hopper cylinder 24 to automatically close the hopper 2. The hopper controller 53 is configured to open the conduits in response to a control command from the controller 50 to cause hydraulic oil to flow out of the bottom-side oil chamber of the hopper cylinder 24, thereby retracting the hopper cylinder 24 to open the hopper 2.

[0038] The travel controller 54 is configured to control the travel speed of the asphalt finisher 100. According to the example illustrated in FIG. 2, the travel controller 54 is a solenoid valve to control the flow rate of hydraulic oil flowing into each of the rear wheel travel motor and the front wheel travel motor. Specifically, the travel controller 54 increases or decreases a flow area that is the cross-sectional area of a conduit connecting the hydraulic pump and each of the rear wheel travel motor and the front wheel travel motor in response to a control command from the controller 50. More specifically, the travel controller 54 increases the flow area, thereby increasing the flow rate of hydraulic oil flowing into each of the rear wheel travel motor and the front wheel travel motor to increase the travel speed of the asphalt finisher 100. The conveyor controller 52 decreases the flow area, thereby decreasing the flow rate of hydraulic oil flowing into each of the rear wheel travel motor and the front wheel travel motor to decrease the travel speed of the asphalt finisher 100.

[0039] The output device 55 is configured to output information. The information includes visual information and aural information. According to the example illu-

strated in FIG. 2, the output device 55 is configured to impart information to workers working in an area surrounding the asphalt finisher 100. The workers working in an area surrounding the asphalt finisher 100 may include the operator of the asphalt finisher 100 and the driver of a dump truck. Specifically, the output device 55 is a main monitor 55A (see FIGS. 1A and 1B), a sound output device 55B (see FIGS. 1A and 1B), and an indicator 55C (see FIGS. 1A and 1B). The output device 55, however, may be one or two of the main monitor 55A, the sound output device 55B, and the indicator 55C.

[0040] The main monitor 55A is configured to display various kinds of information. According to the example illustrated in FIG. 2, the main monitor 55A is a liquid crystal display and can display various kinds of information in response to a control command from the controller 50. Furthermore, the main monitor 55A may include an input device such as a touchscreen to receive the operation input of the operator of the asphalt finisher 100.

[0041] The sound output device 55B is configured to output a sound to an area surrounding the asphalt finisher 100. According to the example illustrated in FIG. 2, the sound output device 55B is a loudspeaker to output a sound to an area surrounding the asphalt finisher 100 and can output an alarm sound in response to a control command from the controller 50. The sound output device 55B may output a voice message.

[0042] The indicator 55C is a display device that includes a display part facing an area in front of the asphalt finisher 100. According to the example illustrated in FIG. 2, the indicator 55C is so attached to the tractor 1 as to be visible to the driver of a dump truck seated in the driver's seat of the dump truck. Specifically, the indicator 55C is installed at a position higher than the upper surface of the tractor 1. The indicator 55C is an LED panel and can display various kinds of information in response to a control command from the controller 50. For example, the indicator 55C can display an instruction to move backward to the driver of a dump truck loaded with paving material to notify the driver that it is possible to move the dump truck backward.

[0043] According to the example illustrated in FIG. 2, the indicator 55C is configured to be able to be unfolded to protrude outward from the right side of the tractor 1 when in use. That is, the indicator 55C is configured to be foldable to stay within the vehicle width of the asphalt finisher 100 when not in use.

[0044] The controller 50 obtains information from the space recognition device CM, the screw rotational speed sensor 45, the conveyor feed rate sensor 46, the travel speed sensor 47, the secondary storage 48, etc., and performs various kinds of operations, and thereafter outputs control commands to the screw controller 51, the conveyor controller 52, the hopper controller 53, the travel controller 54, the output device 55, etc., according to the results of the operations.

[0045] Specifically, the controller 50 determines whether a predetermined condition is satisfied based

on information obtained from at least one of the space recognition device CM, the screw rotational speed sensor 45, the conveyor feed rate sensor 46, the travel speed sensor 47, and the secondary storage 48, and outputs a control command to at least one of the screw controller 51, the conveyor controller 52, the hopper controller 53, the travel controller 54, the output device 55, etc., in response to determining that the predetermined condition is satisfied.

[0046] More specifically, the controller 50 includes a space recognition part 50A and a hopper control part 50B as functional blocks constituted of software, hardware, or their combination.

[0047] The space recognition part 50A is configured to recognize a situation in an area in front of the tractor 1 based on the output of the space recognition device CM. According to the example illustrated in FIG. 2, the space recognition part 50A is configured to identify the height of paving material in the hopper 2. The height of paving material in the hopper 2 is, for example, the distance between the bottom surface of the hopper 2 and the surface of the paving material in a central part MP (see FIG. 1B) in the hopper 2. The central part MP of the hopper 2 is, for example, where the conveyor CV is exposed.

[0048] Specifically, the space recognition part 50A derives the height of paving material in the central part MP in the hopper 2 by performing predetermined image processing on an image captured by a monocular camera serving as the space recognition device CM. The space recognition part 50A may also derive the volume, weight or the like of paving material in the central part MP in the hopper 2 by performing predetermined image processing on an image captured by a monocular camera serving as the space recognition device CM. Furthermore, the space recognition part 50A may also derive paving material in the central part MP in the hopper 2 based on the output of a LIDAR serving as the space recognition device CM.

[0049] The space recognition part 50A determines whether the derived height is greater than a predetermined height. The predetermined height is, for example, a value (height) pre-recorded in the secondary storage 48. The predetermined height is, for example, the height of the entrance OP of the conveyance path CP. In the case of deriving the volume of paving material in the central part MP in the hopper 2, the space recognition part 50A determines whether the derived volume is greater than a predetermined volume.

[0050] The space recognition part 50A may also be configured to determine the presence or absence of a dump truck in front of the asphalt finisher 100. Specifically, the space recognition part 50A may be configured to determine, by performing predetermined image processing on an image captured by a monocular camera serving as the space recognition device CM, whether a dump truck is contacting the asphalt finisher 100 via the push rollers 2b, whether a dump truck is lifting the front of

a bed, whether a dump truck is moving toward the asphalt finisher 100, whether a dump truck is moving away from the asphalt finisher 100, or the like. When a dump truck is contacting the asphalt finisher 100, the rear wheels of the dump truck are in contact with the push rollers 2b (see FIGS. 1A and 1B) placed on the front side of the hopper 2. At this point, the driver of the dump truck shifts the gear of the dump truck to neutral. This causes the dump truck to be pushed by the driving force of the asphalt finisher 100 to move forward together with the asphalt finisher 100.

[0051] FIGS. 3A through 3C are left side views of the asphalt finisher 100 and a dump truck 200. The dump truck 200 is an example of a transporter vehicle that transports paving material to be supplied into the hopper 2 of the asphalt finisher 100.

[0052] FIGS. 3A through 3C illustrate three states of the dump truck 200. Specifically, FIG. 3A illustrates the state of the asphalt finisher 100 and the dump truck 200 when paving material loaded on the bed of the dump truck 200 is being supplied into the hopper 2 of the asphalt finisher 100. In FIG. 3A, the front of a bed 200b of the dump truck 200 contacting the asphalt finisher 100 is lifted.

[0053] FIG. 3B illustrates the state of the asphalt finisher 100 and the dump truck 200 when the bed 200b is returned to a state where the lifted front is no longer lifted after all of the paving material loaded on the bed 200b is supplied into the hopper 2. In FIG. 3B, the dump truck 200 is still in contact with the asphalt finisher 100 via the push rollers 2b.

[0054] FIG. 3C illustrates the state of the asphalt finisher 100 and the dump truck 200 when the dump truck 200 moves forward to be apart from the asphalt finisher 100.

[0055] By performing predetermined image processing on an image captured by a monocular camera serving as the space recognition device CM, the space recognition part 50A can determine whether the current state of the asphalt finisher 100 and the dump truck 200 is the state as illustrated in FIG. 3A, the state as illustrated in FIG. 3B, the state as illustrated in FIG. 3C, or the like.

[0056] Furthermore, the space recognition part 50A may also be configured to determine the presence or absence of an entering object in the hopper 2. Specifically, the space recognition part 50A may be configured to determine, by performing predetermined image processing on an image captured by a monocular camera serving as the space recognition device CM, whether a worker has entered the hopper 2, whether a tool such as a rake or a shovel is in the hopper 2, or the like.

[0057] Furthermore, the space recognition part 50A may also be configured to determine whether the hopper 2 has run out of paving material. Specifically, the space recognition part 50A may be configured to determine whether the hopper 2 has run out of paving material by performing predetermined image processing on an image captured by a monocular camera serving as the space recognition device CM.

[0058] The hopper control part 50B is configured to close the hopper 2 when a predetermined condition is satisfied. According to the example illustrated in FIG. 2, the space recognition part 50A determines whether the height of paving material in the central part MP in the hopper 2 is greater than a predetermined height based on an image captured by a monocular camera serving as the space recognition device CM. In response to the space recognition part 50A determining that the height of paving material in the central part MP in the hopper 2 is greater than the predetermined height, the hopper control part 50B transmits a CLOSE command to the hopper controller 53. In response to receiving the CLOSE command, the hopper controller 53 causes hydraulic oil to flow into the bottom-side oil chamber of the hopper cylinder 24, thereby extending the hopper cylinder 24 to close the hopper 2. The hopper control part 50B may extend the hopper cylinder 24 until the hopper 2 is completely closed or may extend the hopper cylinder 24 a predetermined length, for example.

[0059] Furthermore, the hopper control part 50B may transmit an OUTPUT command to the output device 55 when closing the hopper 2, namely, when extending the hopper cylinder 24. In response to receiving the OUTPUT command, the output device 55 may notify the operator of the asphalt finisher 100 that the operation of closing the hopper 2 is being automatically performed by causing the main monitor 55A to display a text message such as "HOPPER CLOSING," for example. The output device 55 may also notify a worker working in an area surrounding the asphalt finisher 100 that the operation of closing the hopper 2 is being automatically performed by causing the sound output device 55B to output a voice message such as "HOPPER CLOSING," for example. The output device 55 may also notify the driver of the dump truck 200 that the operation of closing the hopper 2 is being automatically performed by causing the indicator 55C to output a text message such as "HOPPER CLOSING," for example.

[0060] The hopper control part 50B may also be configured not to close the hopper 2 even when the space recognition part 50A determines that the above-described predetermined condition is satisfied, if the space recognition part 50A determines that the dump truck 200 is in contact with the asphalt finisher 100 based on an image captured by a monocular camera serving as the space recognition device CM. This is for preventing contact between a hopper wing and the dump truck. In this case, the hopper control part 50B may be configured not to transmit a CLOSE command to the hopper controller 53 or may transmit a STOP command to the hopper controller 53. In response to receiving the STOP command, the hopper controller 53 stops hydraulic oil flowing into the bottom-side oil chamber of the hopper cylinder 24, thereby stopping the extension of the hopper cylinder 24 to stop the movement of the hopper 2.

[0061] Furthermore, the hopper control part 50B may also be configured not to close the hopper 2, the same as

in the case where the space recognition part 50A determines that the dump truck 200 is in contact with the asphalt finisher 100, even when the space recognition part 50A determines that the dump truck 200 is out of contact with the asphalt finisher 100, if the space recognition part 50A determines that the distance between the dump truck 200 and the asphalt finisher 100 is less than a predetermined distance.

[0062] Furthermore, the hopper control part 50B may also be configured not to close the hopper 2 even when the space recognition part 50A determines that the above-described predetermined condition is satisfied, if the space recognition part 50A determines that an entering object is present in the hopper 2 based on an image captured by a monocular camera serving as the space recognition device CM. This is for preventing contact between a hopper wing and the entering object or for preventing the entering object (for example, a shovel) from being buried under paving material in the hopper 2. In this case, the hopper control part 50B may be configured not to transmit a CLOSE command to the hopper controller 53 or may be configured to transmit a STOP command to the hopper controller 53.

[0063] Furthermore, the hopper control part 50B may also be configured to reduce the feed rate of the conveyor CV, the rotational speed of the screw SC, and the travel speed of the asphalt finisher 100 if the space recognition part 50A determines that the hopper 2 has run out of paving material based on an image captured by a monocular camera serving as the space recognition device CM. Furthermore, the hopper control part 50B may also be configured to stop the movement of the conveyor CV, the screw SC, the rear wheels 5, and the front wheels 6. This is because if the asphalt finisher 100 continues construction without paving material in the hopper 2, depressions may be formed in a road to be newly constructed because of a deficiency of paving material.

[0064] In this case, the hopper control part 50B transmits a DECELERATE command or a STOP command to each of the screw controller 51, the conveyor controller 52, and the travel controller 54. In response to receiving the DECELERATE command or the STOP command, the screw controller 51 decreases the flow rate of hydraulic oil flowing into the hydraulic motor that drives the screw SC to decrease the rotational speed of the screw SC or stop the rotation of the screw SC. The same is the case with the conveyor controller 52 and the travel controller 54.

[0065] FIGS. 4A through 4E are front elevational views of the asphalt finisher 100. FIGS. 4A through 4E schematically illustrate five states of paving material PM in the hopper 2. For clarification, the paving material PM in the hopper 2 is marked with a dot pattern in FIGS. 4A through 4E. Furthermore, a base part 1BF, the front wheels 6 (a left front wheel 6L and a right front wheel 6R), and the hopper cylinder 24 (a left hopper cylinder 24L and a right hopper cylinder 24R) of the tractor 1 are depicted in FIG. 4A, but are omitted in FIGS. 4B through 4E. Furthermore,

in FIGS. 4A, 4C and 4D, of the entrance OP of the conveyance path CP formed in the front 1FW of the tractor 1, a part buried under the paving material PM to be actually invisible is represented by a dashed line.

[0066] Specifically, FIG. 4A illustrates the state of the paving material PM in the hopper 2 immediately after the paving material PM is supplied by the dump truck 200. Specifically, FIG. 4A illustrates the state of the paving material PM in the hopper 2 after paving material loaded on the bed 200b of the dump truck 200 is supplied into the hopper 2 as illustrated in FIG. 3B. More specifically, FIG. 4A illustrates a state where a sufficient amount of the paving material PM is accumulated in a space in the hopper 2 surrounded by the front 1FW of the tractor 1 and a hopper wing 2W (a left hopper wing 2WL and a right hopper wing 2WR)

[0067] FIG. 4B illustrates a state where the amount of the paving material PM in the hopper 2 has decreased. Specifically, FIG. 4B illustrates the state when the height of the paving material PM in the central part MP of the hopper 2 has become a height H1 after the paving material PM in the central part MP of the hopper 2 is conveyed to the rear side of the tractor 1 by the conveyor CV. That is, FIG. 4B illustrates that the height H1 of the paving material PM in the central part MP of the hopper 2 is smaller than a predetermined height Ht. According to the example illustrated in FIG. 4B, the predetermined height Ht corresponds to the height of the entrance OP of the conveyance path CP formed in the front 1FW of the tractor 1. FIG. 4B also illustrates that the height of the paving material PM at each of a left end part and a right end part in the hopper 2 is a height H2 and is still greater than the predetermined height Ht.

[0068] In the state illustrated in FIG. 4B, the space recognition part 50A can determine that the height H1 of the paving material in the central part MP in the hopper 2 is smaller than the predetermined height Ht based on an image captured by a monocular camera serving as the space recognition device CM.

[0069] In response to the space recognition part 50A determining that the height H1 of the paving material in the central part MP in the hopper 2 is smaller than the predetermined height Ht, the hopper control part 50B transmits a CLOSE command to the hopper controller 53. In response to receiving the CLOSE command, the hopper controller 53 causes hydraulic oil to flow into the bottom-side oil chamber of the hopper cylinder 24, thereby extending the hopper cylinder 24 to close the hopper 2.

[0070] FIGS. 4C and 4D illustrate states of the paving material PM in the hopper 2 when the hopper 2 is closed. Specifically, FIG. 4C illustrates a state when each of the left hopper wing 2WL and the right hopper wings 2WR is about half closed (when the hopper angle is an angle $\alpha 1$), and FIG. 4D illustrates a state when each of the left hopper wing 2WL and the right hopper wings 2WR is completely closed (when the hopper angle is an angle $\alpha 2$). FIGS. 4A and 4B illustrate states when each of the left hopper wing 2WL and the right hopper wings 2WR is

completely open (when the hopper angle is zero). The hopper angle is, for example, an angle formed between the bottom surface of the hopper 2 and a predetermined virtual plane. The predetermined virtual plane is, for example, a virtual plane in which the asphalt finisher 100 is positioned, and is typically a virtual horizontal plane.

[0071] FIG. 4E illustrates a state when the paving material PM has run out in the central part MP while the paving material PM remains in each of the left end part and the right end part in the hopper 2. Specifically, FIG. 4E illustrates the state of the paving material PM in the hopper 2 that results when the completely open state of the hopper 2 is kept as is after the state illustrated in FIG. 4B.

[0072] The hopper control part 50B can gather the paving material PM in each of the left end part and the right end part in the hopper 2 to the central part MP by automatically closing the hopper 2 when the height of the paving material in the central part MP in the hopper 2 becomes less than or equal to the predetermined height Ht. Therefore, the hopper control part 50B can prevent the occurrence of a situation where the paving material PM has run out in the central part MP while the paving material PM remains in each of the left end part and the right end part in the hopper 2 as illustrated in FIG. 4E. As a result, the hopper control part 50B can prevent formation of depressions in a road to be newly constructed due to a deficiency of the paving material PM supplied to the screed 3.

[0073] As described above, the asphalt finisher 100 includes the tractor 1, the hopper 2 installed in front of the tractor 1 to receive paving material, the conveyor CV to convey the paving material in the hopper 2 to the rear side of the tractor 1, the screw SC to lay and spread the paving material conveyed by the conveyor CV behind the tractor 1, and the screed 3 to lay and level the paving material laid and spread by the screw SC behind the screw SC. The asphalt finisher 100 further includes the space recognition device CM to monitor a state in the hopper 2 and the controller 50 to move the hopper 2 based on the output of the space recognition device CM.

[0074] According to this configuration, the asphalt finisher 100 can ensure that the hopper 2 moves when the amount of the paving material PM in the hopper 2 decreases. Therefore, the asphalt finisher 100 can ensure that a situation where the paving material PM supplied to the screed 3 runs short although the paving material PM sufficiently remains in end parts in the hopper 2 is prevented from occurring.

[0075] The controller 50 is configured to close the hopper 2 in response to determining that the amount of the paving material PM in the hopper 2 is less than a predetermined amount. For example, the controller 50 may be configured to determine that the amount of the paving material PM in the hopper 2 is less than a predetermined amount and automatically close the hopper 2, in response to determining that the height of the paving

material PM in the central part MP in the hopper 2 is smaller than the predetermined height Ht. Furthermore, the controller 50 may be configured to, in the case of automatically closing the hopper 2, so notify a surrounding area.

[0076] The controller 50 may also be configured to close the hopper 2 in response to determining that the paving material PM in the hopper 2 has changed from being more than a predetermined amount to being less than the predetermined amount. For example, the controller 50 may be configured to determine that the paving material PM in the hopper 2 has changed from being more than a predetermined amount to being less than the predetermined amount and close the hopper 2, in response to determining that the height of the paving material PM in the central part MP in the hopper 2 has changed from being greater than the predetermined height Ht to being smaller than the predetermined height Ht. The controller 50 may be configured to, in the case of closing the hopper 2, so notify a surrounding area.

[0077] According to these configurations, the asphalt finisher 100 can ensure that the hopper 2 is closed when the amount of the paving material PM in the hopper 2 is less than a predetermined amount. Furthermore, by using the output device 55, the asphalt finisher 100 can notify a worker working in an area surrounding the asphalt finisher 100 that the hopper 2 is going to be closed or an operation to close the hopper 2 is being performed.

[0078] The controller 50 may also be configured to determine the presence or absence of an entering object in the hopper 2 before moving the hopper 2 or while moving the hopper 2. For example, the controller 50 may be configured to determine whether a worker has entered the hopper 2, whether a tool such as a rake or a shovel is in the hopper 2, or the like by performing predetermined image processing on an image captured by a monocular camera serving as the space recognition device CM. The controller 50 may prevent the hopper 2 from being closed even when determining that the amount of the paving material PM in the hopper 2 is less than a predetermined amount, if determining that an entering object such as a worker, a rake, or a shovel is in the hopper 2. This is for preventing contact between the hopper wing 2W and the entering object or for preventing the entering object from being buried under the paving material PM in the hopper 2.

[0079] Furthermore, while a hydraulic motor is used according to the above-described embodiment, an electric motor may be used instead of a hydraulic motor.

[0080] A preferred embodiment of the present invention is described in detail above. The present invention, however, is not limited to the above-described embodiment. Various variations, substitutions, etc., may be applied to the above-described embodiment without departing from the scope of the present invention. Furthermore, separately described features may be combined to the extent that no technical contradiction is caused.

[0081] For example, according to the above-described

embodiment, the controller 50 is configured to close the hopper 2 when a predetermined condition is satisfied. Typically, the controller 50 is configured to stop the extension of the hopper cylinder 24 when the hopper 2 is completely closed. The controller 50, however, may extend or retract the hopper cylinder 24 for a predetermined period of time when the hopper 2 is completely closed or when the hopper 2 is about to be completely closed. That is, the controller 50 may shake the hopper 2. This is for shaking off the paving material PM stuck to the inner wall or the bottom surface of the hopper wing 2W.

[0082] Furthermore, the controller 50 may also be configured to perform feedback control on the hopper angle based on the height of the paving material PM derived by the space recognition part 50A so that the height of the paving material PM in the central part MP in the hopper 2 becomes a desired height.

[0083] The controller 50 may recognize the state of the paving material PM in the hopper 2 before closing the hopper 2 based on an image captured by a monocular camera serving as the space recognition device CM. The controller 50 may estimate the state of the paving material PM in the hopper 2 when the hopper 2 is closed based on the recognition result. The state of the paving material PM in the hopper 2 is estimated based on, for example, the angle of repose β of the paving material PM (see FIG. 4B) or the like. Typically, the angle of repose β is preset according to the type of the paving material PM. In this case, the controller 50 may determine a target hopper angle based on the estimation result. That is, the controller 50 may determine how much to close the hopper 2.

[0084] Furthermore, the controller 50 may perform various determinations using trained models that have learned control conditions. For example, the space recognition part 50A of the controller 50 may perform various determinations using trained models that have learned control conditions of the hopper 2. Various determinations include, for example, a determination as to whether the amount of paving material in the hopper 2 is more than or less than a predetermined amount, a determination as to whether the dump truck 200 is present in front of the asphalt finisher 100, a determination as to whether the dump truck 200 is moving away from the asphalt finisher 100, a determination as to whether there is an entering object in the hopper 2, a determination as to whether the height of paving material in the central part MP in the hopper 2 is greater than a predetermined height, and a determination as to whether the paving material in the hopper 2 has run out.

[0085] Specifically, the space recognition part 50A performs various determinations based on an input image that is an image captured by a monocular camera serving as the space recognition device CM, using trained models stored in a nonvolatile storage. Specifically, the space recognition part 50A performs various determinations based on the input image by loading trained models into a primary storage such as a RAM from the nonvolatile storage and causing the CPU to execute processes

based on the trained models.

[0086] For example, as illustrated in FIG. 5, a trained model may be constituted mainly of a neural network 401. According to this example, the neural network 401 is a so-called deep neural network including one or more intermediate layers (hidden layers) between an input layer and an output layer. According to the example of FIG. 5, the number of intermediate layers is N (where N is a natural number greater than or equal to two). According to the neural network 401, a weight parameter that represents the strength of connection with a lower layer is defined with respect to each of the neurons of each intermediate layer. According to the example of FIG. 5, the number of neurons is L (where L is a natural number greater than or equal to two). The neural network 401 is configured such that a neuron of each layer outputs the sum of the values obtained by multiplying input values from the upper-layer neurons by their respective defined weight parameters to lower-layer neurons through a threshold function.

[0087] Machine learning, specifically, deep learning, is performed on the neural network 401 to optimize the above-described weight parameters. As a result, for example, as illustrated in FIG. 5, the input image is input to the neural network 401 as an input signal x, and the neural network 401 can output a predefined monitoring target list (the probability (predicted probability) of the presence of an object with respect to each type of object according to this example) and a scene (situation) based on their positional relationship, etc., as an output signal y. The neural network 401 is, for example, a convolutional neural network (CNN). The CNN is a neural network to which existing image processing techniques (convolution and pooling) are applied. Specifically, the CNN repeats a combination of convolution and pooling on the input image to extract feature data (a feature map) smaller in size than the input image. The pixel value of each pixel of the extracted feature map is input to a neural network constituted of fully connected layers, and the output layer of the neural network can output, for example, a value representing the state of the paving material in the hopper 2.

[0088] Thus, the neural network 401 may also be configured such that the input image is input as the input signal x and the position and the size of an object in the input image (namely, an area occupied by the object in the input image) and the type of the object can be output as the output signal y (for example, a value representing the state of the paving material in the hopper 2). That is, the neural network 401 may be configured to detect an object in the input image (determine the presence or absence of an area occupied by an object in the input image) and classify the object. Furthermore, in this case, the output signal y may be configured in the format of image data in which the occupied area of the object and information on its classification are added to the input image serving as the input signal x in a superimposed manner. This enables the space recognition part 50A to

identify, for example, a value representing the state of the paving material in the hopper 2 based on the position, size, etc., of the occupied area of the object in the input image.

[0089] According to the above-described embodiment, the monocular camera serving as the space recognition device CM is fixed to the upper end portion of the front end of the tractor 1 and its imaging range (angle of view) is predefined (prefixed). When the position of an object (the paving material in the hopper 2) detected by a leaned model is within a monitoring area and the object is classified as an object in the monitoring target list, the space recognition part 50A can determine the detection of a monitoring target object within the monitoring area. The neural network 401 may be configured to include individual neural networks corresponding to the process of extracting an occupied area (window) in which an object is present in the input image and the process of identifying the type of the object in the extracted area. That is, the neural network 401 may be configured to perform the detection of an object and the classification of the object in a stepwise manner. Furthermore, the neural network 401 may be configured to include individual neural networks corresponding to the process of defining the classification of an object and the occupied area (Bounding box) of the object with respect to each of grid cells that are a predetermined number of partial areas into which the entire area of the input image is divided and the process of combining the occupied areas of the object with respect to each type based on the classification of the object with respect to each grid cell and finalizing the occupied area of the object. That is, the neural network 401 may be configured to perform the detection of an object and the classification of the object in parallel.

[0090] Furthermore, the controller 50 may be configured to learn a control condition associated with the open/closed state of the hopper 2. For example, the controller 50 may be configured to learn the relationship between the state of the paving material in the hopper 2 and the open/closed state of the hopper 2 (a hopper control condition) according to a dataset created based on the combination of a captured image of the paving material in the hopper 2 obtained by the space recognition device CM or the like and reference information representing "a preferred open/closed state of the hopper 2" serving as determination data prestored in a nonvolatile storage. This learning process may be executed in a management apparatus (machine learning apparatus) connected to the asphalt finisher 100 via radio communications. In this case, a trained model created in the management apparatus (machine learning apparatus) is transmitted to the asphalt finisher 100. The hopper control part 50B may determine a preferred open/closed state of the hopper 2 corresponding to the current state of the paving material in the hopper 2 using the received trained model and control the hopper 2 to be in the preferred open/closed state.

[0091] The present application is based upon and

claims priority to Japanese Patent Application No. 2020-059058, filed on March 27, 2020, the entire contents of which are hereby incorporated herein by reference.

DESCRIPTION OF THE REFERENCE NUMERALS

[0092] 1 ... tractor 1BF ... base part 1FW ... front 2 ... hopper 2b ... push roller 2W ... hopper wing 3 ... screed 3A ... leveling arm 5 ... rear wheel 6 ... front wheel 23 ... leveling cylinder 24 ... hopper cylinder 25 ... screed lift cylinder 30 ... main screed 31 ... extendable screed 40 ... side plate 41 ... extendable mold board 42 ... screed step 43 ... retaining plate 45 ... screw rotational speed sensor 46 ... conveyor feed rate sensor 47 ... travel speed sensor 48 ... secondary storage 50 ... controller 50A ... space recognition part 50B ... hopper control part 51 ... screw controller 52 ... conveyor controller 53 ... hopper controller 54 ... travel controller 55 ... output device 55A ... main monitor 55B ... sound output device 55C ... indicator 60 ... extendable cylinder 100 ... asphalt finisher 200 ... dump truck 200b ... bed CM ... space recognition device CP ... conveyance path CV ... conveyor MP ... central part OP ... entrance PM ... paving material SC ... screw

Claims

1. An asphalt finisher (100) comprising:

a tractor (1);
a hopper (2) installed in front of the tractor (1) to receive paving material (PM);
a conveyor (CV) configured to convey the paving material (PM) in the hopper (2) to a rear side of the tractor (1);
a screw (SC) configured to lay and spread the paving material (PM) conveyed by the conveyor (CV) behind the tractor (1); and
a screed (3) configured to lay and level the paving material (PM) laid and spread by the screw (SC) behind the screw (SC),
further comprising:

a space recognition device (CM) configured to monitor a state in the hopper (2); and
a controller (50) configured to move the hopper (2) based on an output of the space recognition device (CM), **characterized in that:**

the controller (50) is configured to close the hopper (2) in response to determining that an amount of the paving material (PM) in the hopper (2) is less than a predetermined amount.

2. The asphalt finisher (100) as claimed in claim 1, wherein the controller (50) is configured to, when

moving the hopper (2), so notify a surrounding area.

3. The asphalt finisher (100) as claimed in claim 1, wherein the controller (50) is configured to close the hopper (2) in response to determining that the paving material (PM) in the hopper (2) has changed from being more than a predetermined amount to being less than the predetermined amount. 5
4. The asphalt finisher (100) as claimed in claim 1, wherein the controller (50) is configured to determine a presence or absence of an entering object in the hopper (2) before moving the hopper (2). 10
5. A machine learning apparatus **characterized in that** it creates a trained model based on which an asphalt finisher as in the preceding claims is operated, whereby a control condition for a hopper (2) of an asphalt finisher (100) is learned according to a dataset including a combination of information on paving material (PM) in the hopper (2) and a preferred open/closed state of the hopper (2). 15 20
6. An asphalt finisher as in claims 1 to 4 wherein the trained model created by the machine learning apparatus as set forth in claim 5 is input and an open/closed state of the hopper (2) corresponding to an input of current information on the paving material (PM) in the hopper (2) is output based on the trained model. 25 30

Patentansprüche

1. Asphaltfertiger (100), umfassend: 35
 - einen Traktor (1);
 - einen vor dem Traktor (1) angebrachten Trichter (2) zur Aufnahme von Straßendeckenmaterial (PM); 40
 - einen Förderer (CV), der so konfiguriert ist, dass er das Straßendeckenmaterial (PM) in dem Trichter (2) zu einer Rückseite des Traktors (1) fördert;
 - eine Schnecke (SC), die so konfiguriert ist, dass sie das von dem Förderer (CV) geförderte Straßendeckenmaterial (PM) hinter dem Traktor (1) legt und verteilt; und 45
 - eine Bohle (3), die so konfiguriert ist, dass sie das von der Schnecke (SC) gelegte und verteilte Straßendeckenmaterial (PM) hinter der Schnecke (SC) legt und nivelliert, 50
 ferner umfassend:
 - eine Raumerkennungsvorrichtung (CM), 55
 - die so konfiguriert ist, dass sie einen Zustand in dem Trichter (2) überwacht; und
 - eine Steuerung (50), die so konfiguriert ist,

dass sie den Trichter (2) basierend auf einer Ausgabe der Raumerkennungsvorrichtung (CM) bewegt, **dadurch gekennzeichnet, dass:**

die Steuerung (50) so konfiguriert ist, dass sie den Trichter (2) als Reaktion darauf, dass sie bestimmt, dass eine Menge des Straßendeckenmaterials (PM) in dem Trichter (2) geringer ist als eine vorbestimmte Menge, schließt.

2. Asphaltfertiger (100) nach Anspruch 1, wobei die Steuerung (50) so konfiguriert ist, dass sie beim Bewegen des Trichters (2) einen umliegenden Bereich informiert.
3. Asphaltfertiger (100) nach Anspruch 1, wobei die Steuerung (50) so konfiguriert ist, dass sie den Trichter (2) als Reaktion darauf, dass sie bestimmt, dass sich das Straßendeckenmaterial (PM) in dem Trichter (2) von mehr als einer vorbestimmten Menge auf weniger als die vorbestimmte Menge geändert hat, schließt.
4. Asphaltfertiger (100) nach Anspruch 1, wobei die Steuerung (50) so konfiguriert ist, dass sie ein Vorhandensein oder Nichtvorhandensein eines in den Trichter (2) eintretenden Objekts bestimmt, bevor sie den Trichter (2) bewegt.
5. Vorrichtung für maschinelles Lernen, **dadurch gekennzeichnet, dass** sie ein trainiertes Modell erzeugt, auf dessen Grundlage ein Asphaltfertiger wie in den vorangegangenen Ansprüchen betrieben wird, wobei eine Steuerbedingung für einen Trichter (2) eines Asphaltfertigers (100) gemäß einem Datensatz gelernt wird, der eine Kombination von Informationen über Straßendeckenmaterial (PM) in dem Trichter (2) und einen bevorzugten offenen/geschlossenen Zustand des Trichters (2) enthält.
6. Asphaltfertiger (100) nach Ansprüchen 1 bis 4, wobei das trainierte Modell, das von der Vorrichtung für maschinelles Lernen gemäß Anspruch 5 erzeugt wurde, eingegeben wird und ein offener/geschlossener Zustand des Trichters (2), der einer Eingabe aktueller Informationen über das Straßendeckenmaterial (PM) in dem Trichter (2) entspricht, basierend auf dem trainierten Modell ausgegeben wird.

Revendications

1. Une finisseuse d'asphalte (100) comprenant :
 - un tracteur (1) ;
 - une trémie (2) installée en face du tracteur (1) afin de recevoir un matériau routier (PM) ;

- un convoyeur (CV) configuré pour acheminer le matériau routier (PM) qui se trouve dans la trémie (2) vers un côté arrière du tracteur (1) ;
 une vis (SC) configurée pour poser et étaler le matériau routier (PM) acheminé par le convoyeur (CV) derrière le tracteur (1) ; et
 une règle à araser (3) configurée pour poser et niveler le matériau routier (PM) posé et étalé par la vis (SC) derrière la vis (SC),
 comprenant en outre :
- un dispositif de reconnaissance d'espace (CM) configuré pour surveiller un état dans la trémie (2) ; et
 un contrôleur (50) configuré pour déplacer la trémie (2) sur la base d'un résultat du dispositif de reconnaissance d'espace (CM), **caractérisée en ce que** :
 le contrôleur (50) est configuré pour fermer la trémie (2) en réponse à la détermination du fait qu'une quantité de matériau routier (PM) dans la trémie (2) soit inférieure à une quantité prédéterminée.
2. La finisseuse d'asphalte (100) selon la revendication 1, dans laquelle le contrôleur (50) est configuré pour, lors du déplacement de la trémie (2), avertir une zone environnante.
 3. La finisseuse d'asphalte (100) selon la revendication 1, dans laquelle le contrôleur (50) est configuré pour fermer la trémie (2) en réponse à la détermination du fait que le matériau routier (PM) dans la trémie (2) soit passé du fait d'être supérieur à une quantité prédéterminé au fait d'être inférieur à la quantité prédéterminée.
 4. La finisseuse d'asphalte (100) selon la revendication 1, dans laquelle le contrôleur (50) est configuré pour déterminer une présence ou l'absence d'un objet dans la trémie (2) avant de déplacer la trémie (2).
 5. Un dispositif d'apprentissage machine **caractérisé en ce qu'il** crée un modèle entraîné sur la base duquel une finisseuse d'asphalte selon les revendications précédentes fonctionne, moyennant quoi une condition de commande destinée à une trémie (2) d'une finisseuse d'asphalte (100) est apprise selon un ensemble de données comprenant une combinaison d'informations sur le matériau routier (PM) dans la trémie (2) et un état ouvert/fermé préféré de la trémie (2).
 6. La finisseuse d'asphalte (100) selon les revendications 1 à 4, dans laquelle le modèle entraîné créé par le dispositif d'apprentissage machine selon la revendication 5 est fourni et l'état ouvert/fermé de la trémie (2) qui correspond à une entrée d'informations ac-
- tuelles sur le matériau routier (PM) dans la trémie (2) est délivré sur la base du modèle entraîné.

FIG.1A

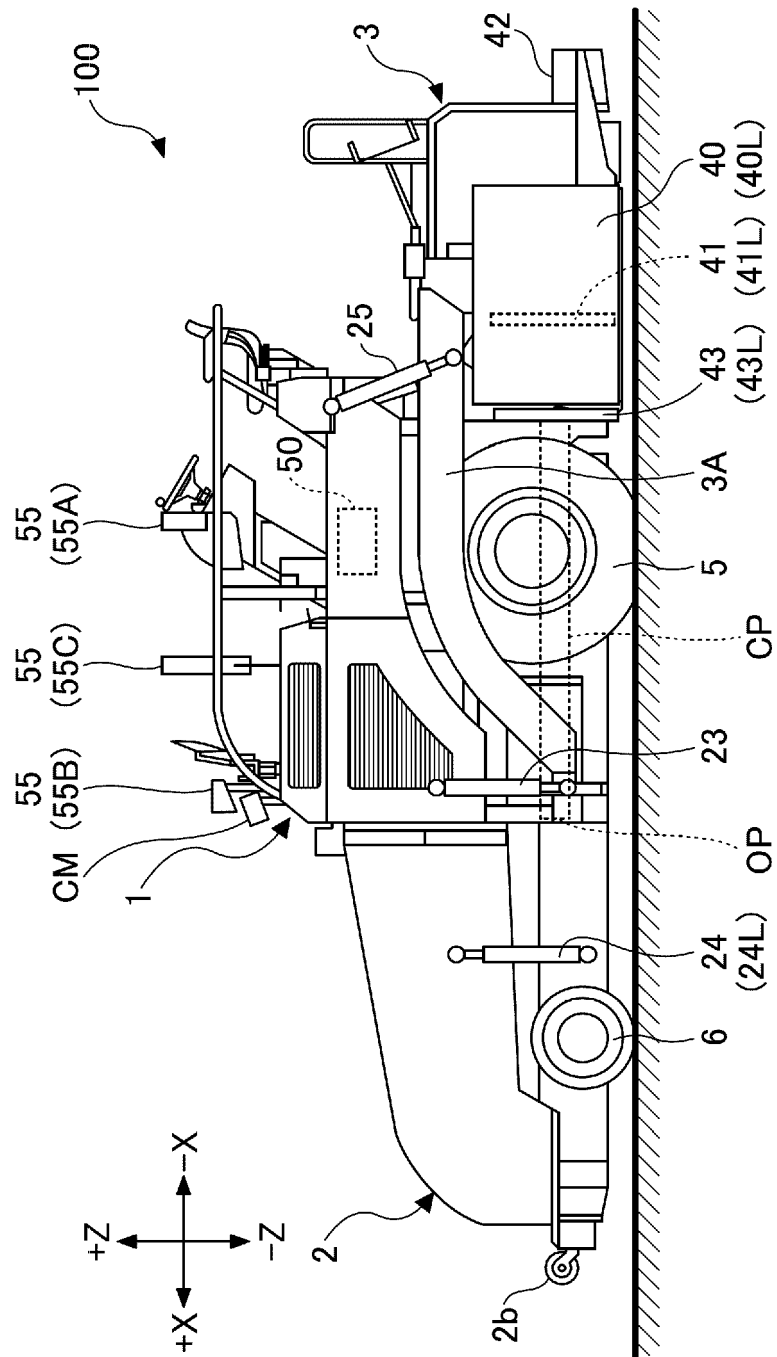


FIG.1B

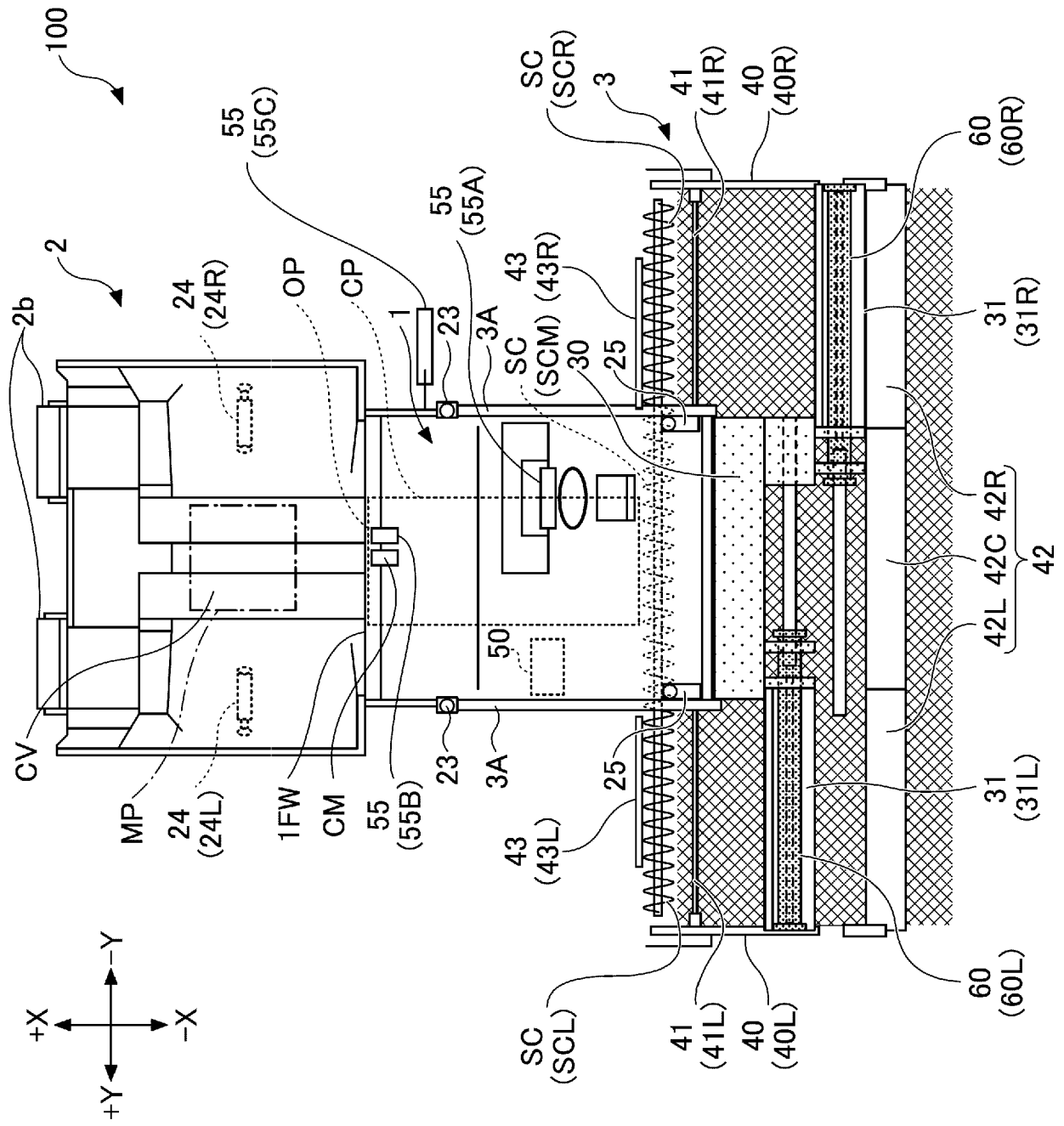


FIG.2

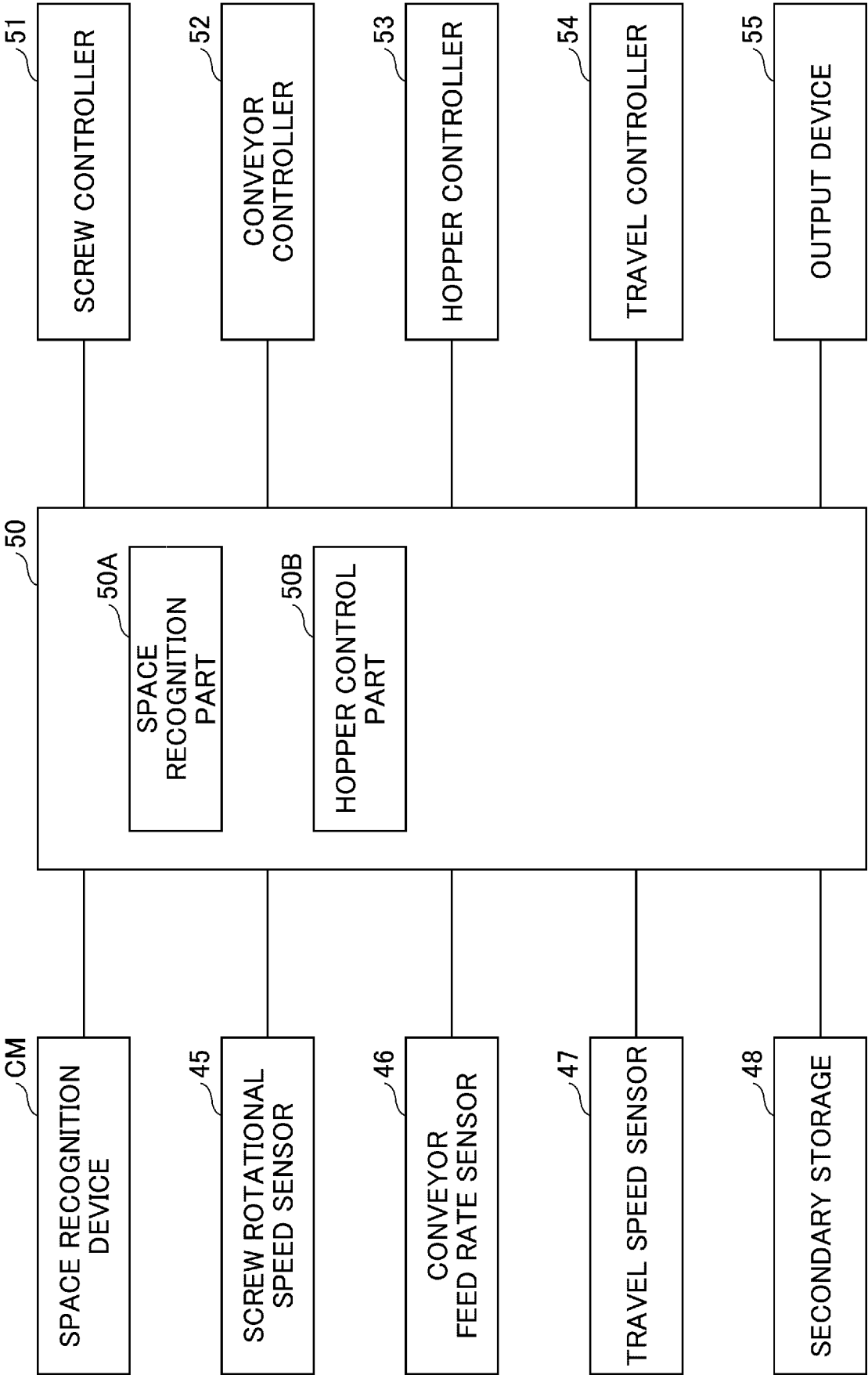


FIG.3A

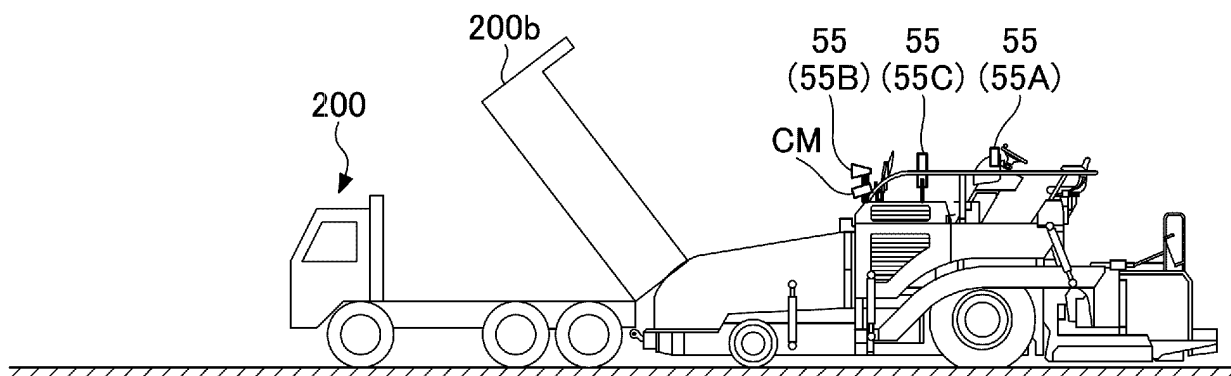


FIG.3B

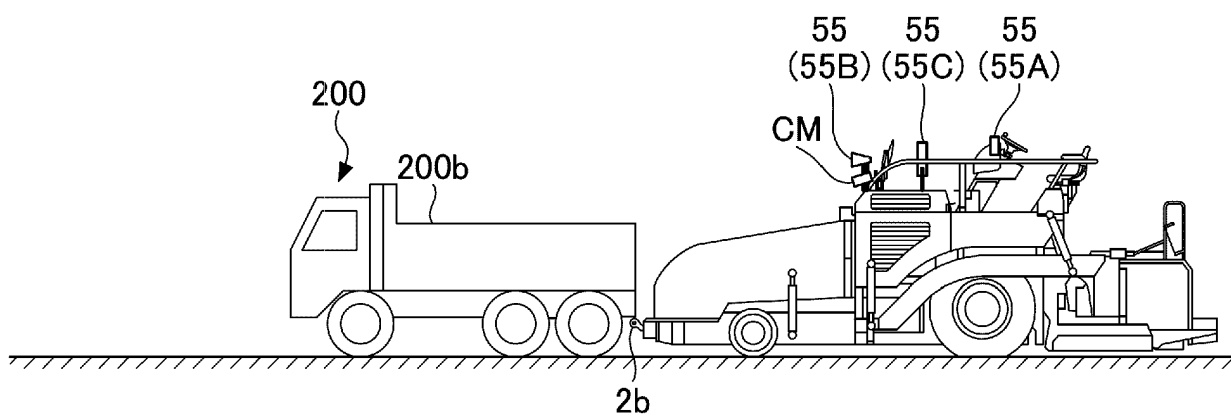


FIG.3C

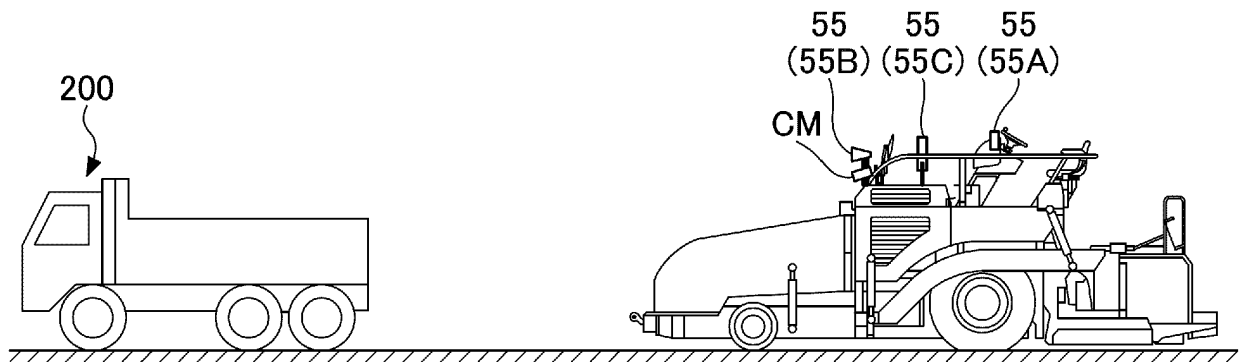


FIG.4A

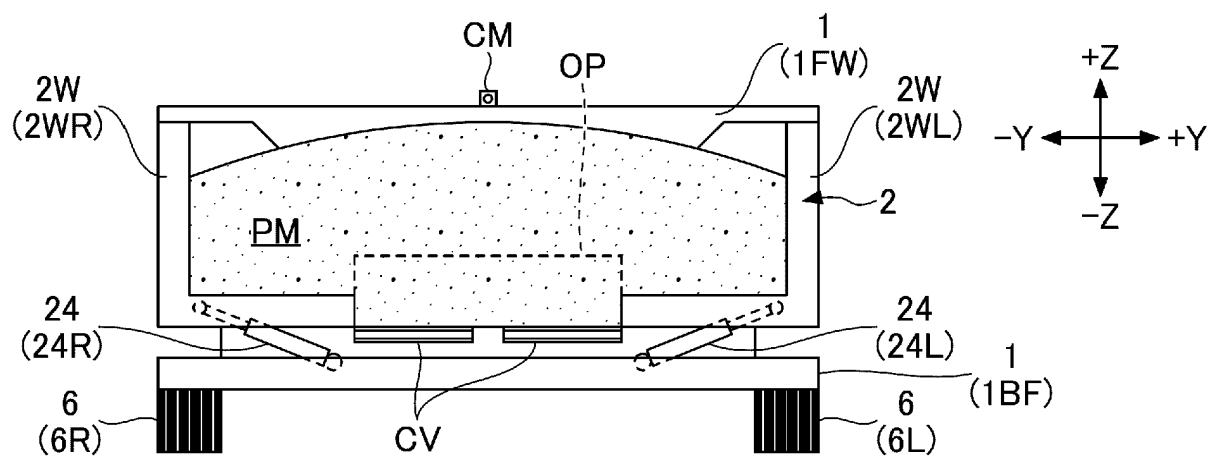


FIG.4B

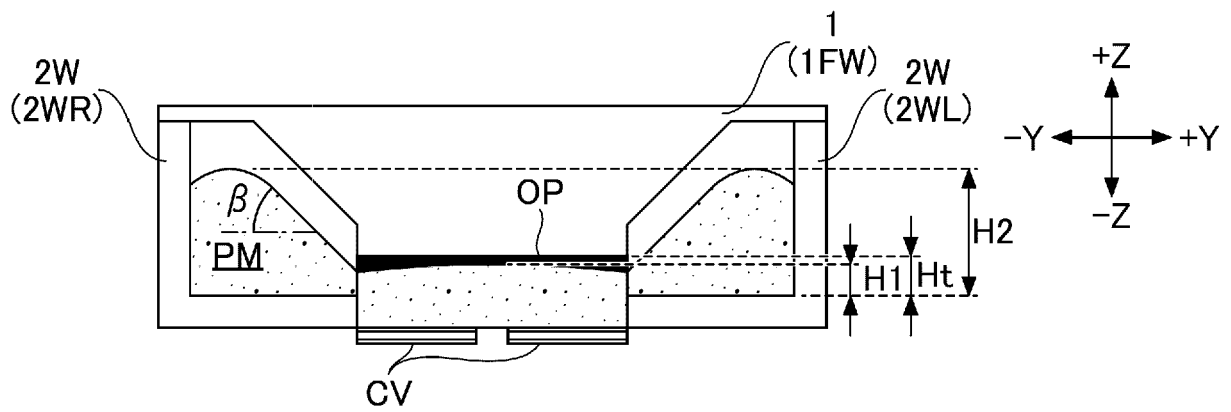


FIG.4C

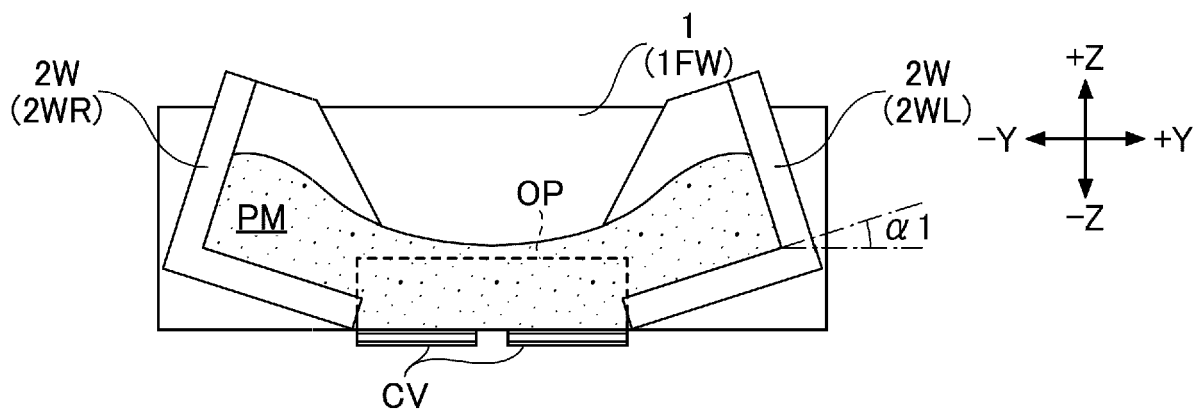


FIG.4D

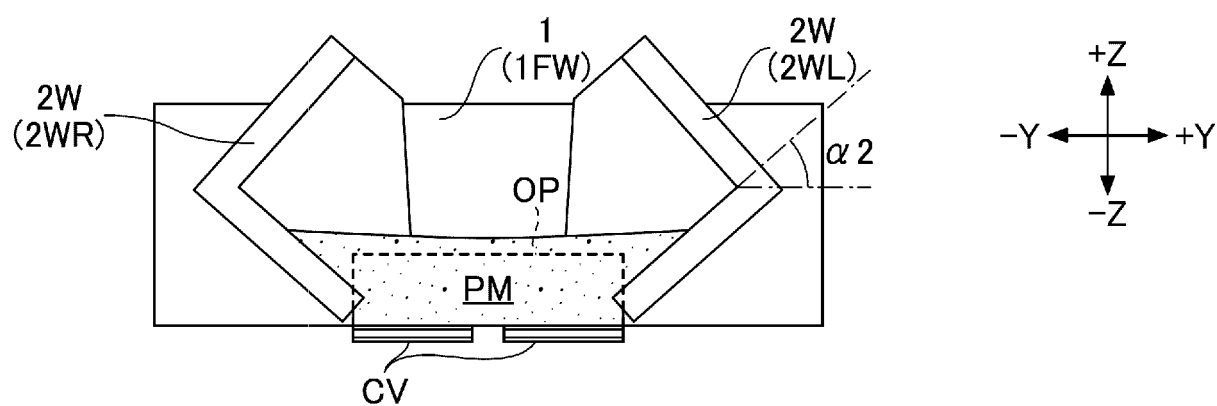


FIG.4E

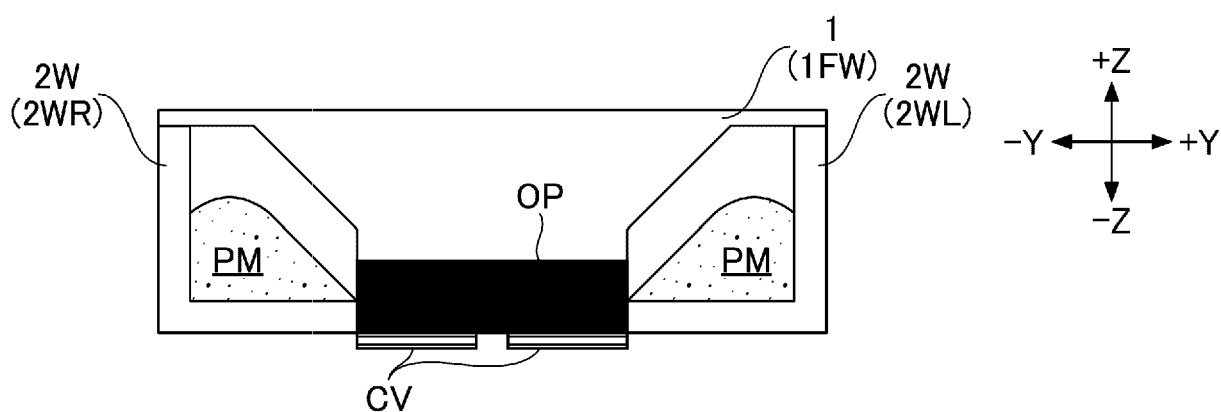
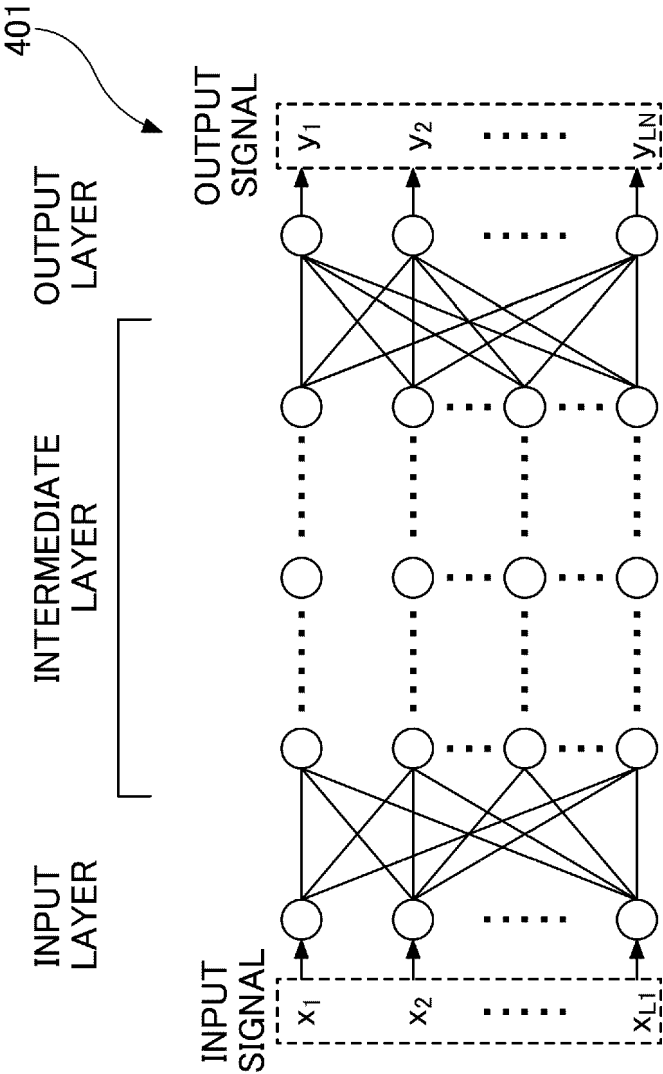


FIG.5



REFERENCES CITED IN THE DESCRIPTION

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