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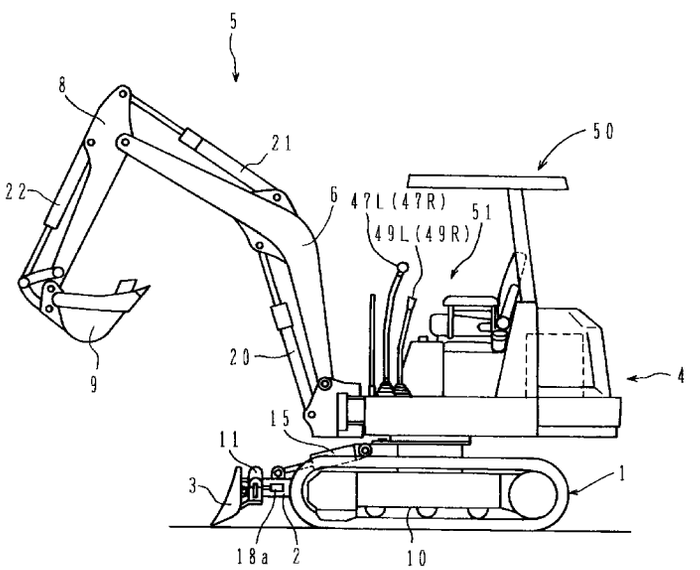
(54) Hydraulic drive system for hydraulic excavator

(57) When a changeover switch (45) is turned to a "front side" position, upstream portions of pilot lines are connected to boom-up/down lines, arm dumping/crowding lines, and bucket crowding/dumping lines, respectively, causing pilot pressures to control valves for driving hydraulic actuators of a work front (5). When the changeover switch is turned to a "blade side" position, the upstream portions of the pilot lines are connected to blade-up/down lines, blade left/right-angling lines, and blade right/left-rising tilt pilot lines, respectively, causing pilot pressures to control valves for driving hydraulic actuators of a blade (3). The blade can be operated in various behaviors without narrowing a space in a cab and deteriorating operability of the blade.

FIG.2



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Description

BACKGROUND OF THE INVENTION

The present invention relates to a hydraulic drive system for a hydraulic excavator, and more particularly to a hydraulic drive system for a hydraulic excavator having a blade.

Conventional hydraulic excavators having blades include a hydraulic cylinder for vertically moving the blade, and a control lever for extending and contracting the blade hydraulic cylinder to vertically move the blade is provided independently of control levers for operating a work front. When carrying out work using the blade, the blade hydraulic cylinder is extended to lower the blade down onto the ground. In other situations, the blade hydraulic cylinder is contracted to raise the blade from the ground surface. Such an arrangement has however accompanied a problem that a space for installation of the control lever for vertically moving the blade is required separately and a space within a cab becomes narrow. In view of the problem, there is proposed a structure wherein operating means for vertically moving a blade is attached to a travel control lever to omit the need of providing a separate control lever for vertically moving the blade, as disclosed in JP, A, 7-247572, for example.

SUMMARY OF THE INVENTION

With an increased variety of works using a blade, a structure enabling the blade to be not only moved up and down, but also tilted (with the right side rising or the left side rising) and angled (forward at the right end or forward at the left end) has been recently proposed. If the structure of the above-cited JP, A, 7-247572 is applied to operating means for instructing the above tilting and angling operations, blade-tilt operating means and blade-angle operating means are attached to other two control levers than the travel control lever. When operating the blade to move up and down, tilt and angle, therefore, the operator must manipulate the respective operating means provided on three control levers individually. This raises a problem that operability in blade operation is deteriorated.

An object of the present invention is to provide a hydraulic drive system for a hydraulic excavator which enables a blade to be operated to move variously without narrowing a space in a cab and deteriorating operability of the blade.

(1) To achieve the above object, according to the present invention, there is provided a hydraulic drive system for a hydraulic excavator comprising an upper swing structure, a work front mounted onto the upper swing structure, a under traveling carriage, and a blade attached to the under traveling carriage, the hydraulic drive system including first operating means for operating the work front and the upper swing structure, and second operating means for operating the blade, wherein a partial section of the first operating means is shared by the second operating means, and the hydraulic drive system includes switching means for selectively connecting the shared section and the object to be operated such that the shared section serves as part of the first operating means when the work front and the upper swing structure are operated, and as part of the second operating means when the blade is operated.

Generally, in hydraulic excavators having blades, a work front and an upper swing structure are hardly operated when the blade is operated. In the present invention, therefore, the first operating means for operating the work front and the upper swing structure and the second operating means for operating the blade are constructed to share a partial section. Then, the switching means is shifted to use the shared section as part of the first operating means when the work front and the upper swing structure are operated, and as part of the second operating means when the blade is operated. This eliminates the need of providing the space for the second operating means separately from the first operating means with regard to the share section, and hence can avoid the space in a cab from becoming narrow. Also, when the blade is operated, the shared section of the first operating means, which is determined beforehand in consideration of operability, is used as it is as part of the second operating means. Therefore, operability in blade operation is not deteriorated and good operability is always ensured.

(2) In the hydraulic drive system for the hydraulic excavator of above (1), preferably, the work front includes a boom rotatably connected to the upper swing structure, an arm rotatably connected to the boom, and a bucket rotatably connected to the arm; the first operating means includes boom operating means for operating the boom, arm operating means for operating the arm, and bucket operating means for operating the bucket; the shared section includes a boom shared section provided in the boom operating means, an arm shared section provided in the arm operating means, and a bucket shared section provided in the bucket operating means; the second operating means includes up/down operating means for moving the blade up and down, angle operating means for angling the blade, and tilt operating means for tilting the blade; and the switching means selectively connects the shared sections and the object to be operated such that the boom shared section, the arm shared section and the bucket shared section serve respectively as part of the boom operating means, the arm operating means and the bucket operating means

when the work front and the upper swing structure are operated, and such that the boom shared section, the arm shared section and the bucket shared section each serve as part of corresponding one of the up/down operating means, the angle operating means and the tilt operating means when the blade is operated.

(3) In the hydraulic drive system for the hydraulic excavator of above (1), preferably, the work front includes a boom rotatably connected to the upper swing structure, an arm rotatably connected to the boom, and a bucket rotatably connected to the arm; the first operating means includes boom operating means for operating the boom, arm operating means for operating the arm, and bucket operating means for operating the bucket; the shared section includes a boom shared section provided in the boom operating means, an arm shared section provided in the arm operating means, and a bucket shared section provided in the bucket operating means; the second operating means includes up/down operating means for moving the blade up and down, angle operating means for angling the blade, and tilt operating means for tilting the blade; and the switching means includes boom switching means for selectively connecting the boom shared section such that the boom shared section serves as part of the boom operating means, arm switching means for selectively connecting the arm shared section such that the arm shared section serves as part of the arm operating means, and bucket switching means for selectively connecting the bucket shared section such that the bucket shared section serves as part of the bucket operating means, the boom switching means, the arm switching means and the bucket switching means selectively connecting the shared sections and the object to be operated in a manner independently of one another such that the boom shared section, the arm shared section and the bucket shared section each serve as part of corresponding one of the up/down operating means, the angle operating means and the tilt operating means when the blade is operated.

With this feature, switching over between the boom operation and the blade-up/down operation, switching over between the arm operation and the blade angling operation, and switching over between the bucket operation and the blade tilting operation are performed independently of one another. The switching can be therefore more finely depending on desired types of work.

(4) In the hydraulic drive system for the hydraulic excavator of above (2) or (3), preferably, the switching means selectively connects the boom shared section and the object to be operated such that the boom shared section serves as part of other one means of the second operating means other than the up/down operating means when the blade is operated.

With this feature, any shared section is not shared by the boom operating means and the up/down operating means so that the blade up/down operation and the boom operation can be performed at the same time. Accordingly, when there is a fear in carrying out work using the blade that the heap of earth and sand accumulated in front of the blade becomes so high with the progress of work as to contact the bucket, such a contact can be prevented by operating the boom to move up.

(5) In the hydraulic drive system for the hydraulic excavator of above (1), preferably, the first operating means includes one or more control levers and the switching means includes a changeover switch, the changeover switch being provided on at least one of the control levers.

With this feature, operability in switching can be improved.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a hydraulic circuit diagram showing a pilot system in a hydraulic drive system according to a first embodiment of the present invention.

Fig. 2 is a side view showing the entire structure of a hydraulic excavator to which the hydraulic drive system of Fig. 1 is applied.

Fig. 3 is a plan view showing the structure of a blade attaching portion of the hydraulic excavator shown in Fig. 2.

Fig. 4 is a hydraulic circuit diagram showing a typical portion other than the pilot system in the hydraulic drive system according to the first embodiment of the present invention.

Figs. 5A and 5B are each an illustration showing actuator operations capable of being achieved by multi-levers.

Fig. 6 is a view showing the structure of a changeover switch shown in Fig. 1.

Fig. 7 is a hydraulic circuit diagram showing a pilot system in a hydraulic drive system according to a second embodiment of the present invention.

Fig. 8 is a hydraulic circuit diagram showing a pilot system in a modification.

Figs. 9A and 9B are each an illustration showing actuator operations capable of being achieved by multi-levers in the modification.

Fig. 10 is a hydraulic circuit diagram showing a pilot system in a hydraulic drive system according to a third embodiment of the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Preferred embodiments of the present invention will

be described hereunder with reference to the drawings.

A first embodiment of the present invention will be described with reference to Figs. 1 to 6.

A hydraulic drive system according to this embodiment is applied to well-known hydraulic excavators having blades, e.g., a hydraulic excavator disclosed in JP, U, 1-98258. Fig. 2 is a side view showing the entire structure of the hydraulic excavator, and Fig. 3 is a plan view showing the structure of a blade attaching portion of the hydraulic excavator shown in Fig. 2.

In Figs. 2 and 3, the hydraulic excavator comprises a under traveling carriage 1, a blade 3 attached to the under traveling carriage 1 through a blade arm 2, an upper swing structure 4, and a work front 5 mounted onto the upper swing structure 4. The work front 5 includes a boom 6 rotatably connected to the upper swing structure 4, an arm 8 rotatably connected to the boom 6, and a bucket 9 rotatably connected to the arm 8.

The under traveling carriage 1 includes a track frame 10 to which the blade arm 2 is attached movably in the vertical direction. A bracket 11 is attached to a fore end of the blade arm 2 rotatably about an axis P lying in the vertical direction. The blade 3 is attached to the bracket 11 through a ball bearing 12 rotatably about an axis O lying in the back-and-forth direction. Between the bracket 11 and the blade 3, there are provided link members 13, 13 for coupling those two in an movable manner relative to each other. In addition, ball bearings are installed in respective joint portions of the link members 13 to the blade 3 and the bracket 11.

A connecting frame 14 is provided to bridge two side beams of the blade arm 2. A rod portion 15a of a blade-up/down cylinder 15 is rotatably coupled to the connecting frame 14, and a bottom portion 15b thereof is rotatably coupled to the track frame 10. With this structure, the blade 3 can move up and down when the blade-up/down cylinder 15 is operated to contract and extend.

Rod portions 16aa, 16ba of blade-tilt cylinders 16a, 16b are rotatably coupled to the blade 3 at positions near both ends, and bottom portions 16ab, 16bb thereof are rotatably coupled to a central portion of the bracket 11. With this structure, the blade 3 can tilt in the direction to rise at the right side or in the direction to rise at the left side (as viewed from the operator) when the cylinder 16a is operated to extend and the cylinder 16b is operated to contract, or when the cylinder 16a is operated to contract and the cylinder 16b is operated to extend.

Further, rod portions 18aa, 18ba of blade-angle cylinders 18a, 18b are rotatably coupled to both ends of the bracket 11, and bottom portions 18ab, 18bb thereof are rotatably coupled to the blade arm 2. With this structure, the blade 3 can be angled forward at the left end or at the right end (as viewed from the operator) when the cylinder 18a is operated to extend and the cylinder 18b is operated to contract, or when the cylinder 18a is operated to contract and the cylinder 18b is operated to extend.

Figs. 1 and 4 are each a hydraulic circuit diagram showing a hydraulic drive system of this embodiment equipped on the above-stated hydraulic excavator. Fig. 1 shows the circuit of a pilot system and Fig. 4 shows a typical portion of the circuit other than the pilot system.

In Figs. 1 and 4, the hydraulic circuit comprises a hydraulic pump 19 driven by an engine (not shown), a plurality of hydraulic actuators, including a boom cylinder 20 (see Fig. 2), an arm cylinder 21, a bucket cylinder 22 (see Fig. 2), a swing motor (not shown), left and right travel motors (not shown), the blade-up/down cylinder 15 (see Figs. 2), the blade-angle cylinders 18a and 18b, and the blade-tilt cylinders 16a, 16b (see Fig. 3), which are operated by a hydraulic fluid from the hydraulic pump 19, a plurality of control lever units, including control lever units 23 - 26, which are provided to operate the corresponding hydraulic actuators 18, 21, etc., and a plurality of control valves connected between the hydraulic pump 19 and the plurality of hydraulic actuators 18, 21, etc. and controlled by operation signals from the control lever units 23 - 26, etc. for controlling flow rates of the hydraulic fluid supplied to the corresponding hydraulic actuators 18, 21, etc. Note that, by way of example, Fig. 1 shows only an arm control valve 28 and Fig. 4 shows a blade-angle control valve 29 in addition to the valve 28. The above-mentioned components constitute the hydraulic drive system for driving driven members of the hydraulic excavator.

Further, the work front 5, the upper swing structure 4, the under traveling carriage 1 and the blade 3, mentioned above, constitute the driven members of the hydraulic excavator to be driven by the corresponding hydraulic actuators 18, 21, etc., and their operations are instructed by the control lever units 23 - 26, etc.

The control lever units 23 - 26 are constructed of the so-called pilot operating units; namely, they are of hydraulic pilot type outputting pilot pressures as the operation signals and driving the corresponding control valves 28, 29, etc. Specifically, the control lever units 23 - 26 are constituted as a boom/blade-up/down control lever unit 23, an arm/blade-angle control lever unit 24, a bucket/blade-tilt control lever unit 25, and a swing control lever unit 26. As shown in Fig. 1, the control lever units 23, 24, 25, 26 are made up of respectively control levers 23a, 24a, 25a, 26a manipulated by the operator, and pressure reducing valves 23b, 24b, 25b, 26b for producing pilot pressures depending on the input amounts by and the directions in which the control levers 23a, 24a, 25a, 26a are manipulated.

The pressure reducing valves 23b, 24b, 25b, 26b are connected at the primary port side to a hydraulic source 48 (e.g., a pilot pump driven by the engine), and at the secondary port side to hydraulic driving sectors 28a, 28b; 29a, 29b, etc. of the corresponding control valves 28, 29, etc. through pilot lines 30, 31, 32, 33, 34, 35, 36, 38.

The pilot lines 30 - 38 are constituted as a boom-up/blade-up pilot line 30, a boom-down/blade-down pilot line 31, an arm dumping/blade left-angling pilot line 32, an arm crowding/blade right-angling pilot line 33, a bucket crowding/blade right-rising tilt pilot line 34, a bucket dumping/blade left-rising tilt pilot line 35, a left swing pilot line 36, and a right swing pilot line 38. Of these pilot lines, the pilot lines 30, 31, 32, 33, 34, 35 are each branched at the downstream side into two lines 30a, 30b; 31a, 31b; 32a, 32b; 33a, 33b; 34a, 34b; and 35a, 35b, respectively, and switching valves 39, 40, 41, 42, 43, 44 are provided at the respective branched points.

More specifically, an upstream portion 30c of the boom-up/blade-up pilot line 30 is selectively connected to the boom-up pilot line 30a and the blade-up pilot line 30b through the switching valve 39, an upstream portion 31c of the boom-down/blade-down pilot line 31 is selectively connected to the boom-down pilot line 31a and the blade-down pilot line 31b through the switching valve 40, an upstream portion 32c of the arm dumping/blade left-angling pilot line 32 is selectively connected to the arm dumping pilot line 32a and the blade left-angling pilot line 32b through the switching valve 41, an upstream portion 33c of the arm crowding/blade right-angling pilot line 33 is selectively connected to the arm crowding pilot line 33a and the blade right-angling pilot line 33b through the switching valve 42, an upstream portion 34c of the bucket crowding/blade right-rising tilt pilot line 34 is selectively connected to the bucket crowding pilot line 34a and the blade right-rising tilt pilot line 34b through the switching valve 43, and an upstream portion 35c of the bucket dumping/blade left-rising tilt pilot line 35 is selectively connected to the bucket dumping pilot line 35a and the blade left-rising tilt pilot line 35b through the switching valve 44.

The switching valves 39 - 44 are each shifted by a hydraulic pressure introduced thereto from the hydraulic source 48 through a solenoid switching valve 46 which is driven in response to a signal from a changeover switch 45. Specifically, when the changeover switch 45 is turned to a "front side" position, no drive signal is output and the solenoid switching valve 46 is shifted to an upper position in Fig. 1 by action of a restoring spring 46a. Therefore, the pilot pressure from the hydraulic source 48 is not introduced to the switching valves 39 - 44 and the switching valves 39 - 44 are held in upper positions in Fig. 1, whereby the upstream portions 30c - 38c of the pilot lines 30 - 38 are connected respectively to the boom-up pilot line 30a, the boom-down pilot line 31a, the arm dumping pilot line 32a, the arm crowding pilot line 33a, the bucket crowding pilot line 34a, and the bucket dumping pilot line 35a. As a result, the pilot pressure is introduced to the driving sectors of the control valve 28, etc. for driving the hydraulic actuators 20, 21, etc. of the work front 5.

On the other hand, when the changeover switch 45 is turned to a "blade side" position, the drive signal is output and the solenoid switching valve 46 is shifted to a lower position in Fig. 1. Therefore, the pilot pressure from the hydraulic source 48 is introduced to the switching valves 39 - 44 and the switching valves 39 - 44 are shifted to lower positions in Fig. 1, whereupon the upstream portions 30c - 38c of the pilot lines 30 - 38 are connected respectively to the blade-up pilot line 30b, the blade-down pilot line 31b, the blade left-angling pilot line 32b, the blade right-angling pilot line 33b, the blade right-rising tilt pilot line 34b, and the blade left-rising tilt pilot line 35b. As a result, the pilot pressure is introduced to the driving sectors of the control valve 29, etc. for driving the hydraulic actuators 15, 16, 18 of the blade 3.

Of the plurality of control lever units, the control levers 23a - 26a of the control lever units 23 - 26 are constructed as so-called multi-levers 49; i.e., the control levers 23a and 24a are constructed as one multi-lever, and the control levers 25a and 26a are constructed as the other multi-lever. Thus, two actuators can be operated by manipulating one lever. The operations instructed by the control levers are shown in Figs. 5A and 5B.

Fig. 5A shows one example set of actuator operations capable of being achieved by the multi-levers when the changeover switch 45 is in the "front side" position. The drawing is illustrated corresponding to the operating direction viewed from the operator in a cab 50; i.e., the vertical direction in the drawing corresponds to the back-and-forth direction in the cab 50 and the left-and-right direction in the drawing corresponds to the left-and-right direction in the cab 50. As shown (see also Fig. 2), two multi-levers 49L, 49R are provided one on each of left and right sides of an operator's seat 51. In this example, the right-hand lever 49R serves as a lever for operating the boom and bucket, and the left-hand lever 49L serves as a lever for operating the arm and swinging the upper swing structure. When the right-hand lever 49R is operated in the back-and-forth direction, the boom 6 is moved up and down, and when it is operated in the left-and-right direction, the bucket 9 is crowded and dumped. When the right-hand lever 49R is pulled rearward leftward, for example, the combined operation of boom-up and bucket crowding can be performed. Further, when the left-hand lever 49L is operated in the back-and-forth direction, the upper swing structure 4 is swinged to the left and right, and when it is operated in the left-and-right direction, the arm 8 is dumped and crowded. When the left-hand lever 49L is pulled rearward rightward, for example, the combined operation of left swing and arm crowding can be performed.

On the other hand, Fig. 5B shows one example set of actuator operations capable of being achieved by the multi-levers 49L, 49R when the changeover switch 45 is in the "blade side" position. As with Fig. 5A, the drawing is illustrated corresponding to the operating direction viewed from the operator in the cab 50. In this example,

the right-hand lever 49R is a lever for tilting and moving the blade up and down, and the left-hand lever 49L is a lever for angling the blade and swinging the upper swing structure. When the right-hand lever 49R is operated in the back-and-forth direction, the blade 3 is moved up and down, and when it is operated in the left-and-right direction, the blade 3 is tilted to rise at the right side and the left side. When the right-hand lever 49R is pulled rearward leftward, for example, the blade can be tilted to rise at the right side while moving up. Further, when the left-hand lever 49L is operated in the left-and-right direction, the blade 3 is angled forward at the left end and the right end. Incidentally, when the left-hand lever 49L is operated in the back-and-forth direction, the upper swing structure 4 is swinged to the left and right as with the case of Fig. 5A.

Of the plurality of control lever units, the control lever units for operating the left and right travel motors have travel control levers 47L, 47R (see Fig. 2) which are provided in more front positions than the multi-levers 49L, 49R with respect to the operator's seat 51. The changeover switch 45 for shifting the switching valves 39 - 44 is disposed on one of the travel control levers 47L, 47R, as shown in Fig. 6. This arrangement of the changeover switch 45 improves operability in shifting the switching valves 39 - 44.

In the above structure, the control lever units 23 - 26, etc., the upstream portions 30c - 35c and the front pilot lines 30a - 35a of the pilot lines 30 - 35, the pilot lines 36, 38, the control valves 28, etc., and the hydraulic actuators 20, 21, 22, etc. jointly constitute first operating means for operating the work front 5 and the upper swing structure 4. The control lever units 23 - 25, the upstream portions 30c - 35c and the blade pilot lines 30b - 35b of the pilot lines 30 - 35, the control valves 29, etc., and the blade cylinders 15, 16, 18 jointly constitute second operating means for operating the blade 3. Further, the control lever units 23 - 25 and the upstream portions 30c - 35c of the pilot lines 30 - 35 constitute a section shared by the first operating means and the second operating means. The changeover switch 45, the solenoid switching valve 46 and the switching valves 39 - 44 constitute switching means for selectively connecting the shared section such that the shared section serves as part of the first operating means when the work front 5 and the upper swing structure 4 are operated, and as part of the second operating means when the blade 3 is operated.

Also, the control lever unit 23, the upstream portions 30c, 31c and the boom-up/down pilot lines 30a, 31a of the pilot lines 30, 31, the boom control valve (not shown), and the boom cylinder 20 jointly constitute boom operating means. The control lever unit 24, the upstream portions 32c, 33c and the arm dumping/crowding pilot lines 32a, 33a of the pilot lines 32, 33, the arm control valve 28, and the arm cylinder 21 jointly constitute arm operating means. The control lever unit 25, the upstream portions 34c, 35c and the bucket dumping/crowding pilot lines 34a, 35a of the pilot lines 34, 35, the bucket control valve (not shown), and the bucket cylinder 22 jointly constitute bucket operating means.

The control lever unit 23 and the upstream portions 30c, 31c of the pilot lines 30, 31 constitute a boom shared section. The control lever unit 24 and the upstream portions 32c, 33c of the pilot lines 32, 33 constitute an arm shared section. The control lever unit 25 and the upstream portions 34c, 35c of the pilot lines 34, 35 constitute a bucket shared section.

The control lever unit 23, the upstream portions 30c, 31c and the blade-up/down pilot lines 30b, 31b of the pilot lines 30, 31, the blade-up/down control valve (not shown), and the blade-up/down cylinder 15 jointly constitute up/down operating means for moving the blade 3 up and down. The control lever unit 24, the upstream portions 32c, 33c and the blade left-angling/-right-angling pilot lines 32b, 33b of the pilot lines 32, 33, the angle control valve 29, and the angle cylinder 18 jointly constitute angle operating means for angling the blade 3. The control lever unit 25, the upstream portions 34c, 35c and the blade right-rising/left-rising tilt pilot lines 34b, 35b of the pilot lines 34, 35, the tilt control valve (not shown), and the tilt cylinder 16 jointly constitute tilt operating means for tilting the blade 3.

The operation of the hydraulic drive system explained above will be described below.

(1) When operating the work front 5 and swinging the upper swing structure 4

For example, when the operator intends to dump the arm 8, it is required for the operator to turn the changeover switch 45 to the "front side" for shifting the switching valves 39 - 44 to the upper positions in Fig. 1, and to move the left-hand lever 49L shown in Fig. 5A to the left (this corresponds to that the control lever 24a of the arm/blade-angle control lever unit 24 is moved in the direction A in Fig. 1). Upon the operator's manipulation, the original pilot pressure from the hydraulic source 48 is changed by the pressure reducing valve 24b to a pressure proportional to the input amount of the control lever 24a and then output to the upstream portion 32c of the pilot line 32. At this time, since the upstream portion 32c is connected to the arm dumping pilot line 32a through the switching valve 41, the pressure is applied to the hydraulic driving sector 28a of the arm control valve 28 through the arm dumping pilot line 32a, and a spool of the control valve 28 is shifted to a left-hand position in Fig. 4. As a result, the hydraulic fluid from the hydraulic pump 19 is supplied to the bottom side of the arm cylinder 21, whereby the arm cylinder 21 is operated to extend and the arm 8 is moved to dump.

When the operator intends to crowd the arm 8, it is required for the operator to move the left-hand lever 49L shown in Fig. 5A to the right (this corresponds to that the control lever 24a of the arm/blade-angle control

lever unit 24 is moved in the direction B in Fig. 1). Upon the operator's manipulation, the original pilot pressure from the hydraulic source 48 is changed by the pressure reducing valve 24b to a pressure proportional to the input amount of the control lever 24a and then output to the upstream portion 33c of the pilot line 33. At this time, since the upstream portion 33c is connected to the arm crowding pilot line 33a through the switching valve 42, the pressure is applied to the hydraulic driving sector 28b of the arm control valve 28 through the arm crowding pilot line 33a, and the spool of the control valve 28 is shifted to a right-hand position in Fig. 4. As a result, the hydraulic fluid from the hydraulic pump 19 is supplied to the rod side of the arm cylinder 21, whereby the arm cylinder 21 is operated to contract and the arm 8 is moved to crowd. Also, when the operator intends to stop the arm 8, it is required for the operator to return the left-hand lever 49L shown in Fig. 5A to a neutral position (this corresponds to that the control lever 24a of the arm/blade-angle control lever unit 24 is returned to a neutral position). Upon the operator's manipulation, the pressure reducing valve 24b connects the upstream portions 32c, 33c of the pilot lines 32, 33 to a reservoir 52, thus releasing the pilot pressure applied to the control valve 28. As a result, the control valve 28 is returned to a neutral position by action of a restoring spring and the movement of the arm 8 is stopped.

While the operation of dumping and crowing the arm 8 has been explained, the above description is also equally applied to any of other operations of moving the boom 6 up and down, dumping and crowing the bucket 9, and swinging the upper swing structure 4 to the right and left. By performing the above-explained lever manipulations individually or in an appropriately combined manner, the work front 5 can be articulately moved in a desired behavior and the upper swing structure 4 can be swinged at a desired speed; hence intended works such as excavating and loading can be achieved.

(2) When operating the blade 3

For example, when the operator intends to angle the blade 3 forward at the left end, it is required for the operator to turn the changeover switch 45 to the "blade side" for shifting the switching valves 39 - 44 to the lower positions in Fig. 1, and to move the left-hand lever 49L shown in Fig. 5B to the left (this corresponds to that the control lever 24a of the arm/blade-angle control lever unit 24 is moved in the direction A in Fig. 1). Upon the operator's manipulation, the original pilot pressure from the hydraulic source 48 is changed by the pressure reducing valve 24b to a pressure proportional to the input amount of the control lever 24a and then output to the upstream portion 32c of the pilot line 32. At this time, since the upstream portion 32c is connected to the blade left-angling pilot line 32b through the switching valve 41, the pressure is applied to the hydraulic driving sector 29a of the blade-angle control valve 29 through the blade left-angling pilot line 32b, and a spool of the control valve 29 is shifted to the left-hand position in Fig. 4. As a result, the hydraulic fluid from the hydraulic pump 19 is supplied to the rod side of the blade-angle cylinder 18a and the bottom side of the blade-angle cylinder 18b, whereby the cylinder 18a is operated in the direction to contract and the cylinder 18b is operated in the direction to extend. The blade 3 is thus moved to perform left-angling (i.e., moved forward at the left end as viewed from the operator).

When the operator intends to angle the blade 3 forward at the right end, it is required for the operator to move the left-hand lever 49L shown in Fig. 5B to the right (this corresponds to that the control lever 24a of the arm/blade-angle control lever unit 24 is moved in the direction B in Fig. 1). Upon the operator's manipulation, the original pilot pressure from the hydraulic source 48 is changed by the pressure reducing valve 24b to a pressure proportional to the input amount of the control lever 24a and then output to the upstream portion 33c of the pilot line 33. At this time, since the upstream portion 33c is connected to the blade right-angling pilot line 33b through the switching valve 42, the pressure is applied to the hydraulic driving sector 29b of the control valve 29 through the blade right-angling pilot line 33b, and the spool of the control valve 29 is shifted to a right-hand position in Fig. 4. As a result, the hydraulic fluid from the hydraulic pump 19 is supplied to the rod side of the blade-angle cylinder 18b and the bottom side of the blade-angle cylinder 18a, whereby the cylinder 18b is operated in the direction to contract and the cylinder 18a is operated in the direction to extend. The blade 3 is thus moved to perform right-angling (i.e., moved forward at the right end as viewed from the operator). Also, when the operator intends to stop the angling operation of the blade 3, it is required for the operator to return the left-hand lever 49L shown in Fig. 5B to the neutral position (this corresponds to that the control lever 24a of the arm/blade-angle control lever unit 24 is returned to the neutral position). Upon the operator's manipulation, the pressure reducing valve 24b connects the upstream portions 32c, 33c of the pilot lines 32, 33 to the reservoir 52, thus releasing the pilot pressure applied to the control valve 29. As a result, the control valve 29 is returned to a neutral position by action of a restoring spring and the angling operation of the blade 3 is stopped.

While the operation of angling the blade 3 forward at the left end and the right end has been explained, the above description is also equally applied to any of other operations of the blade 3, i.e., up/down movement and left-and right-tilting (in which the blade 3 is moved to rise at the left end and the right end as viewed from the operator). By performing the above-explained lever manipulations individually or in an appropriately combined manner, the blade 3 can be operated in a desired behavior and various types of work using the blade can be achieved. Additionally, in this case, the swinging

operation stated above in the case of (1) can also be performed at the same time by moving the left-hand lever 49L shown in Fig. 5B in the back-and-forth direction.

The hydraulic drive system of this embodiment, having the above-explained construction, can provide advantages as follows.

Generally, in the hydraulic excavator having the blade 3, the work front 5 and the upper swing structure 4 are hardly operated when the blade 3 is operated. In this embodiment, therefore, the control lever units 23 - 26 and the upstream portions 30c - 35c of the pilot lines 30 - 35 are constructed to be shared by both the case of operating the work front 5 and the upper swing structure 4 and the case of operating the blade 3. Specifically, when the work front 5 and the upper swing structure 4 are operated, the switching valves 39 - 44 are shifted to the upper positions in Fig. 1 so that the shared section is used for operating the work front 5 and the upper swing structure 4. When the blade 3 is operated, the switching valves 39 - 44 are shifted to the lower positions in Fig. 1 so that the shared section is used for operating the blade 3. This eliminates the need of providing additional control lever units for the blade separately from the control lever units 23 - 26, and hence can avoid the space in the cab 50 from becoming narrow. Another advantage is that, comparing the case of providing additional control lever units for the blade separately from the control lever units 23 - 26, the number of parts can be reduced and the cost of parts can be cut down correspondingly. Further, since the blade 3 can be operated by manipulating the multi-levers 49L, 49R which are conventionally installed for operating the work front 5 and swinging the upper swing structure 4, good operability is achieved in operating the blade 3.

Note that while the changeover switch 45 is provided on one of the travel control levers 47L, 47R in the above embodiment, the present invention is not limited to the illustrated embodiment, and the changeover switch 45 may be provided on one of the multi-levers 49L, 49R.

A second embodiment of the present invention will be described below with reference to Fig. 7. This embodiment differs from the above first embodiment in structure of the switching valves and manner of shifting the switching valves. Equivalent members to those in the first embodiment are denoted by the same reference numerals and are not explained here.

Fig. 7 is a hydraulic circuit diagram showing a circuit of a pilot system in a hydraulic drive system of this second embodiment, and corresponds to Fig. 1 for the first embodiment. As shown in Fig. 7, this embodiment particularly differs from the above first embodiment in that solenoid switching valves 201a - 201c are provided instead of the switching valves 39 - 44 and shifted independently of one another in response to signals output from three changeover switches 202a - 202c each of which is the same as the changeover switch 45 in the first embodiment.

More specifically, when the changeover switches 202a - 202c are turned to "front side" positions, no drive signals are output and the solenoid switching valves 201a - 201c are held in upper positions in Fig. 7 by action of associated restoring springs. The upstream portions 30c - 35c of the pilot lines 30 - 35 are therefore connected respectively to the boom-up pilot line 30a, the boom-down pilot line 31a, the arm dumping pilot line 32a, the arm crowding pilot line 33a, the bucket crowding pilot line 34a, and the bucket dumping pilot line 35a. On the other hand, when the changeover switches 202a - 202c are turned to "blade side" positions, drive signals are output and the solenoid switching valves 201a - 201c are shifted to lower positions in Fig. 7. The upstream portions 30c - 35c of the pilot lines 30 - 35 are therefore connected respectively to the blade-up pilot line 30b, the blade-down pilot line 31b, the blade left-angling pilot line 32b, the blade right-angling pilot line 33b, the blade right-rising tilt pilot line 34b, and the blade left-rising tilt pilot line 35b.

Additionally, the changeover switches 202a - 202c are provided on a console (not shown) within the cab 50 unlike the changeover switch 45 in the first embodiment.

The other structure is basically the same as in the first embodiment.

In the above construction, the changeover switch 202a and the solenoid switching valve 201a constitute arm switching means for selectively connecting the arm shared section such that the arm shared section serves as part of the arm operating means when the arm 8 is operated. The changeover switch 202b and the solenoid switching valve 201b constitute boom switching means for selectively connecting the boom shared section such that the boom shared section serves as part of the boom operating means when the boom 6 is operated. The changeover switch 202c and the solenoid switching valve 201c constitute bucket switching means for selectively connecting the bucket shared section such that the bucket shared section serves as part of the bucket operating means when the bucket 9 is operated.

In addition to the advantages obtainable with the first embodiment, this second embodiment constructed as explained above can provide an advantage below. Since switching over between the boom-up/down operation and the blade-up/down operation, switching over between the arm dumping/crowding operation and the blade left/right-angling operation, and switching over between the bucket dumping/crowding operation and the blade left/right-rising tilt operation are performed independently of one another, the switching can be more finely depending on desired types of work.

In the above first and second embodiments, the boom-up operation and the blade-up operation, the boom-down operation and the blade-down operation, the arm dumping operation and the blade left-angling operation, the arm crowding operation and the blade

right-angling operation, the bucket dumping operation and the blade left-rising tilt operation, and the bucket crowding operation and the blade right-rising tilt operation are related to each other in such a manner as being able to switch over between two types of operations in each pair. However, the present invention is not limited to those combinations and the combined pairs of operations may be changed appropriately depending on applications of the hydraulic excavator. Irrespective of change in combination, the same advantages as in the above embodiments can be provided. The combined pairs of operations may be modified below, by way of example, for a particular object. A hydraulic drive system according to this modification will be described with reference to Figs. 8, 9A and 9B.

Fig. 8 is a hydraulic circuit diagram of a pilot system of the hydraulic drive system and corresponds to Fig. 7 for the second embodiment. In Fig. 8, this modification differs from the second embodiment in that the boom-up/down and the bucket crowding/dumping are exchanged in the above combinations of operations; i.e., the bucket crowding operation and the blade-up operation, the bucket dumping operation and the blade-down operation, the boom-down operation and the blade left-rising tilt operation, and the boom-up operation and the blade right-rising tilt operation are related to each other in such a manner as being able to switch over between two types of operations in each pair. Resulting relationships between the operating directions of the multi-levers 49L, 49R and the types of operations instructed by the multi-levers are shown in Figs. 9A and 9B.

Fig. 9A shows the actuator operations capable of being achieved by the multi-levers 49L, 49R when the changeover switches 202a - 202c are all in the "front side" positions, and corresponds to Fig. 5A for the first embodiment. As will be seen from Comparing with Fig. 5A, the boom-up/down and the bucket crowding/dumping are exchanged such that when the right-hand lever 49R is operated in the back-and-forth direction, the bucket 9 is crowded and dumped, and when it is operated in the left-and-right direction, the boom 6 is moved up and down. This modification has an advantage below.

For example, when the hydraulic excavator is under work using the blade with the changeover switches 202a - 202c shifted to the "blade side" positions and the solenoid switching valves 201a - 201c shifted to the lower positions in Fig. 8, there may occur a fear that the heap of earth and sand accumulated in front of the blade 3 becomes so high with the progress of the work as to contact the bucket 9. In such an event, the changeover switch 202c is turned to the "front side" position, causing the solenoid switching valve 201c to restore to the upper position in Fig. 8. The actuator operations capable of being achieved by the multilevers 49L, 49R at this time are shown in Fig. 9B. Since the operation of the boom 6 is now enabled by the right-hand lever 49R instead of the blade tilt operation as will be seen from Fig. 9B, the bucket 9 can be avoided from contacting the earth and sand by manipulating the right-hand lever 49R to the left to move up the boom 6, while continuing the operation of moving the blade 3 up and down as basic operation.

While the above modification has been described as exchanging the boom-up/down and the bucket crowding/-dumping in the combinations of operations in Fig. 5, a pair of operations to be exchanged is not limited to the above pair. Specifically, it is also possible to exchange the boom-up/down and the arm crowding/dumping, or the boom-up/down and the left/right swing. In the latter case, the boom 6 can be always operated by the control lever 26a irrespective of any switching valves 202, and the left/-right swing operation and the blade-up/down operation can be selectively performed by the control lever unit 23 upon the changeover switch 202b turned to the "front side" or "blade side" position. It is thus essential that the circuit design is changed in line connection so that the means for operating the boom 6 and the means for moving the blade 3 up and down are not shared in any section, enabling blade-up/down operation and the boom-up/down operation to be performed at the same time. Any of those cases can also provide the same advantages as in the above modification.

A third embodiment of the present invention will be described with reference to Fig. 10. This embodiment employs control lever units equipped with the so-called electrical levers. Equivalent members to those in the first and second embodiments are denoted by the same reference numerals and are not explained here.

Fig. 10 is a hydraulic circuit diagram showing a circuit of a pilot system in a hydraulic drive system of this third embodiment. In Fig. 10, this embodiment particularly differs from the above first embodiment in that control lever units 301 - 308 equipped with control levers 301a - 308a are provided instead of the control lever units 23 - 26, and a controller 309 for receiving operations signals from the control lever units 301 - 308 and solenoid pressure reducing valves 310 - 317 for reducing the pressure of the hydraulic fluid from the hydraulic source 48 in accordance with output signals from the controller 309 are provided additionally.

More specifically, the control lever units 301 - 308 are constituted as a left swing control lever unit 301, a right swing control lever unit 302, a bucket crowding/blade right-rising tilt control lever unit 303, a bucket dumping/blade left-rising tilt control lever unit 304, a boom-up/blade-up control lever unit 305, a boom-down/-blade-down control lever unit 306, an arm dumping/blade left-angling control lever unit 307, and an arm crowding/blade right-angling control lever unit 308. Also, the control lever units 301 - 308 include respective potentiometers 301b - 308b for detecting shift positions of the control levers 301a - 308a and then outputting corresponding electrical signals. On the basis of the

electrical signals from the potentiometers 301b - 308b, the controller 309 executes predetermined arithmetic operations and outputs drive signals to the corresponding solenoid pressure reducing valves 310 - 317. The solenoid pressure reducing valves 310 - 317 are connected at the primary side to the hydraulic source 48, and at the secondary side to the corresponding pilot lines 30 - 38. As with the first embodiment, the control lever units 301 - 308 are constructed of two multi-levers 49L, 49R so that the actuator operations shown in Figs. 5A and 5B can be selectively performed upon the changeover switch 45 turned to the "front side" or "blade side" position.

The other structure is basically the same as in the first embodiment.

In the above hydraulic drive system, for example, when the operator turns the changeover switch 45 to the "front side" and moves the left-hand lever 49L shown in Fig. 5A to the left (this corresponds to that the control lever 307a of the arm dumping/blade left-angling control lever unit 307 is moved in Fig. 10) with the intention of dumping the arm 8, an electrical signal corresponding to the input amount of the control lever 307a is input to the controller 309 which outputs a corresponding drive signal to the solenoid pressure reducing valve 316. The original pilot pressure from the hydraulic source 48 is changed by the solenoid pressure reducing valve 316 to a pressure proportional to the lever input amount and then output to the upstream portion 32c of the pilot line 32. The subsequent process is the same as in the first embodiment. When the operator moves the left-hand lever 49L shown in Fig. 5A to the right with the intention of crowding the arm 8, a drive signal corresponding to the lever input amount is output from the controller 309 to the solenoid pressure reducing valve 317. The original pilot pressure is changed to a pressure proportional to the lever input amount and then output to the upstream portion 33c of the pilot line 33. The subsequent process is the same as in the first embodiment. Further, when the operator returns the left-hand lever 49L shown in Fig. 5A to the neutral position for stopping the arm 8, a corresponding drive signal is output from the controller 309 to the solenoid pressure reducing valves 316, 317, whereupon the solenoid pressure reducing valves 316, 317 connect the upstream portions 32c, 33c of the pilot lines 32, 33 to the reservoir 52. The subsequent process is the same as in the first embodiment. The boom-up/down operation, the bucket dumping/crowding operation, and the left/right swing operation can also be performed in a similar manner.

When operating the blade 3, the changeover switch 45 is turned to the "blade side" position for shifting the switching valves 39 - 44 to the lower positions in Fig. 10 and the control levers 303 - 308 are manipulated corresponding to the desired type of work. Flows of signals and pilot pressures in the case of operating the blade 3 are basically the same as in the above case of operating the work front, and hence are not explained here.

This third embodiment can also provide the same advantages as in the first embodiment.

In the above first to third embodiments, the multi-levers 49L, 49R are assigned with the respective actuator operations for each of the operating directions, as shown in Figs. 5A and 5B, but assignment of the actuator operations to the multi-levers for each of the operating directions is not limited to the illustrated example. As other examples, the left-hand lever 49L may serve as a lever for operating the boom and the bucket, and the right-hand lever 49R may serve as a lever for operating the arm and swinging the upper swing structure. Alternatively, the left-hand lever 49L may serve as a lever for operating the boom and swinging the upper swing structure, and the right-hand lever 49R may serve as a lever for operating the arm and the bucket. Any of those cases can also provide the same advantages as in the above embodiments.

According to the present invention, the need of securing the space for installation of the second operating means separately from the space for installation of the first operating means is eliminated with regard to the shared section, and hence the space in the cab is avoided from becoming narrow. Also, when the blade is operated, the shared section of the first operating means, which is determined beforehand in consideration of operability, is used as it is as part of the second operating means. As a result, operability in blade operation is not deteriorated and good operability is always ensured.

Claims

1. A hydraulic drive system for a hydraulic excavator comprising an upper swing structure (4), a work front (5) mounted onto said upper swing structure, a under traveling carriage (1), and a blade (3) attached to said under traveling carriage, said hydraulic drive system including first operating means (20-26) for operating said work front and said upper swing structure, and second operating means (15-18, 23-25) for operating said blade, wherein:

   a partial section (23-25) of said first operating means is shared by said second operating means, and

   said hydraulic drive system includes switching means (45, 202a-c) for selectively connecting said shared section and the object to be operated such that said shared section serves as part of said first operating means when said work front and said upper swing structure are operated, and as part of said second operating means when said blade is operated.

2. A hydraulic drive system for a hydraulic excavator according to Claim 1, wherein said work front (5) includes a boom (6) rotatably connected to said

upper swing structure (4), an arm (8) rotatably connected to said boom (6), and a bucket (9) rotatably connected to said arm (8); said first operating means includes boom operating means (20, 23) for operating said boom, arm operating means (21, 24) for operating said arm, and bucket operating means (22, 25) for operating said bucket; said shared section (23-25) includes a boom shared section (23) provided in said boom operating means, an arm shared section (24) provided in said arm operating means, and a bucket shared section (25) provided in said bucket operating means; said second operating means includes up/down operating means (15, 23) for moving said blade up and down, angle operating means (18, 24) for angling said blade, and tilt operating means (16, 25) for tilting said blade; and said switching means (45) selectively connects said shared sections and the object to be operated such that said boom shared section, said arm shared section and said bucket shared section serve respectively as part of said boom operating means, said arm operating means and said bucket operating means when said work front and said upper swing structure are operated, and such that said boom shared section, said arm shared section and said bucket shared section each serve as part of corresponding one of said up/down operating means, said angle operating means and said tilt operating means when said blade is operated.

3. A hydraulic drive system for a hydraulic excavator according to Claim 1, wherein said work front (5) includes a boom (6) rotatably connected to said upper swing structure (4), an arm (8) rotatably connected to said boom (6), and a bucket (9) rotatably connected to said arm (8); said first operating means includes boom operating means (20, 23) for operating said boom, arm operating means (21, 24) for operating said arm, and bucket operating means (22, 25) for operating said bucket; said shared section (23-25) includes a boom shared section (23) provided in said boom operating means, an arm shared section (24) provided in said arm operating means, and a bucket shared section (25) provided in said bucket operating means; said second operating means includes up/down operating means (15, 23) for moving said blade up and down, angle operating means (18, 24) for angling said blade, and tilt operating means (16, 25) for tilting said blade; and said switching means (202a-c) includes boom switching means (202c) for selectively connecting said boom shared section such that said boom shared section serves as part of said boom operating means, arm switching means (202a) for selectively connecting said arm shared section such that said arm shared section serves as part of said arm operating means, and bucket switching means (202b) for selectively connecting said bucket shared section such that said bucket shared section serves as part of said bucket operating means, said boom switching means, said arm switching means and said bucket switching means selectively connecting said shared sections and the object to be operated in a manner independently of one another such that said boom shared section, said arm shared section and said bucket shared section each serve as part of corresponding one of said up/down operating means, said angle operating means and said tilt operating means when said blade is operated.

4. A hydraulic drive system for a hydraulic excavator according to Claim 2 or 3, wherein said switching means selectively connects said boom shared section and the object to be operated such that said boom shared section serves as part of other one means of said second operating means than said up/down operating means when said blade is operated.

5. A hydraulic drive system for a hydraulic excavator according to Claim 1, wherein said first operating means includes one or more control levers and said switching means includes a changeover switch, said changeover switch being provided on at least one of said control levers.

FIG.1

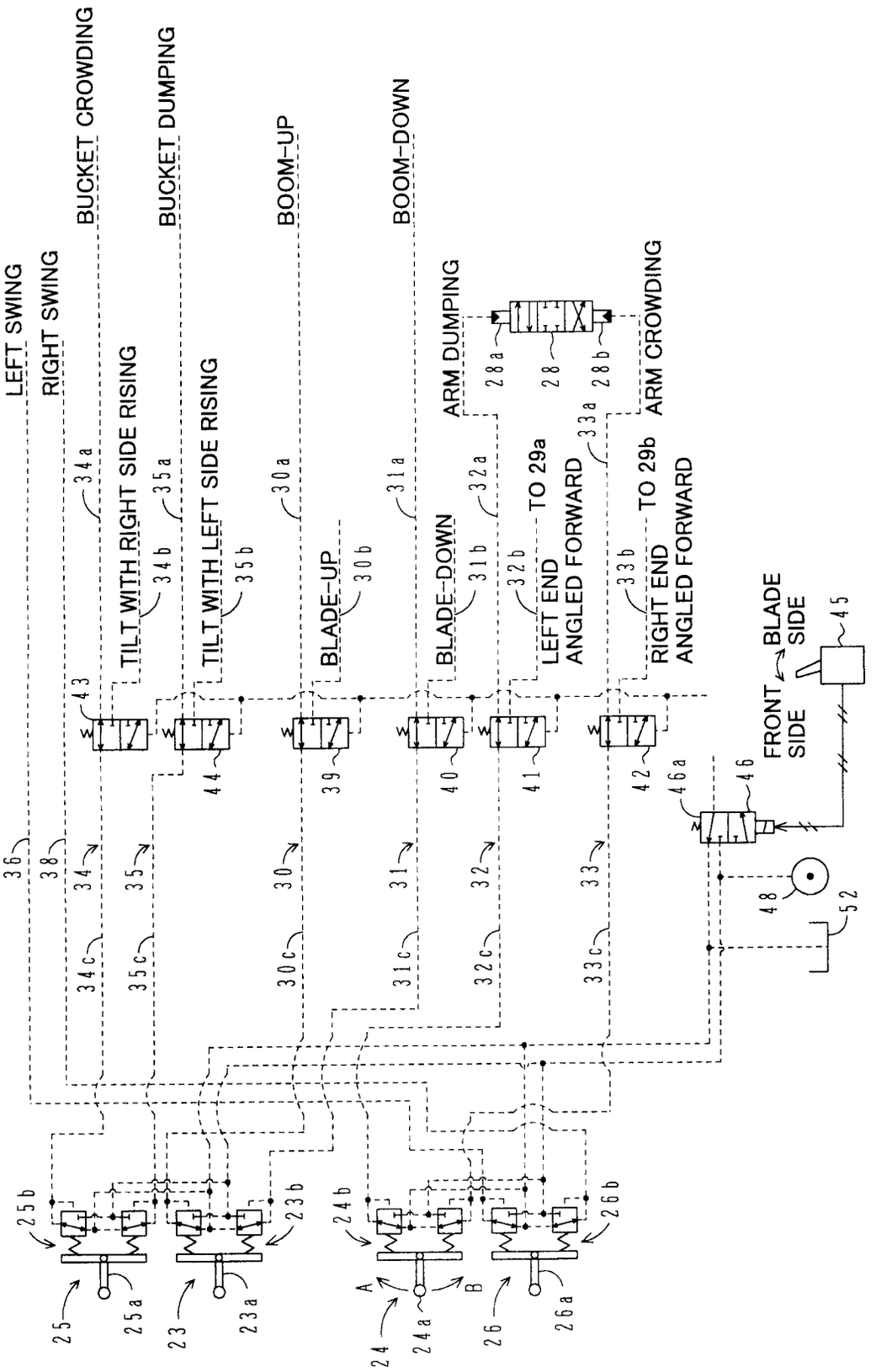

LEFT SWING
RIGHT SWING
BUCKET CROWDING
TILT WITH RIGHT SIDE RISING
BUCKET DUMPING
TILT WITH LEFT SIDE RISING
BOOM-UP
BLADE-UP
BOOM-DOWN
BLADE-DOWN
ARM DUMPING
TO 29a
LEFT END ANGLED FORWARD
TO 29b
RIGHT END ANGLED FORWARD
ARM CROWDING
FRONT SIDE
BLADE SIDE
A
B

FIG.2

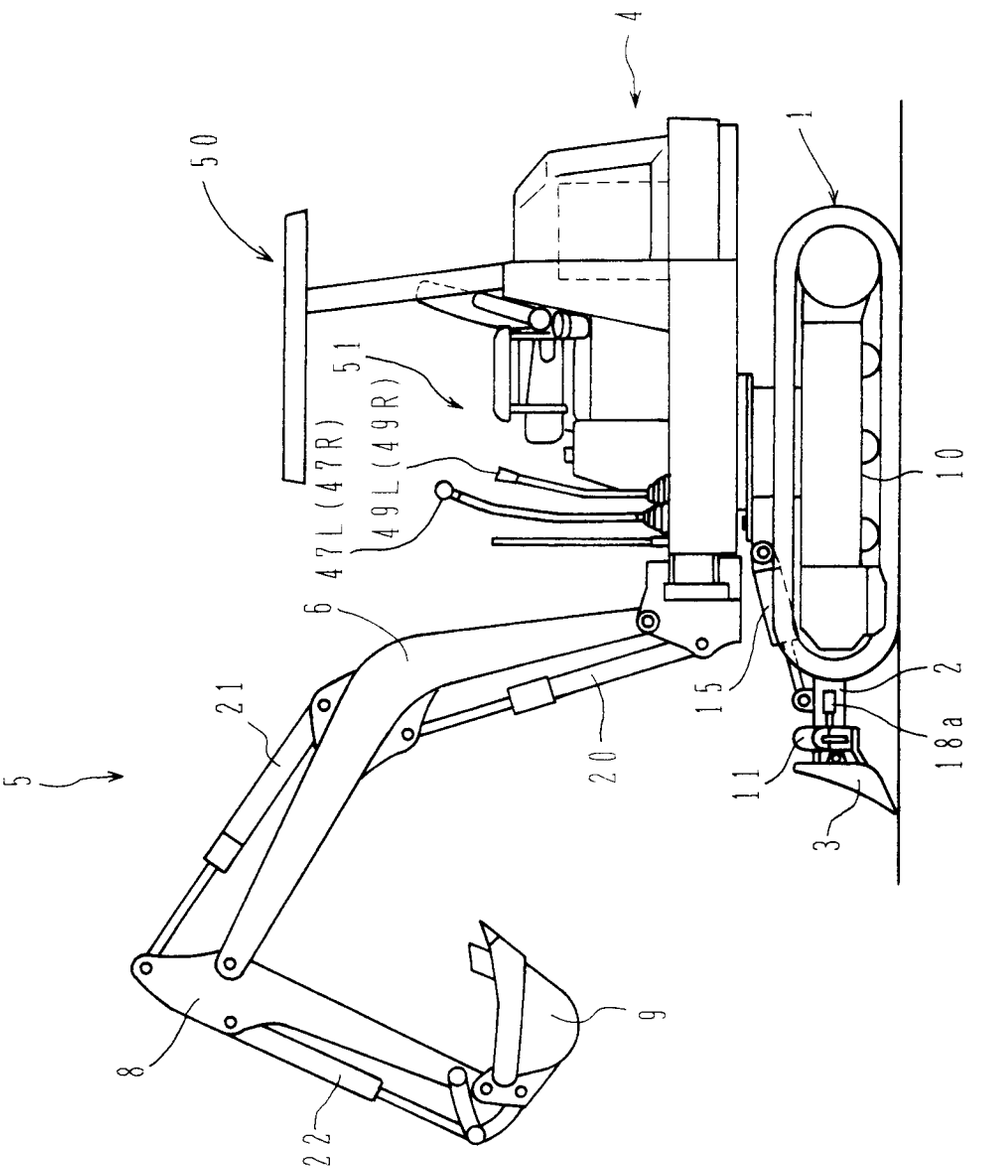


FIG.3

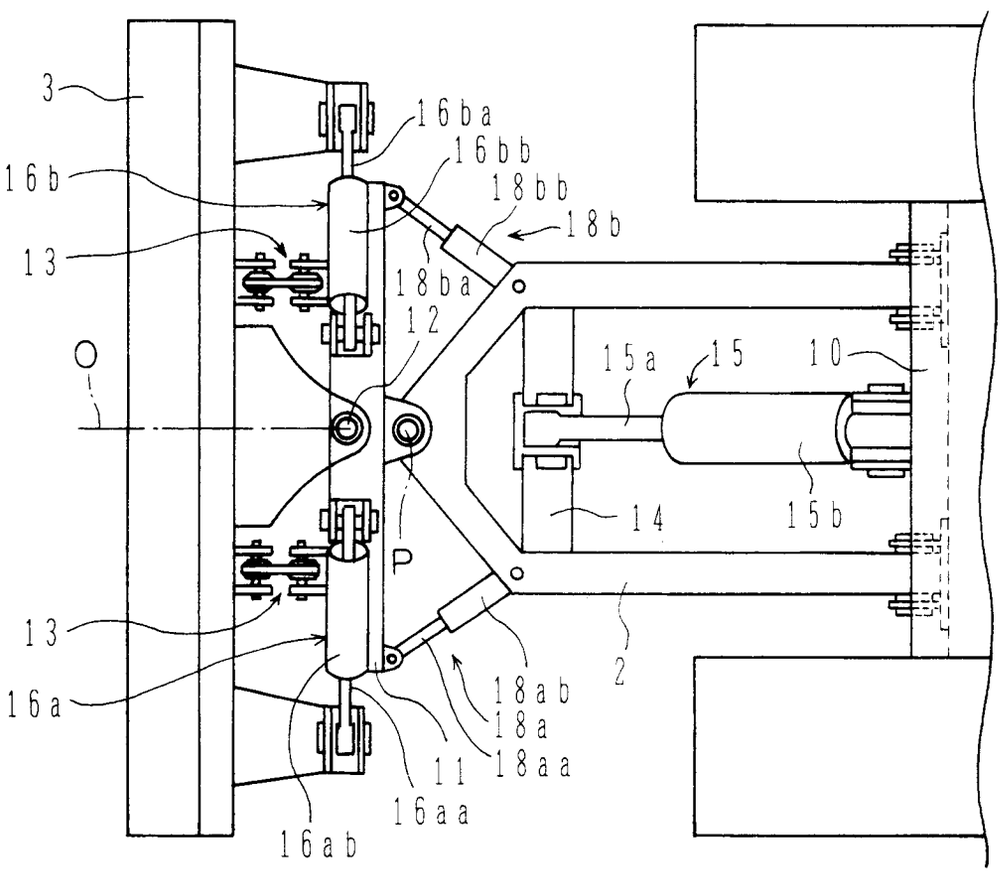

3
16ba
16bb
16b
18bb
18b
13
18ba
12
O
15a
15
10
14
15b
P
13
16a
2
18ab
18a
18aa
11
16aa
16ab

FIG.4

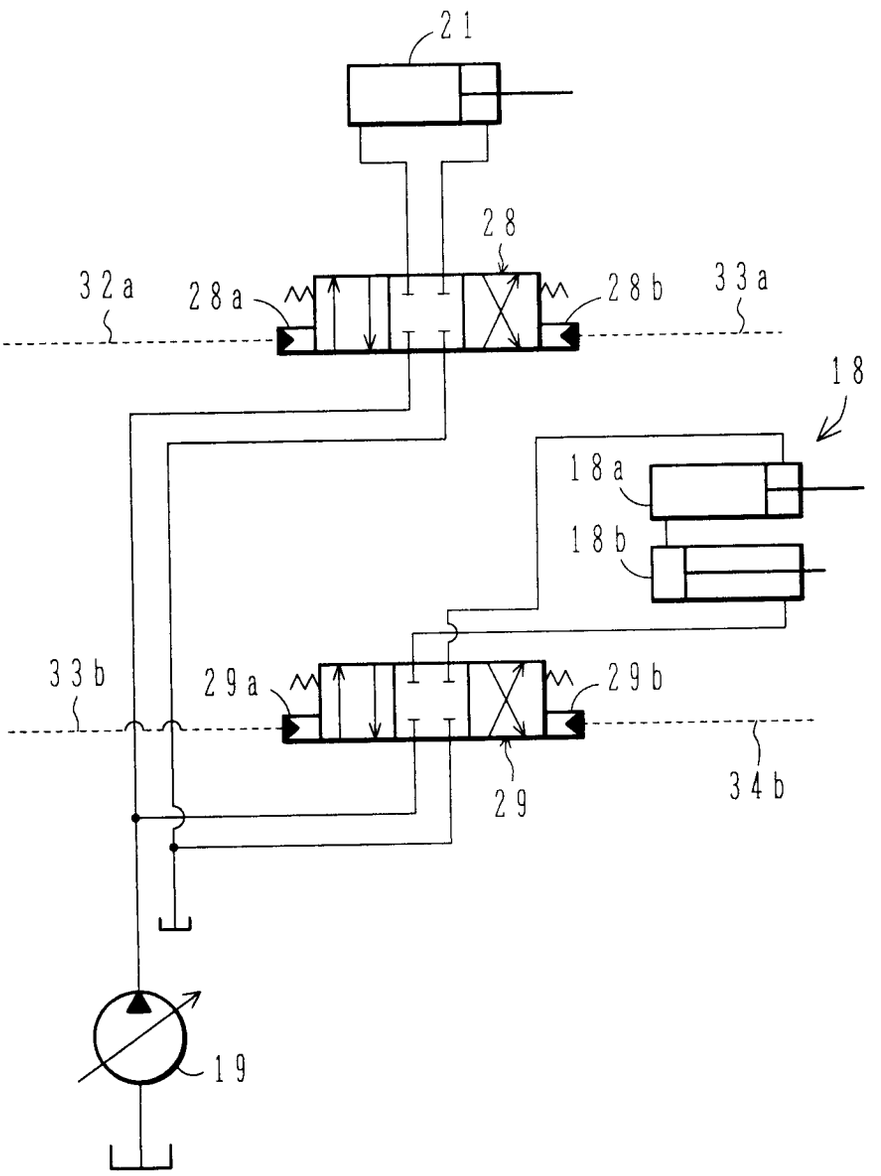


FIG.5A

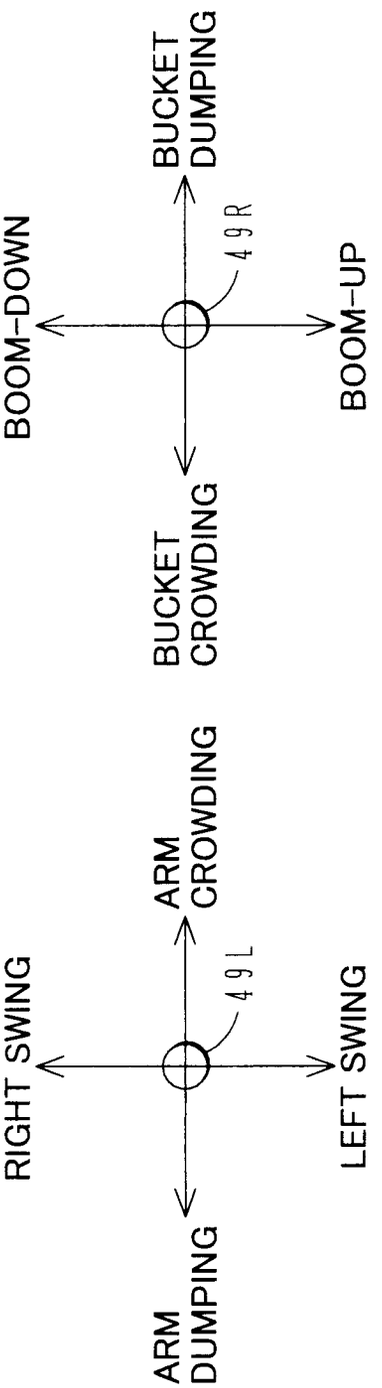

BOOM-DOWN
BOOM-UP
BUCKET DUMPING
BUCKET CROWDING
49R
RIGHT SWING
LEFT SWING
ARM CROWDING
ARM DUMPING
49L

FIG.5B


BLADE-DOWN
BLADE-UP
TILT WITH LEFT SIDE RISING
TILT WITH RIGHT SIDE RISING
49R
RIGHT SWING
LEFT SWING
RIGHT END ANGLED FORWARD
LEFT END ANGLED FORWARD
49L

FIG.6

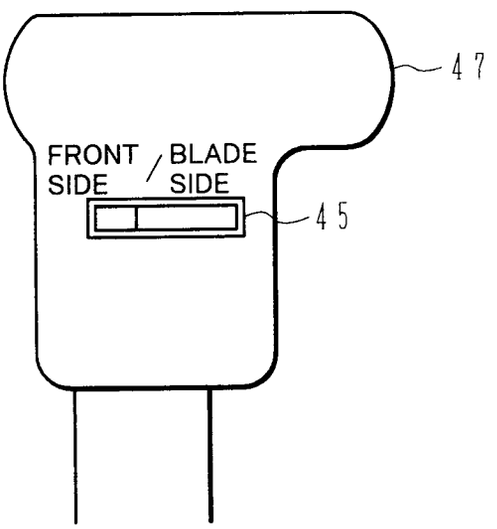


FIG.7

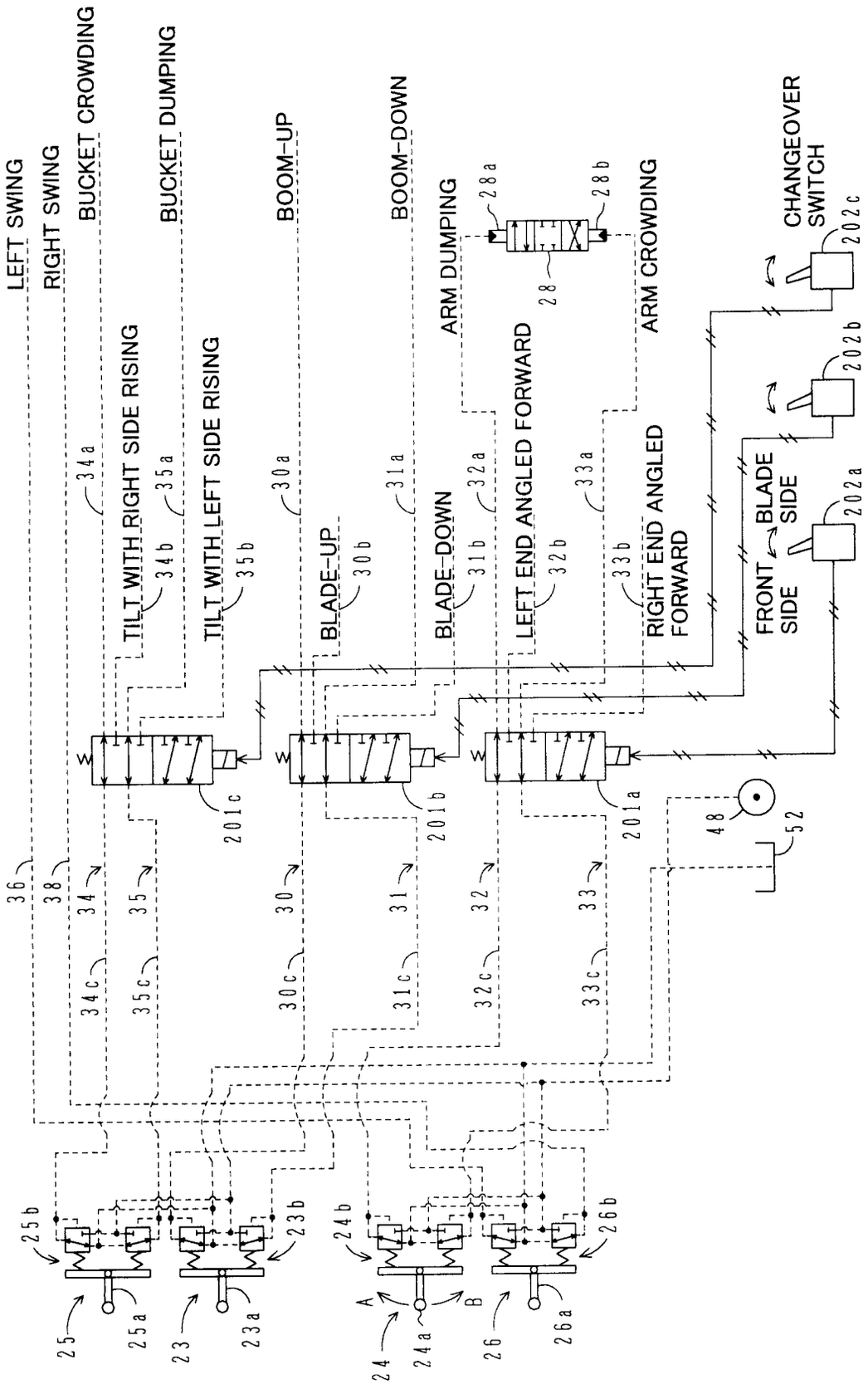

LEFT SWING
RIGHT SWING
BUCKET CROWDING
BUCKET DUMPING
BOOM-UP
BOOM-DOWN
ARM DUMPING
ARM CROWDING
TILT WITH RIGHT SIDE RISING
TILT WITH LEFT SIDE RISING
BLADE-UP
BLADE-DOWN
LEFT END ANGLED FORWARD
RIGHT END ANGLED FORWARD
FRONT
BLADE SIDE
CHANGEOVER SWITCH
A
B
36
38
34
35
30
31
32
33
34a
35a
30a
31a
32a
33a
28a
28b
28
34b
35b
30b
31b
32b
33b
34c
35c
30c
31c
32c
33c
201c
201b
201a
202c
202b
202a
48
52
25b
23b
24b
26b
25
25a
23
23a
24
24a
26
26a

FIG.8

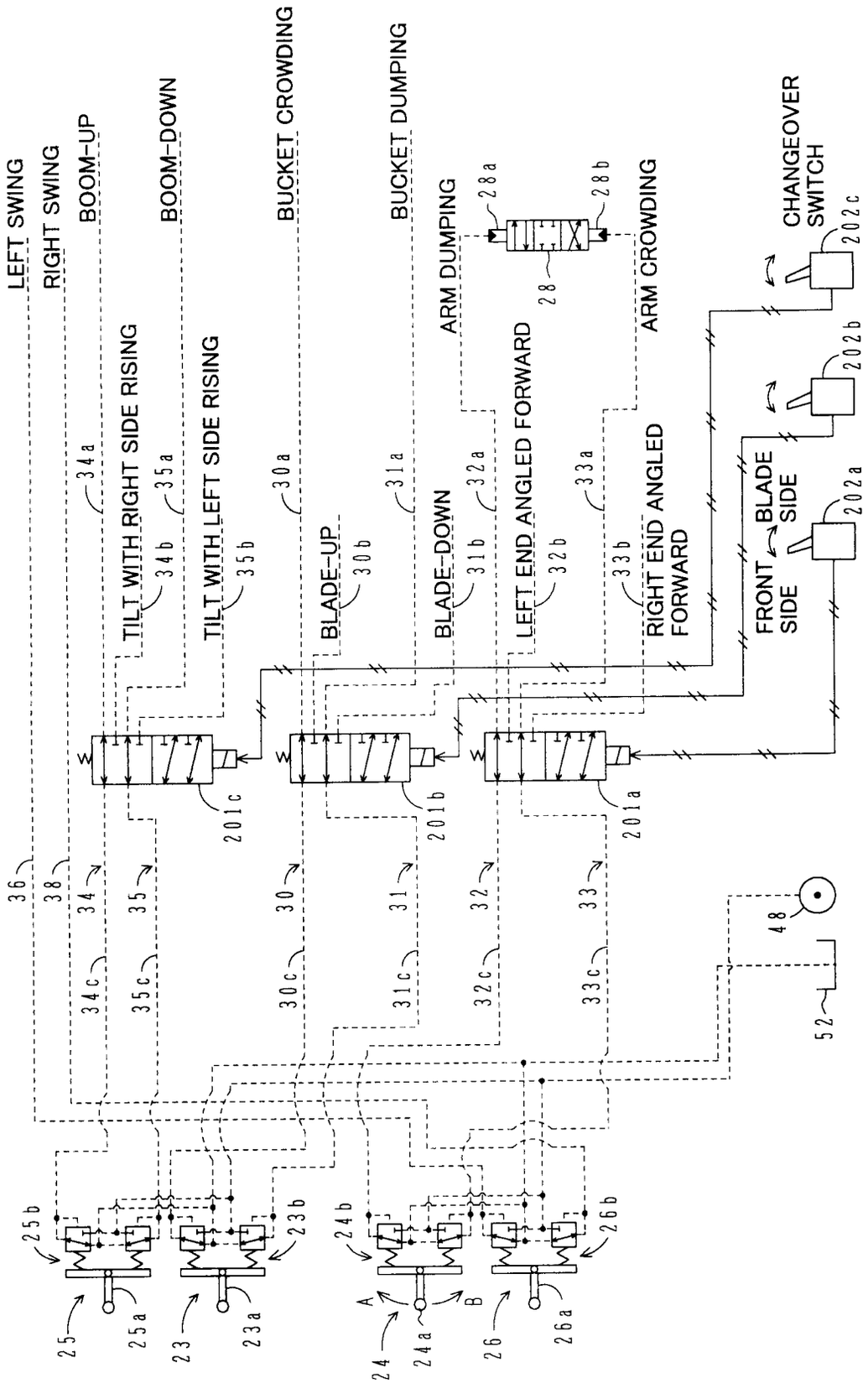

LEFT SWING
RIGHT SWING
BOOM-UP
BOOM-DOWN
TILT WITH RIGHT SIDE RISING
TILT WITH LEFT SIDE RISING
BUCKET CROWDING
BUCKET DUMPING
ARM DUMPING
ARM CROWDING
BLADE-UP
BLADE-DOWN
LEFT END ANGLED FORWARD
RIGHT END ANGLED FORWARD
FRONT ↔ BLADE SIDE
CHANGEOVER SWITCH
A
B

FIG.9A

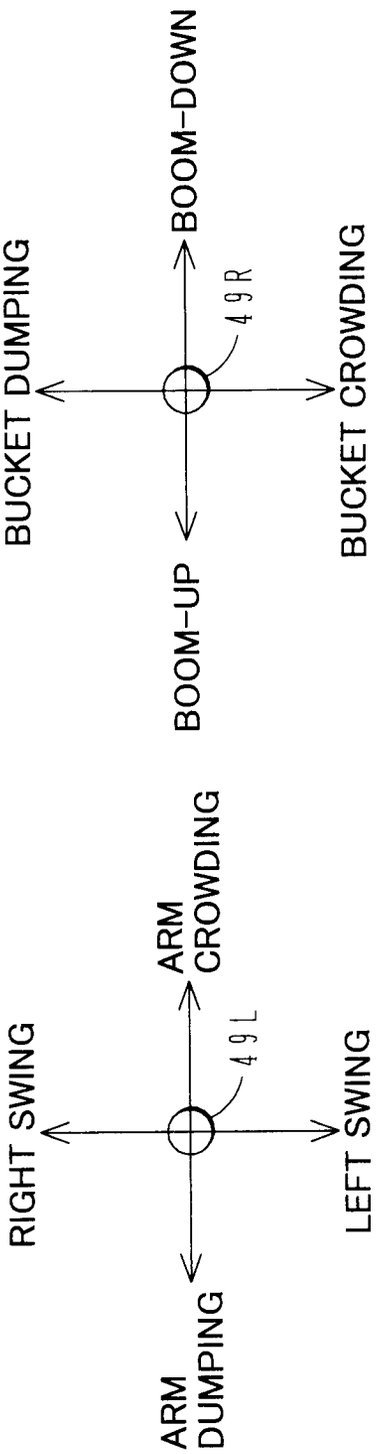
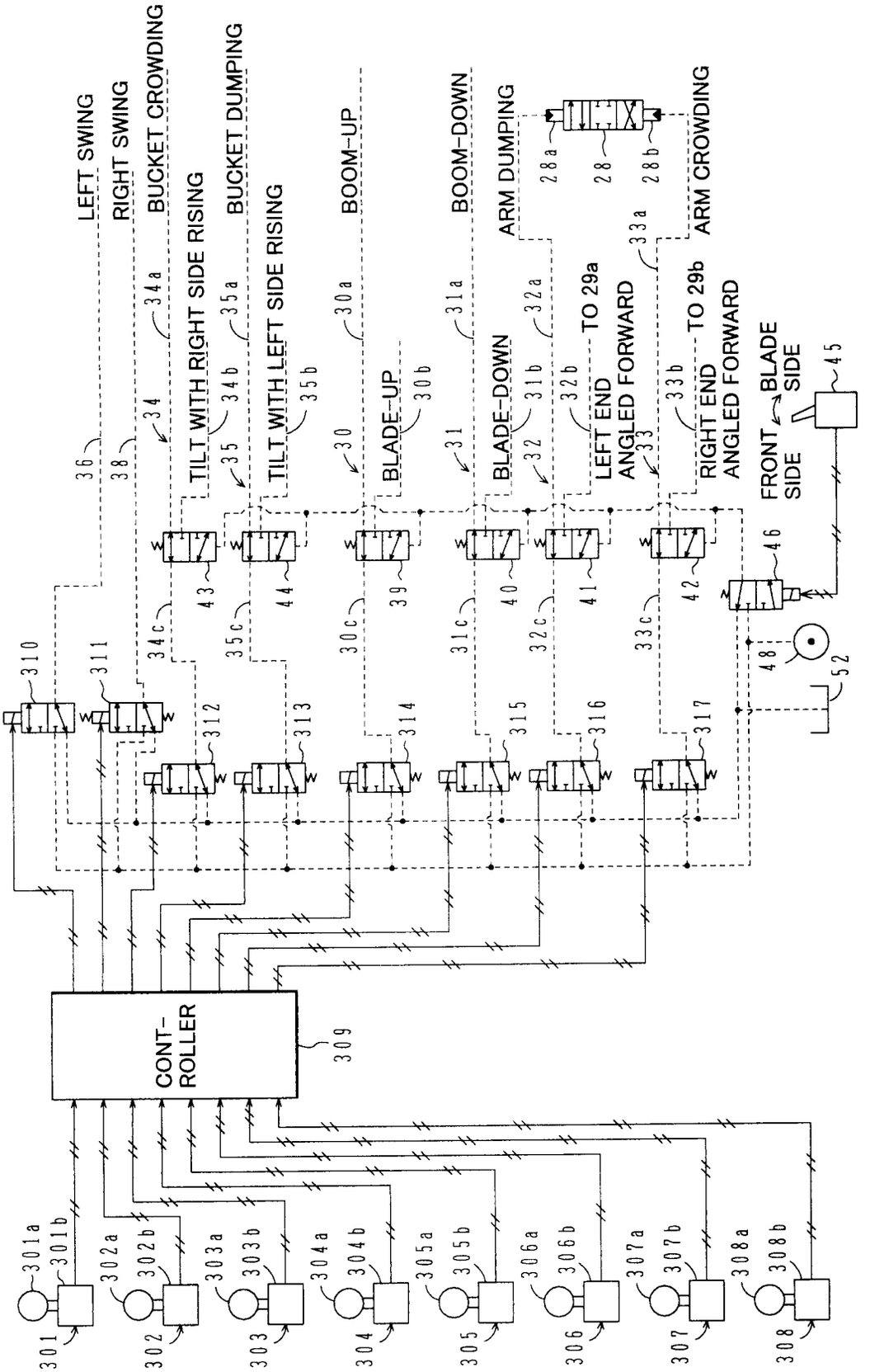

BUCKET DUMPING
BOOM-DOWN
BOOM-UP
BUCKET CROWDING
49R
RIGHT SWING
ARM CROWDING
ARM DUMPING
LEFT SWING
49L

FIG.9B


BLADE-DOWN
BOOM-DOWN
BOOM-UP
BLADE-UP
49R
RIGHT SWING
RIGHT END ANGLED FORWARD
LEFT END ANGLED FORWARD
LEFT SWING
49L

FIG.10


LEFT SWING
RIGHT SWING
BUCKET CROWDING
TILT WITH RIGHT SIDE RISING
BUCKET DUMPING
TILT WITH LEFT SIDE RISING
BOOM-UP
BLADE-UP
BOOM-DOWN
BLADE-DOWN
ARM DUMPING
TO 29a
LEFT END ANGLED FORWARD
TO 29b
RIGHT END ANGLED FORWARD
ARM CROWDING
FRONT SIDE
BLADE SIDE
CONT-ROLLER
309
301
302
303
304
305
306
307
308
310
311
312
313
314
315
316
317
30
31
32
33
34
35
36
38
39
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42
43
44
45
46
48
52

European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 97 12 0554

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
A,D	PATENT ABSTRACTS OF JAPAN vol. 096, no. 001, 31 January 1996 & JP 07 247572 A (HITACHI CONSTR MACH CO LTD), 26 September 1995, * abstract * * figures 1,4,8,11 *	1	E02F9/20 E02F3/84 E02F9/22
A	PATENT ABSTRACTS OF JAPAN vol. 015, no. 208 (M-1117), 28 May 1991 & JP 03 056706 A (KUBOTA CORP), 12 March 1991, * abstract * * figures 1,3,4 *	1	
			TECHNICAL FIELDS SEARCHED (Int.Cl.6) E02F

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	17 March 1998	Guthmuller, J

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
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