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(54) **MULTIDIRECTIONAL SWITCHING VALVE FOR CONSTRUCTION MACHINE**

(57) The object of the present invention is to provide a multiple direction switching valve capable of stopping acceleration of a first actuator upon operation of a second actuator, without adding any outside pipe. A boom accelerating valve 4 is located in a valve member block 10, the boom accelerating valve 4 having an accelerating position 4a at which pressure oil from a second pump 52 is supplied to a boom hydraulic cylinder 55, and a neutral position 4b at which the pressure oil from the second pump 52 is not supplied to the boom hydraulic cylinder 55. In addition, a boom acceleration releasing mechanism is provided in the valve member block 10, the boom acceleration releasing mechanism being configured to return the boom accelerating valve 4 to the neutral position 4b from the accelerating position 4a, when an arm direction switching valve 2z is operated.

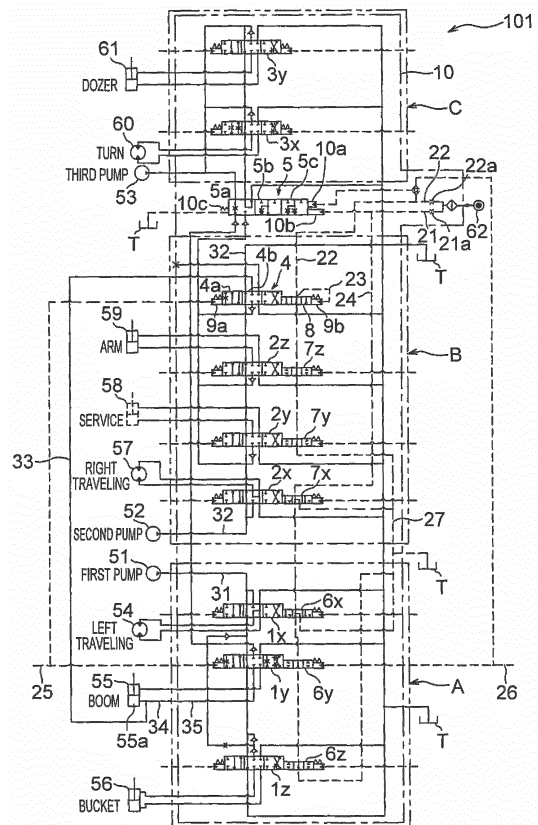


FIG. 1

Description

TECHNICAL FIELD

[0001] The present invention relates to a multiple direction switching valve for moving a plurality of hydraulic actuators mounted on a construction equipment such as a hydraulic shovel.

BACKGROUND ART

[0002] Patent Document 1 discloses an invention related to a multiple direction switching valve of this type. In the multiple direction switching valve (hydraulic circuit) described in Patent Document 1, when a boom direction switching valve 5a is operated in a boom raising direction, a boom-acceleration direction switching valve 14a is simultaneously switched, to allow pressure oil to be supplied from a first hydraulic pump 1 and a second hydraulic pump 2 to a boom cylinder 5 (boom acceleration).

[0003] At this time, when an arm direction switching valve 8a is further operated so that an arm cylinder 8 is moved, the pressure oil is continuously supplied from the second hydraulic pump 2 to the boom cylinder 5 (boom acceleration is maintained).

[0004] Patent Document 1: JP2004-324208A

DISCLOSURE OF THE INVENTION

[0005] In order that the boom acceleration is stopped when the arm direction switching valve 8a is operated, there is considered a method in which a signal indicating that the arm direction switching valve 8a has been operated is inputted to the boom-acceleration direction switching valve 14a from outside (outside the multiple direction switching valve), and the boom-acceleration direction switching valve 14a is returned to its neutral position based on the signal. However, this method is disadvantageous in that it additionally needs an outside pipe.

[0006] The present invention has been made in view of the above circumstances. The object of the present invention is to provide a multiple direction switching valve capable of stopping acceleration of a first actuator upon operation of a second actuator, without adding any outside pipe.

[0007] The present invention is a multiple direction switching valve of a construction equipment, comprising a first circuit and a second circuit that are formed in a valve member block,

wherein:

the first circuit is supplied with pressure oil from a first pump, with a first direction switching valve being located on the first circuit;
the second circuit is supplied with pressure oil from a second pump, with a second direction switching valve being located on the second circuit;

the first direction switching valve is a valve that controls supply and discharge of the pressure oil from the first pump to the first actuator; and
the second direction switching valve is a valve that controls supply and discharge of the pressure oil from the second pump to the second actuator.

[0008] A first actuator accelerating valve is located in the valve member block, the first actuator accelerating valve having an accelerating position at which the pressure oil from the second pump is supplied to the first actuator, and a neutral position at which the pressure oil from the second pump is not supplied to the first actuator; and

a first actuator acceleration releasing mechanism is disposed in the valve member block, the first actuator acceleration releasing mechanism being configured to switch the first actuator accelerating valve from the accelerating position to the neutral position, when the second direction switching valve is operated.

[0009] In addition, the present invention is a multiple direction switching valve of a construction equipment, comprising a first circuit, a second circuit and a third circuit that are formed in a valve member block,

wherein:

the first circuit is supplied with pressure oil from a first pump, with a first direction switching valve being located on the first circuit;

the second circuit is supplied with pressure oil from a second pump, with a second direction switching valve being located on the second circuit;

the third circuit is supplied with pressure oil from a third pump, with a third direction switching valve being located on the third circuit;

the first direction switching valve is a valve that controls supply and discharge of the pressure oil from the first pump to the first actuator;

the second direction switching valve is a valve that controls supply and discharge of the pressure oil from the second pump to the second actuator; and

the third direction switching valve is a valve that controls supply and discharge of the pressure oil from the third pump to the third actuator.

[0010] A first actuator acceleration releasing mechanism is disposed in the valve member block, the first actuator acceleration releasing mechanism being configured to switch from flow of the pressure oil from the third pump to the first actuator to flow of the pressure oil from the third pump to the second actuator, when the second direction switching valve is operated.

[0011] The aforementioned two inventions have the unity of invention in that the first actuator acceleration releasing mechanism, which is activated when the second direction switching valve is operated, is provided in the valve member block.

[0012] According to the multiple direction switching

valve of the present invention, the acceleration of the first actuator can be stopped upon operation of the second actuator, without adding any outside pipe.

BRIEF DESCRIPTION OF THE DRAWINGS

[0013]

Fig. 1 is a hydraulic circuit diagram showing a multiple direction switching valve according to a first embodiment of the present invention.

Fig. 2 is a hydraulic circuit diagram showing a modification example of the multiple direction switching valve shown in Fig. 1.

Fig. 3 is a hydraulic circuit diagram showing a multiple direction switching valve according to a second embodiment of the present invention.

Fig. 4 is a hydraulic circuit diagram showing a modification example of the multiple direction switching valve shown in Fig. 3.

MODE FOR CARRYING OUT THE INVENTION

[0014] Embodiments for carrying out the present invention will be explained herebelow with reference to the drawings. Although the embodiments of a multiple direction switching valve for a hydraulic shovel is shown below, the multiple direction switching valve of the present invention can be applied to a construction equipment other than a hydraulic shovel.

(First Embodiment)

<Structure of Multiple Direction Switching Valve>

[0015] As shown in Fig. 1, a hydraulic shovel to which a multiple direction switching valve 101 is applied includes three pumps (hydraulic pumps) 51, 52 and 53. These three hydraulic pumps 51, 52 and 53 are driven by, e.g., an engine (not shown). In addition, the hydraulic shovel has hydraulic actuators, such as two traveling hydraulic motors 54 and 57, a boom hydraulic cylinder 55, a bucket hydraulic cylinder 56, an arm hydraulic cylinder 59, a turn hydraulic motor 60, a dozer hydraulic cylinder 61 and so on, which are mounted on necessary positions. In addition, an optional actuator 58 (service) may be mounted on the hydraulic shovel.

[0016] The left traveling hydraulic motor 54, the boom hydraulic cylinder 55 and the bucket hydraulic cylinder 56 are first actuators, operations of which are respectively controlled by a left traveling direction switching valve 1x, a boom direction switching valve 1y and a bucket direction switching valve 1z which are located on a first circuit A. These direction switching valves are spool valves of a hydraulic pilot type, and are sometimes referred to as control valves (this also applies to another direction switching valve described below). Pressure oil is supplied mainly from the first pump 51 to the respective

direction switching valves (first circuit A) located on the first circuit A.

[0017] The left traveling direction switching valve 1x, the boom direction switching valve 1y and the bucket direction switching valve 1z are first direction switching valves, respectively.

[0018] The right traveling hydraulic motor 57, the actuator 58 and the arm hydraulic cylinder 59 are second actuators, operations of which are respectively controlled by a right traveling direction switching valve 2x, a service direction switching valve 2y and an arm direction switching valve 2z which are located on a second circuit B. Pressure oil is supplied mainly from the second pump 52 to the respective direction switching valves (second circuit B) located on the second circuit B.

[0019] The right traveling direction switching valve 2x, the service direction switching valve 2y and the arm direction switching valve 2z are second direction switching valves, respectively.

[0020] In addition, the turn hydraulic motor 60 and the dozer hydraulic cylinder 61 are third actuators, operations of which are controlled by a turn direction switching valve 3x and a dozer direction switching valve 3y which are located on a third circuit C. Pressure oil is supplied from a third pump 53 to the turn direction switching valve 3x (third circuit C). Pressure oil is supplied mainly from the third pump 53 to the respective direction switching valve (third circuit C) located on the third circuit C.

[0021] The turn direction switching valve 3x and the dozer direction switching valve 3y are third direction switching valves, respectively.

[0022] The respective direction switching valves (1x to 1z, 2x to 2z, 3x and 3y) and the respective circuits (A, B, C) are disposed in a valve member block 10.

<Boom Accelerating Valve (First Actuator Accelerating Valve)>

[0023] A boom accelerating valve 4 (first actuator accelerating valve) is located on the second circuit B in the valve member block 10. When the pressure oil from the second pump 52 is supplied to a cylinder chamber 55a on a boom raising side of the boom hydraulic cylinder 55, the boom accelerating valve 4 accelerates an operation for raising the boom.

[0024] The boom accelerating valve 4 is located in an unloading path 32, which extends from the second pump 52 to a tank T, at a position on a downstream side of the arm direction switching valve 2z. The boom accelerating valve 4 may be located in the unloading path 32 at a position on an upstream side of the arm direction switching valve 2z.

[0025] The structure of the boom accelerating valve 4 is explained. The boom accelerating valve 4 is a three-position spool valve of a hydraulic pilot type, which includes an accelerating position 4a and a neutral position 4b. The accelerating position 4a is a position at which the pressure oil from the second pump 52 is supplied to

the cylinder chamber 55a on the boom raising side of the boom hydraulic cylinder 55. The neutral position 4b is a position at which the pressure oil from the second pump 52 is not supplied to the boom hydraulic cylinder 55. A sub valve 8 is integrally provided on the boom accelerating valve 4. A pilot port 9a (pilot chamber 9a) is disposed on one side of the boom accelerating valve 4, and a pilot port 9b (pilot chamber 9b) is disposed on the other side thereof (on the side of the sub valve 8).

[0026] In a condition where pilot pressure is not introduced to any of the pilot ports 9a and 9b, the boom accelerating valve 4 takes the neutral position 4b. When the pilot pressure is introduced to the pilot port 9a, the boom accelerating valve 4 switches to the accelerating position 4a. When the pilot pressure is introduced to the pilot port 9b while the pilot pressure is being introduced to the pilot port 9a, the boom accelerating valve 4 returns to the neutral position 4b from the accelerating position 4a.

[0027] A boom-raising pilot line 25 is connected to the pilot port 9a of the boom accelerating valve 4. A boom actuation signal (pilot pressure) for raising the boom is introduced to the boom-raising pilot line 25.

<Merging Valve>

[0028] In the valve member block 10, there is provided a merging valve 5 that supplies the pressure oil from the third pump 53 to the first direction switching valve and/or the second direction switching valve.

[0029] The merging valve 5 is a three-position spool valve of a hydraulic pilot type, which includes a neutral position 5a, an arm merging position 5b (arm and service merging position) and an independent traveling position 5c. Two pilot ports, i.e., a first pilot port 10a and a second pilot port 10b are disposed on one side of the merging valve 5, and a spring 10c is disposed on the other side thereof.

[0030] In a condition where pilot pressure is not introduced to any of the first and second pilot ports 10a and 10b, the merging valve 5 takes the neutral position 5a by means of an elastic force of the spring 10c. When the pilot pressure is introduced to the first pilot port 10a, the merging valve 5 switches to the arm merging position 5b. When the pilot pressure is introduced to the second pilot port 10b, the merging valve 5 switches to the independent traveling position 5c.

[0031] A boom-lowering pilot line 26 is connected to the first pilot port 10a of the merging valve 5. A boom actuation signal (pilot pressure) for lowering the boom is introduced to the boom-lowering pilot line 26. In addition, an independent-traveling-signal (pilot pressure) pilot line 21 (independent traveling signal pilot path) connecting to the pilot pump 62 is connected to the second pilot port 10b of the merging valve 5.

[0032] A pilot line 22 (pilot path) is connected to the pilot pump 62 in such a manner that the pilot line 22 is diverged from the pilot line 21. A side bypass line 24 is

connected to the pilot line 21 at a position on the downstream side of the position at which the pilot line 22 is diverged from the pilot line 21. The pilot line 21 and the pilot line 22 are equipped with a throttle 21a and a throttle 22a, respectively.

[0033] The pilot line 22 runs through the sub valve 8 which cooperates with the boom accelerating valve 4, a sub valve 7z which cooperates with the arm direction switching valve 2z, and a sub valve 7y which cooperates with the service direction switching valve 2y, in this order. On the downstream side thereof, the pilot line 22 is connected to a draining line 27 in communication with a tank T.

[0034] The side bypass line runs through a sub valve 7x which cooperates with the right traveling direction switching valve 2x, a sub valve 6x which cooperates with the left traveling direction switching valve 1x, a sub valve 6y which cooperates with the boom direction switching valve 1y, and a sub valve 6z which cooperates with the bucket direction switching valve 1z, in this order. On the downstream side thereof, the side bypass line 24 is connected to the draining line 27 in communication with the tank T.

[0035] The sub valve 8 of the boom accelerating valve 4, the sub valve 7x of the right traveling direction switching valve 2x, and the sub valve 6x of the left traveling direction switching valve 1x are configured to be opened at all times, regardless of the positions of the boom accelerating valve 4 and the respective direction switching valves 2x and 1x. When the arm direction switching valve 2z, the service direction switching valve 2y, the boom direction switching valve 1y and the bucket direction switching valve 1z take their neutral positions, the sub valves 7z, 7y, 6y and 6z of the respective direction switching valves 2z, 2y, 1y and 1z are configured to be opened. On the other hand, when the arm direction switching valve 2z, the service direction switching valve 2y, the boom direction switching valve 1y and the bucket direction switching valve 1z take their actuation positions, the sub valves 7z, 7y, 6y and 6z of the respective direction switching valves 2z, 2y, 1y and 1z are configured to be closed.

<Boom Acceleration Releasing Mechanism (First Actuator Acceleration Releasing Mechanism)>

[0036] In the valve member block 10, there is provided a boom acceleration releasing mechanism (first actuator acceleration releasing mechanism) which switches (returns) the boom accelerating valve 4 from the accelerating position 4a to the neutral position 4b, when the arm direction switching valve 2z (second direction switching valve) is operated.

[0037] The boom acceleration releasing mechanism is composed of the sub valve 7z which cooperates with the arm direction switching valve 2z, the pilot line 22 connected to the pilot pump 62, and an acceleration releasing signal line 23 (acceleration releasing signal path) which

connects an upstream side of the sub valve 7z in the pilot line 22 to the pilot port 9b of the boom accelerating valve 4 (sub valve 8 which cooperates with the boom accelerating valve 4).

<Action and Function/Effect of Multiple Direction Switching Valve>

(1) Independent Boom Raising Operation

[0038] When a boom raising operation for independently raising the boom is carried out, a boom actuation signal (pilot pressure) for raising the boom is introduced from the pilot line 25 to the boom direction switching valve 1y and the pilot port 9a of the boom accelerating valve 4. Thus, the boom accelerating valve 4 switches from the neutral position 4b to the accelerating position 4a. Pressure oil from the second pump 52 is supplied from an accelerating path 33 to the cylinder chamber 55a on the boom raising side of the boom hydraulic cylinder 55. Therefore, the pressure oil is supplied to the boom hydraulic cylinder 55 from the first pump 51 and the second pump 52 (boom acceleration).

[0039] In this embodiment, a place to which the accelerating pressure oil from the second pump 52 is supplied is a supply and discharge path 34 that is outside the valve member block 10 with respect to the boom hydraulic cylinder 55. However, the place to which the accelerating oil from the second pump 52 may not be the supply and discharge path 34 (this also applies to a modification example and another embodiment described later).

[0040] For example, the place to which the accelerating pressure oil from the second pump 52 is supplied may be a place in the unloading path 31 of the first pump 51, which is on the upstream side of the boom direction switching valve 1y, through which the pressure oil flows from the first pump 51 to the boom hydraulic cylinder 55.

[0041] Further, the place to which the accelerating pressure oil from the second pump 52 is supplied may be a supply and discharge path 35 that is inside the valve member block 10 with respect to the boom hydraulic cylinder 55.

[0042] In a case where the place to which the accelerating pressure oil from the second pump 52 is supplied is the unloading path 31 of the first pump 51, or the supply and discharge path 35 that is inside the valve member block 10 with respect to the boom hydraulic cylinder 55, the accelerating path 33 can be formed only inside the valve member block 10. By forming the accelerating path 33 only inside the valve member block 10, the number of outside pipes can be reduced (this also applies to a modification example and another embodiment described later).

(2) Independent Boom Raising Operation + Arm Operation

[0043] When the arm direction switching valve 2z is

operated during the independent boom raising operation, the sub valve 7z, which cooperates with the arm direction switching valve 2z, is closed, so that the sub valve 7z shuts off the pilot line 22. Thus, the upstream side of the sub valve 7z in the pilot line 22 has the pilot pressure. Thus, the pilot pressure is introduced from the acceleration releasing signal line 23 to the pilot port 9b of the boom accelerating valve 4 (sub valve 8 which cooperates with the boom accelerating valve 4). As a result, the boom accelerating valve 4 returns to the neutral position 4b from the accelerating position 4a.

[0044] Thus, the pressure oil from the second pump 52 is not supplied to the boom hydraulic cylinder 55 any more, so that the boom hydraulic cylinder 55 is operated by means of the pressure oil from the first pump 51 (stop of boom acceleration). At this time, since the merging valve 5 takes the arm merging position 5b, the arm hydraulic cylinder 59 is operated by means of the pressure oil from the second pump 52 and the third pump 53.

(3) Function/Effect

[0045] According to the multiple direction switching valve 101 in this embodiment, since the boom acceleration releasing mechanism is formed inside the valve member block 10, the acceleration of the boom hydraulic cylinder 55 (first actuator) can be stopped upon operation of the arm hydraulic cylinder 59 (second actuator), without adding any outside pipe.

[0046] In a case where a path is structured such that a bucket actuation signal (pilot pressure), instead of the boom actuation signal, is introduced to the pilot port 9a of the accelerating valve 4, and that the pressure oil from the accelerating valve 4 is supplied to the bucket hydraulic cylinder 56, instead of the boom hydraulic cylinder 55, an acceleration releasing mechanism, which is composed of the sub valve 7z, the pilot line 22 and the acceleration releasing signal line 23 (acceleration releasing signal path), serves as a bucket acceleration releasing mechanism. Namely, the first actuator acceleration releasing mechanism of the multiple direction switching valve of the present invention may not be the boom acceleration releasing mechanism shown in this embodiment, but may be the bucket acceleration releasing mechanism (this also applies to a modification example and another embodiment described later).

[0047] In the above description about the action of the multiple direction switching valve, when the arm direction switching valve 2z is operated (arm is operated) during the independent boom raising operation, the boom acceleration stops. However, when the service direction switching valve 2y is operated (service is operated) during the independent boom raising operation, the boom accelerating valve 4 returns to the neutral position 4b from the accelerating position 4a, whereby the boom acceleration stops (this also applies to a modification example and another embodiment described later).

[0048] That is to say, according to the multiple direction

switching valve of the present invention, due to the first actuator acceleration releasing mechanism disposed in the valve member block, the acceleration of the first actuator can be stopped upon operation of the second actuator, without adding any outside pipe.

[0049] Herein, the boom acceleration releasing mechanism (first actuator acceleration releasing mechanism) in this embodiment uses, as one of its constituent elements, the sub valve 7z which cooperates with the arm direction switching valve 2z (second direction switching valve). With the use of the sub valve which cooperates with the second direction switching valve, generation of the acceleration releasing signal for returning the boom accelerating valve 4 (first actuator accelerating valve) to the neutral position 4b from the accelerating position 4a can be facilitated.

[0050] In addition, in this embodiment, the pilot line 22, which is one of the constituent elements of the boom acceleration releasing mechanism (first actuator acceleration releasing mechanism), is diverged from the independent traveling signal pilot path (pilot line 21) connecting to the pilot pump 62. By diverging the pilot line 22 from the existing pilot line 21, increase in size of the valve member block 10 can be prevented.

(Modification Example)

[0051] A multiple direction switching valve 102 according to a modification example of the first embodiment is explained with reference to Fig. 2. A main difference between the first embodiment shown in Fig. 1 and the modification example shown in Fig. 2 is a diverging point (upstream end) of the pilot line 22. Although the structure (circuit structure) of the merging valve 5 slightly differs between the first embodiment shown in Fig. 1 and the modification example shown in Fig. 2, explanation thereof is omitted. The functions of the neutral position 5a, the arm merging position 5b (arm and service merging position) and the independent traveling position 5c of the merging valve 5 shown in Fig. 2 are substantially the same as those of the merging valve 5 shown in Fig. 1.

[0052] Connected to the first pilot port 10a of the merging valve 5 in this modification example is a merger switching signal (pilot pressure) pilot line 25 (merger switching signal pilot path) connecting to the pilot pump 62.

[0053] In this modification example, the pilot line 22 (pilot path) is connected to the pilot pump 62 in such a manner that the pilot line 22 is diverged from the pilot line 25. The pilot line 25 is equipped with a throttle 25a.

[0054] Similarly to the first embodiment, the boom acceleration releasing mechanism (first actuator acceleration releasing mechanism) is composed of the sub valve 7z which cooperates with the arm direction switching valve 2z, the pilot line 22 connected to the pilot pump 62, and an acceleration releasing signal line 23 (acceleration releasing signal path) which connects the upstream side of the sub valve 7z in the pilot line 22 to the pilot port 9b

of the boom accelerating valve 4 (sub valve 8 which cooperates with the boom accelerating valve 4).

<Function/Effect>

[0055] Since motions of the respective members of the multiple direction switching valve 102 in the boom acceleration during the independent boom raising operation and the stop of boom acceleration during the independent boom raising operation + the arm operation are the same as the motions of the respective members of the multiple direction switching valve 101 in the first embodiment, explanation thereof is omitted.

[0056] In this modification example, the pilot path diverges the pilot line 22, which is one of the constituent elements of the boom acceleration releasing mechanism (first actuator acceleration releasing mechanism), from the merger switching signal pilot path (pilot line 25) connecting to the pilot pump 62. By diverging the pilot line 22 from the existing pilot line 25, increase in size of the valve member block 10 can be prevented.

(Second Embodiment)

<Structure of Multiple Direction Switching Valve>

[0057] A multiple direction switching valve 103 in a second embodiment is explained with reference to Fig. 3. A difference between the modification example of the first embodiment shown in Fig. 2 and the second embodiment shown in Fig. 3 is a location of the accelerating valve 4. In this embodiment, the accelerating valve 4 is located on a third circuit C in a valve member block 10.

[0058] The boom accelerating valve 4 is located on an unloading path 36, which extends from a third pump 53 to a tank T, at a position on a downstream side of a turn direction switching valve 3x. The boom accelerating valve 4 may be located on the unloading path 36 at a position on an upstream side of the turn direction switching valve 3x, or at a position on the upstream side of a dozer direction switching valve 3y.

[0059] The boom accelerating valve 4 is a three-position spool valve of a hydraulic pilot type, which includes an accelerating position 4a and a second accelerating position 4b. The second accelerating position 4b is also a neutral position. The accelerating position 4a is a position at which pressure oil from the third pump 53 is supplied to a cylinder chamber 55a on a boom raising side of a boom hydraulic cylinder 55. The second accelerating position 4b is a position at which the pressure oil from the third pump 53 is supplied to the second actuator (arm hydraulic cylinder 59, actuator 58 (service)) through a merging valve 5. A sub valve 8 is integrally provided on the boom accelerating valve 4. A pilot port 9a is disposed on one side of the boom accelerating valve 4, and a pilot port 9b (pilot chamber 9b) is disposed on the other side thereof (on the side of the sub valve 8).

[0060] In a condition where pilot pressure is not intro-

duced to any of the pilot ports 9a and 9b, the boom accelerating valve 4 takes the second accelerating position 4b. When the pilot pressure is introduced to the pilot port 9a, the boom accelerating valve 4 switches to the accelerating position 4a. When the pilot pressure is introduced to the pilot port 9b while the pilot pressure is being introduced to the pilot port 9a, the boom accelerating valve 4 returns to the second accelerating position 4b from the accelerating position 4a.

[0061] A boom-raising pilot line 25 is connected to the pilot port 9a of the accelerating valve 4. A boom actuation signal (pilot pressure) for raising the boom is introduced to the boom-raising pilot line 25.

[0062] In the valve member block 10, there is provided a boom acceleration releasing mechanism (first actuator acceleration releasing mechanism) which switches from the flow of the pressure oil from the third pump 53 to the boom hydraulic cylinder 55 (first actuator), to flow of the pressure oil from the third pump 53 to the arm hydraulic cylinder 59 (second actuator), when the arm direction switching valve 2z (second direction switching valve) is operated.

[0063] In this embodiment, when the arm direction switching valve 2z (second direction switching valve) is operated, the boom acceleration releasing mechanism (first actuator acceleration releasing mechanism) switches (returns) the accelerating valve 4 from the accelerating position 4a to the second accelerating position 4b.

[0064] The boom acceleration releasing mechanism is composed of a sub valve 7z which cooperates with an arm direction switching valve 2z, a pilot line 22 connected to a pilot pump 62, and an acceleration releasing signal line 23 (acceleration releasing signal path) which connects the upstream side of the sub valve 7z in the pilot line 22 to the pilot port 9b of the accelerating valve 4 (sub valve 8 which cooperates with the boom accelerating valve 4).

<Action and Function/Effect of Multiple Direction Switching Valve>

(1) Independent Boom Raising Operation

[0065] When a boom raising operation for independently raising the boom is carried out, a boom actuation signal (pilot pressure) for raising the boom is introduced from the pilot line 25 to a boom direction switching valve 1y and the pilot port 9a of the accelerating valve 4. Thus, the accelerating valve 4 switches from the second accelerating position 4b to the accelerating position 4a. Pressure oil from the third pump 53 is supplied from an accelerating path 33 to the cylinder chamber 55a on the boom raising side of the boom hydraulic cylinder 55. Therefore, the pressure oil is supplied to the boom hydraulic cylinder 55 from the first pump 51 and the third pump 53 (boom acceleration).

(2) Independent Boom Raising Operation + Arm Operation

[0066] When the arm direction switching valve 2z is operated during the independent boom raising operation, the sub valve 7z, which cooperates with the arm direction switching valve 2z, is closed, so that the sub valve 7z shuts off the pilot line 22. Thus, the upstream side of the sub valve 7z in the pilot line 22 has the pilot pressure. Thus, the pilot pressure is introduced from the acceleration releasing signal line 23 to the pilot port 9b of the accelerating valve 4 (sub valve 8 which cooperates with the accelerating valve 4). As a result, the boom accelerating valve 4 returns to the second accelerating position 4b from the accelerating position 4a.

[0067] Thus, the pressure oil from the second pump 52 is not supplied to the boom hydraulic cylinder 55 any more, so that the boom hydraulic cylinder 55 is operated by means of the pressure oil from the first pump 51 (stop of boom acceleration). At this time, since the merging valve 5 takes an arm merging position 5b, the arm hydraulic cylinder 59 is operated by means of the pressure oil from the second pump 52 and the third pump 53.

(3) Function/Effect

[0068] According to the multiple direction switching valve 103 in this embodiment, since the boom acceleration releasing mechanism is formed inside the valve member block 10, the acceleration of the boom hydraulic cylinder 55 (first actuator) can be stopped upon operation of the arm hydraulic cylinder 59 (second actuator), without adding any outside pipe.

[0069] That is to say, according to the multiple direction switching valve of the present invention, due to the first actuator acceleration releasing mechanism disposed in the valve member block, the acceleration of the first actuator can be stopped upon operation of the second actuator, without adding any outside pipe.

[0070] As described above, in this embodiment, the accelerating valve 4 is located on the third circuit C in the valve member block 10. Since the other structure is the same as those of the multiple direction switching valves 101 and 102 in the first embodiment and its modification example, the multiple direction switching valve 103 in this embodiment has the same effect as those of the multiple direction switching valves 101 and 102.

[0071] In this embodiment, similarly to the modification example of the first embodiment, the pilot line 22 (pilot path) is connected to the pilot pump 62 in such a manner that the pilot line 22 is diverged from the pilot line 25 (merger switching signal pilot path) connecting to the pilot pump 62. However, as in the first embodiment, the pilot line 22, which is one of the constituent elements of the boom acceleration releasing mechanism (first actuator acceleration releasing mechanism), may be diverged from the pilot line 21 (independent traveling signal pilot path, see Fig. 1) connecting to the pilot pump 62.

(Modification Example)

[0072] A multiple direction switching valve 104 according to a modification example of the second embodiment is explained with reference to Fig. 4. The second embodiment shown in Fig. 3 and the modification example shown in Fig. 4 are common with each other in that, when the second direction switching valve is operated, the flow of the pressure oil from the third pump 53 to the first actuator is switched to the flow of the pressure oil from the third pump 53 to the second actuator, by means of the first actuator acceleration releasing mechanism disposed in the valve member block 10. The second embodiment shown in Fig. 3 and the modification example shown in Fig. 4 differ from each other in that the multiple direction switching valve 104 (modification example) shown in Fig. 4 is not provided with a valve dedicated to acceleration. In the multiple direction switching valve 104 shown in Fig. 4, a merging valve 5 has a function of the accelerating valve 4 shown in Fig. 3. Namely, the merging valve 5 also serves as the accelerating valve 4, to provide a accelerating and merging valve. In other words, the merging valve 5 is an accelerating valve having the merging valve function.

[0073] As shown in Fig. 4, the merging valve 5 is a four-position spool valve of a hydraulic pilot type, which includes an accelerating position 5a, a neutral position 5b, an arm merging position 5c (arm and service merging position) and an independent traveling position 5d. Two pilot ports, i.e., a first pilot port 10a and a second pilot port 10b are disposed on one side of the merging valve 5, and a first-actuator accelerating pilot port 10d is disposed on the other side thereof.

[0074] The accelerating position 5a is a position at which pressure oil from the third pump 53 is supplied to a cylinder chamber 55a on a boom raising side of a boom hydraulic cylinder 55. The arm merging position 5c is a position at which the pressure oil from the third pump 53 is supplied to a second actuator (arm hydraulic cylinder 59, actuator 58 (service)). In other words, the arm merging position 5c is the second accelerating position of the accelerating valve 4 in the second embodiment. Namely, the arm merging position 5c corresponds to the second accelerating position of the accelerating valve 4 in the second embodiment.

[0075] In a condition where pilot pressure is not introduced to any of the pilot ports 10a, 10b and 10d, the merging valve 5 takes the neutral position 5b. When the pilot pressure is introduced to the pilot port 10d, the merging valve 5 switches to the accelerating position 5a. When the pilot pressure is introduced to the first pilot port 10a while the pilot port is being introduced to the pilot port 10d, the merging valve 5 switches from the accelerating position 5a to the arm merging position 5c.

[0076] When the pilot pressure is introduced to the first pilot port 10a while no pilot pressure is introduced to the pilot port 10d, the merging valve 5 switches from the neutral position 5b to the arm merging position 5c. When the

pilot pressure is introduced to the second pilot port 10b, the merging valve 5 switches to the independent traveling position 5d.

[0077] A boom-raising pilot line 25 is connected to the pilot port 10d of the merging valve 5. A boom actuation signal (pilot pressure) for raising the boom is introduced to the boom-raising pilot line 25.

[0078] In this modification example, when the arm direction switching valve 2z (second direction switching valve) is operated during the boom raising operation, the boom acceleration releasing mechanism (first actuator acceleration releasing mechanism) switches the merging valve 5 from the accelerating position 5a to the arm merging position 5c.

[0079] The boom acceleration releasing mechanism is composed of a sub valve 7z which cooperates with the arm direction switching valve 2z, and a pilot line 22 connected to a pilot pump 62. The pilot line 22 is connected to the pilot pump 62 in such a manner that the pilot line 22 is diverged from a pilot line 25 (merger switching signal pilot path) connecting to the pilot pump 62.

[0080] As in the first embodiment, the pilot line 22, which is one of the constituent elements of the boom acceleration releasing mechanism (first actuator acceleration releasing mechanism), may be diverged from the pilot line 21 (independent traveling signal pilot path, see Fig. 1) connecting to the pilot pump 62.

<Action and Function/Effect of Multiple Direction Switching Valve>

(1) Independent Boom Raising Operation

[0081] When a boom raising operation for independently raising the boom is carried out, a boom actuation signal (pilot pressure) for raising the boom is introduced from the pilot line 25 to a boom direction switching valve 1y and the pilot port 10d of the merging valve 5. Thus, the merging valve 5 switches from the neutral position 5b to the accelerating position 5a. Pressure oil from the third pump 53 is supplied from an accelerating path 37 to the cylinder chamber 55a on the boom raising side of the boom hydraulic cylinder 55. Therefore, the pressure oil is supplied to the boom hydraulic cylinder 55 from the first pump 51 and the third pump 53 (boom acceleration).

(2) Independent Boom Raising Operation + Arm Operation

[0082] When the arm direction switching valve 2z is operated during the independent boom raising operation, a sub valve 7z, which cooperates with the arm direction switching valve 2z, is closed, so that the sub valve 7z shuts off the pilot line 22. Thus, the upstream side of the sub valve 7z in the pilot line 22 has the pilot pressure. Thus, the pilot pressure is introduced to the first pilot port 10a of the merging valve 5. As a result, the merging valve 5 switches from the accelerating position 5a to the arm

merging position 5c.

[0083] Thus, the pressure oil from the third pump 53 is not supplied to the boom hydraulic cylinder 55 any more, so that the boom hydraulic cylinder 55 is operated by means of the pressure oil from the first pump 51 (stop of boom acceleration). At this time, the arm hydraulic cylinder 59 is operated by means of the pressure oil from the second pump 52 and the third pump 53.

(3) Function/Effect

[0084] According to the multiple direction switching valve 104 in this modification example, since there is provided the valve having both the accelerating valve function and the merging valve function, increase in size of the valve member block 10 can be further prevented.

[0085]

- 1x: Left traveling direction switching valve (first direction switching valve) 20
- 1y: Boom direction switching valve (first direction switching valve)
- 1z: Bucket direction switching valve (first direction switching valve)
- 2x: Right traveling direction switching valve (second direction switching valve) 25
- 2y: Service direction switching valve (second direction switching valve)
- 2z: Arm direction switching valve (second direction switching valve) 30
- 3x: Turn direction switching valve (third direction switching valve)
- 3y: Dozer direction switching valve (third direction switching valve)
- 4: Boom accelerating valve (first actuator accelerating valve) 35
- 4a: Accelerating position
- 4b: Neutral position
- 5: Merging valve
- 10: Valve member block 40
- 51: First pump
- 52: Second pump
- 53: Third pump
- 54: Left traveling hydraulic motor (first actuator)
- 55: Boom hydraulic cylinder (first actuator) 45
- 56: Bucket hydraulic cylinder (first actuator)
- 57: Right traveling hydraulic motor (second actuator)
- 58: Actuator (second actuator)
- 59: Arm hydraulic cylinder (second actuator)
- 60: Turn hydraulic motor (third actuator) 50
- 61: Dozer hydraulic cylinder (third actuator)
- 101: Multiple direction switching valve
- A: First circuit
- B: Second circuit
- C: Third circuit 55

Claims

1. A multiple direction switching valve of a construction equipment, comprising a first circuit and a second circuit that are formed in a valve member block, wherein:

the first circuit is supplied with pressure oil from a first pump, with a first direction switching valve being located on the first circuit;
the second circuit is supplied with pressure oil from a second pump, with a second direction switching valve being located on the second circuit;
the first direction switching valve is a valve that controls supply and discharge of the pressure oil from the first pump to the first actuator;
the second direction switching valve is a valve that controls supply and discharge of the pressure oil from the second pump to the second actuator;
a first actuator accelerating valve is located in the valve member block, the first actuator accelerating valve having an accelerating position at which the pressure oil from the second pump is supplied to the first actuator, and a neutral position at which the pressure oil from the second pump is not supplied to the first actuator; and
a first actuator acceleration releasing mechanism is disposed in the valve member block, the first actuator acceleration releasing mechanism being configured to switch the first actuator accelerating valve from the accelerating position to the neutral position, when the second direction switching valve is operated.

2. The multiple direction switching valve of a construction equipment according to claim 1, wherein:

the first actuator acceleration releasing mechanism includes a sub valve that cooperates with the second direction switching valve, a pilot path connected to a pilot pump, and an acceleration releasing signal path that connects an upstream side of the sub valve in the pilot path to a pilot port of the first actuator accelerating valve; and
when the second direction switching valve is operated, the sub valve shuts off the pilot path so that the upstream side of the sub valve has a pilot pressure, whereby the first actuator accelerating valve switches from the accelerating position to the neutral position.

3. The multiple direction switching valve of a construction equipment according to claim 2, wherein the pilot path is diverged from an independent traveling signal pilot path connecting to the pilot pump.

4. The multiple direction switching valve of a construction equipment according to claim 2, wherein the pilot path is diverged from a merger switching signal pilot path connecting to the pilot pump.

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5. A multiple direction switching valve of a construction equipment, comprising a first circuit, a second circuit and a third circuit that are formed in a valve member block, wherein:

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the first circuit is supplied with pressure oil from a first pump, with a first direction switching valve being located on the first circuit;

the second circuit is supplied with pressure oil from a second pump, with a second direction switching valve being located on the second circuit;

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the third circuit is supplied with pressure oil from a third pump, with a third direction switching valve being located on the third circuit;

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the first direction switching valve is a valve that controls supply and discharge of the pressure oil from the first pump to the first actuator;

the second direction switching valve is a valve that controls supply and discharge of the pressure oil from the second pump to the second actuator;

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the third direction switching valve is a valve that controls supply and discharge of the pressure oil from the third pump to the third actuator; and a first actuator acceleration releasing mechanism is disposed in the valve member block, the first actuator acceleration releasing mechanism being configured to switch from flow of the pressure oil from the third pump to the first actuator to flow of the pressure oil from the third pump to the second actuator, when the second direction switching valve is operated.

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6. The multiple direction switching valve of a construction equipment according to claim 5, wherein:

an accelerating valve is located in the valve member block, the accelerating valve having an accelerating position at which the pressure oil from the third pump is supplied to the first actuator, and a second accelerating position at which the pressure oil from the third pump is supplied to the second actuator; and

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when the second direction switching valve is operated, the accelerating valve is switched from the accelerating position to the second accelerating position, by the first actuator acceleration releasing mechanism.

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7. The multiple direction switching valve of a construction equipment according to claim 6, wherein:

the first actuator acceleration releasing mechanism includes a sub valve that cooperates with the second direction switching valve, a pilot path connected to a pilot pump, and an acceleration releasing signal path that connects an upstream side of the sub valve in the pilot path to a pilot port of the accelerating valve; and when the second direction switching valve is operated, the sub valve shuts off the pilot path so that the upstream side of the sub valve has a pilot pressure, whereby the accelerating valve switches from the accelerating position to the second accelerating position.

8. The multiple direction switching valve of a construction equipment according to claim 7, wherein the pilot path is diverged from an independent traveling signal pilot path connecting to the pilot pump.

9. The multiple direction switching valve of a construction equipment according to claim 7, wherein the pilot path is diverged from a merger switching signal pilot path connecting to the pilot pump.

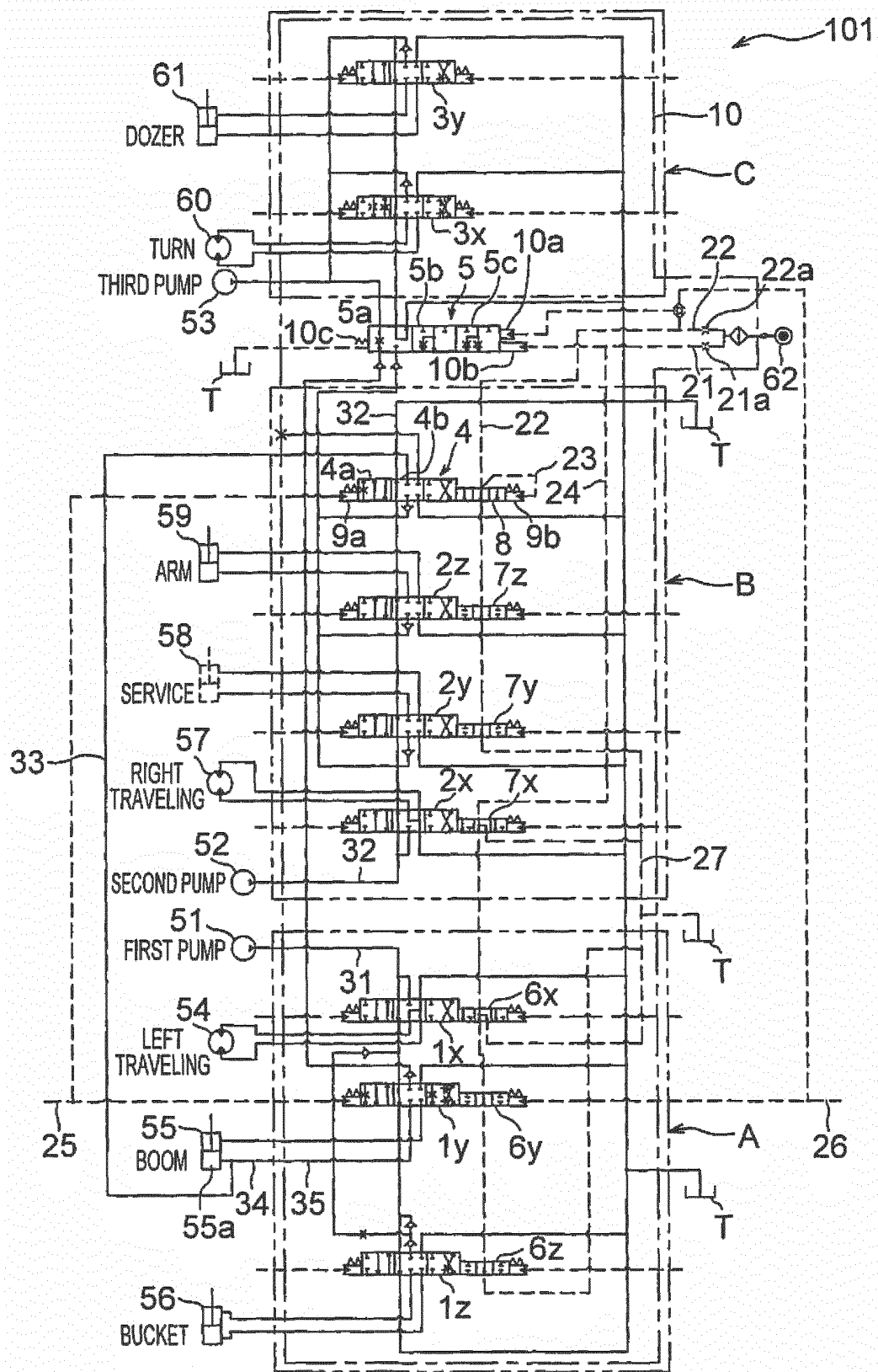


FIG. 1

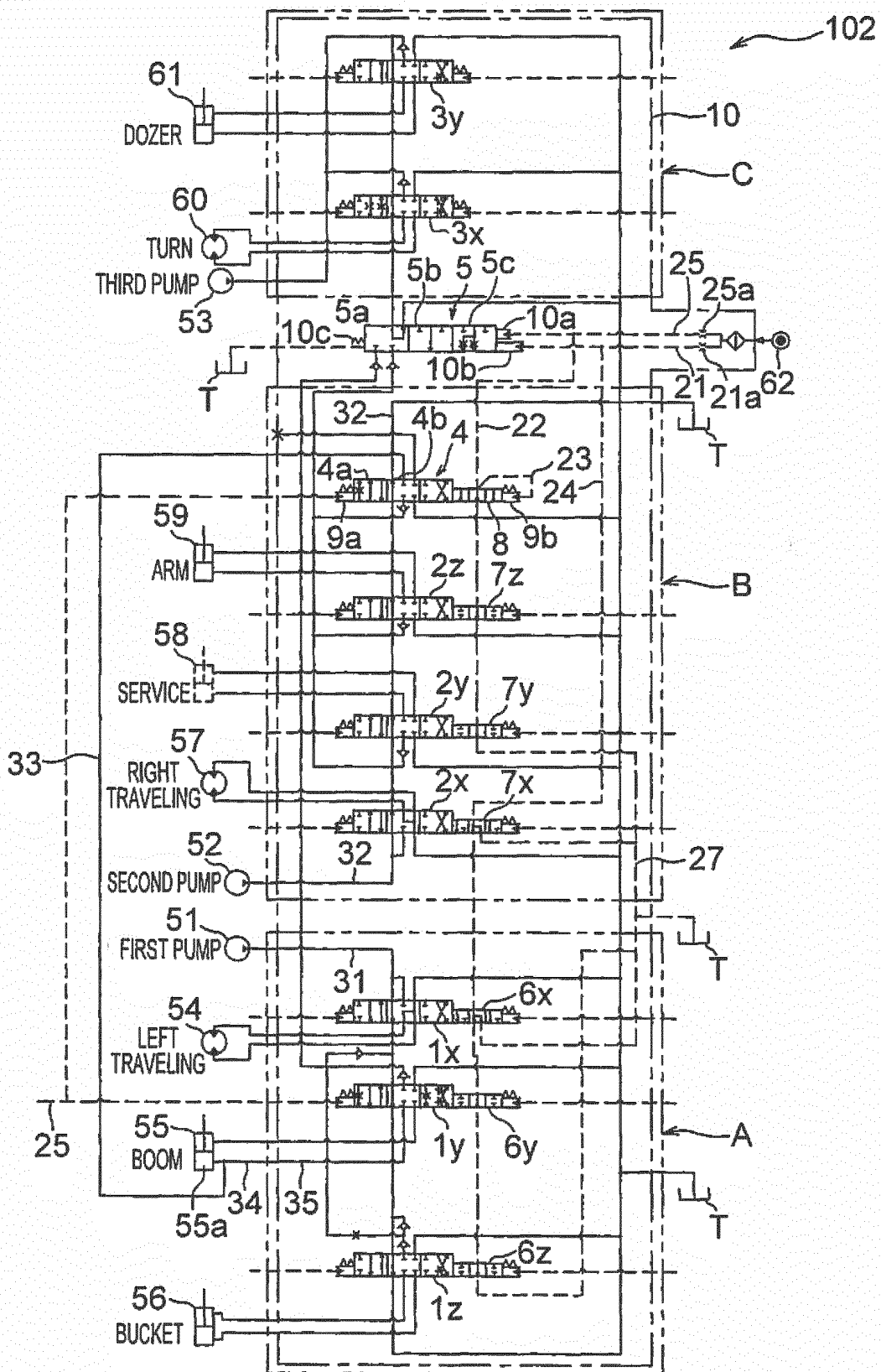


FIG. 2

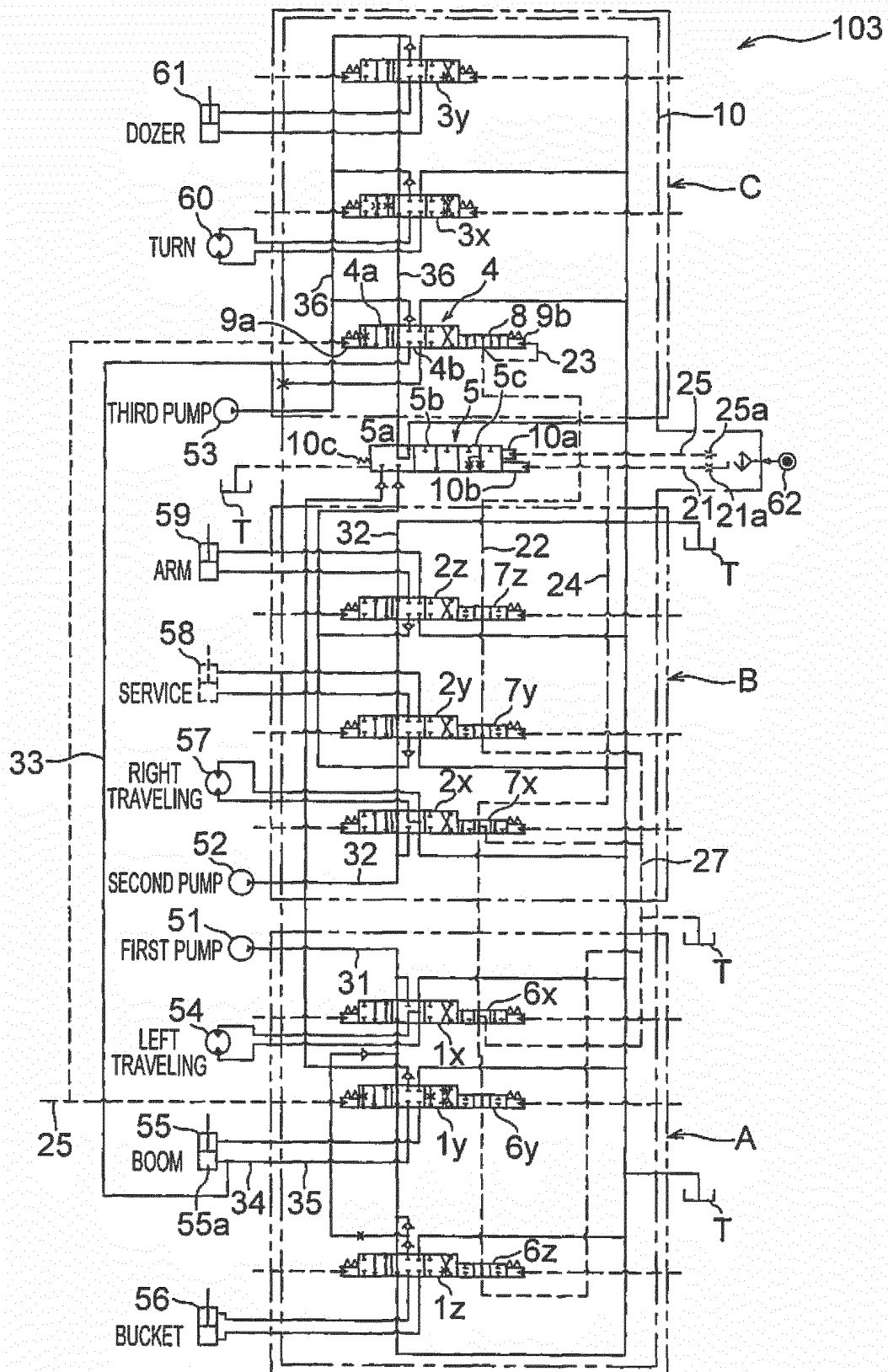


FIG. 3

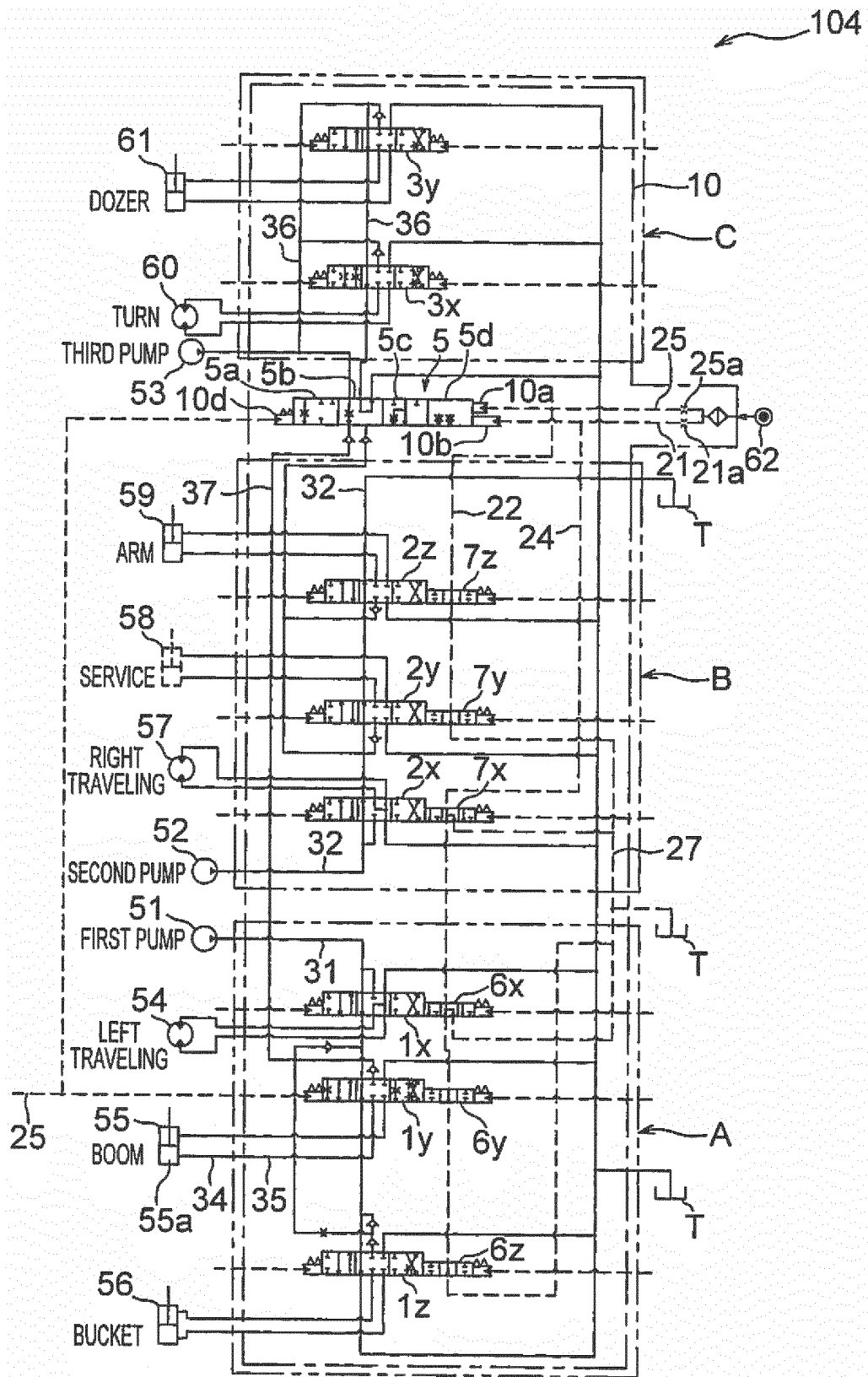


FIG. 4

INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2014/070728

A. CLASSIFICATION OF SUBJECT MATTER

F15B11/00(2006.01)*i*, *E02F9/22*(2006.01)*i*, *F15B11/02*(2006.01)*i*, *F15B11/04*(2006.01)*i*, *F15B11/17*(2006.01)*i*

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

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

F15B11

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

Jitsuyo Shinan Koho 1922-1996 Jitsuyo Shinan Toroku Koho 1996-2014
Kokai Jitsuyo Shinan Koho 1971-2014 Toroku Jitsuyo Shinan Koho 1994-2014

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

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y A	JP 2005-299376 A (Kobelco Construction Machinery Co., Ltd.), 27 October 2005 (27.10.2005), paragraphs [0036] to [0046]; fig. 1 & US 2005/0204734 A1 & EP 1577447 A1	1 2-9
Y A	JP 2001-355602 A (Hitachi Construction Machinery Co., Ltd.), 26 December 2001 (26.12.2001), paragraphs [0025] to [0049]; fig. 1 to 4 (Family: none)	1 2-9
X A	JP 2006-200179 A (Nabtesco Corp.), 03 August 2006 (03.08.2006), paragraphs [0015] to [0030]; fig. 1, 2 & KR 10-2006-0084349 A	5, 6 1-4, 7-9

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

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Date of the actual completion of the international search
02 October, 2014 (02.10.14)

Date of mailing of the international search report
14 October, 2014 (14.10.14)

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INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2014/070728

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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A	JP 4-25603 A (Zexel Corp.), 29 January 1992 (29.01.1992), entire text; fig. 1 & US 5115835 A & EP 439166 A1	1-4
A	JP 2001-295803 A (Hitachi Construction Machinery Co., Ltd.), 26 October 2001 (26.10.2001), entire text; fig. 1 to 4 (Family: none)	1-4
A	JP 2011-99472 A (Kayaba Industry Co., Ltd.), 19 May 2011 (19.05.2011), paragraphs [0011] to [0022]; fig. 1 (Family: none)	2, 7
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A	JP 2013-148175 A (Kobelco Construction Machinery Co., Ltd.), 01 August 2013 (01.08.2013), paragraphs [0074] to [0102]; fig. 1, 2 (Family: none)	5-9

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REFERENCES CITED IN THE DESCRIPTION

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