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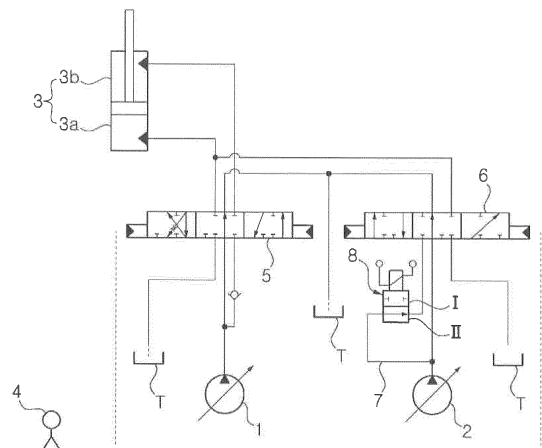
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(54) **HYDRAULIC CONTROL SYSTEM FOR CONSTRUCTION MACHINERY**

(57) A hydraulic control system for a construction machine is disclosed, which can operate an arm cylinder and a bucket cylinder by supplying hydraulic fluid from respective hydraulic pumps to the arm cylinder and the bucket cylinder during a combined operation, such as an excavating work, in which an arm joystick and a bucket joystick are simultaneously operated. The hydraulic control system includes a first arm control valve installed in a flow path between the first hydraulic pump and the arm cylinder and shifted to control a start, stop, and direction change of the arm cylinder in response to an operation of the arm joystick, a second arm control valve installed in a flow path between the second hydraulic pump and the arm cylinder and shifted to make discharged hydraulic fluid of the second hydraulic pump join hydraulic fluid of the arm cylinder to be supplied if a control signal according to the operation of the arm joystick exceeds a set value, a bucket control valve installed in a path between the second hydraulic pump and the bucket cylinder and shifted to control a start, stop, and direction change of the bucket cylinder in response to the operation of the bucket joystick, and a confluence cutoff proportional valve installed in a path between the second hydraulic pump and the second arm control valve.

[Fig. 2]



Description**TECHNICAL FIELD**

5 **[0001]** The present invention relates to a hydraulic control system for a construction machine. More particularly, the present invention relates to a hydraulic control system for a construction machine, which can operate an arm cylinder and a bucket cylinder by supplying hydraulic fluid from respective hydraulic pumps to the arm cylinder and the bucket cylinder during a combined operation such as an excavating work in which an arm joystick and a bucket joystick are simultaneously operated.

BACKGROUND ART

10 **[0002]** A hydraulic control system for a construction machine in the related art, as illustrated in Fig. 1, includes a pair of first and second variable displacement hydraulic pumps (hereinafter referred to as "hydraulic pumps") 1 and 2; an arm cylinder 3 connected to the first hydraulic pump 1; a bucket cylinder (not illustrated) connected to the second hydraulic pump 2; an arm joystick 4 and a bucket joystick (not illustrated) outputting control signals according to operation amounts; a first arm control valve 5 installed in a flow path between the first hydraulic pump 1 and the arm cylinder 3 and shifted to control a start, stop, and direction change of the arm cylinder 3 in response to an operation of the arm joystick 4; a second arm control valve 6 installed in a flow path between the second hydraulic pump 2 and the arm cylinder 3 and shifted to make discharged hydraulic fluid of the second hydraulic pump 2 join the hydraulic fluid of the arm cylinder 3 to be supplied if the control signal according to the operation of the arm joystick 4 exceeds a set value; and a bucket control valve (not illustrated) installed in a path between the second hydraulic pump 2 and the bucket cylinder (not illustrated) and shifted to control a start, stop, and direction change of the bucket cylinder in response to the operation of the bucket joystick.

25 **[0003]** Accordingly, in the case where an excavating work is performed by simultaneously operating an arm and a bucket, the first arm control valve 5 is shifted in the rightward direction in the drawing in accordance with a control signal that is generated through the operation of the arm joystick 4 to perform arm-in driving, and thus hydraulic fluid that is discharged from the first hydraulic pump 1 is supplied to a large chamber 3a of the arm cylinder 3 via the shifted first arm control valve 5. At this time, the hydraulic fluid that returns from a small chamber 3b of the arm cylinder 3 is fed back to a hydraulic tank T via the first arm control valve 5.

30 **[0004]** If an operation amount of the arm joystick 4 exceeds a predetermined value, the second arm control valve 6 is shifted in the leftward direction in the drawing, and thus the hydraulic fluid from the second hydraulic pump 2 joins hydraulic fluid of a large chamber 2a of the arm cylinder 2 via the shifted second arm control valve 6 to be supplied.

35 **[0005]** On the other hand, although not illustrated in the drawing, the bucket cylinder may be driven by the hydraulic fluid that is supplied from the second hydraulic pump 2 due to the operation of the bucket joystick.

[0006] Accordingly, during the combined operation in which the arm and the bucket are simultaneously operated, the arm cylinder 3 may be driven by the hydraulic fluids discharged from the first and second hydraulic pumps 1 and 2 to join each other.

40 **[0007]** As described above, in the case where the excavating work is performed by simultaneously operating the arm and the bucket (in general, a load that is generated on the side of the arm cylinder 3 is relatively higher than a load that is generated on the side of the bucket cylinder), the hydraulic fluids discharged from the first and second hydraulic pumps 1 and 2 join each other and are supplied to the arm cylinder 3 to drive the arm cylinder, and the hydraulic fluid discharged from the second hydraulic pump 2 is supplied only to the bucket cylinder to drive the bucket cylinder. At this time, even in the case where the load is generated on either side of the arm cylinder 3 and the bucket cylinder due to an external load that acts on the arm cylinder 3 or the bucket cylinder, the discharge pressures of the first and second hydraulic pumps 1 and 2 are generally increased. Due to this, a pressure loss occurs, and this exerts a bad influence on the fuel efficiency.

DISCLOSURE**TECHNICAL PROBLEM**

50 **[0008]** Therefore, the present invention has been made to solve the above-mentioned problems occurring in the related art, and one embodiment of the present invention is related to a hydraulic control system for a construction machine, which can prevent a pressure loss of hydraulic pumps by releasing a confluence function and making hydraulic fluids from the respective hydraulic pumps be supplied to an arm cylinder and a bucket cylinder, respectively, during an excavating work in which an arm and a bucket are simultaneously operated.

TECHNICAL SOLUTION

[0009] In accordance with an aspect of the present invention, there is provided a hydraulic control system for a construction machine, which includes first and second variable displacement hydraulic pumps; an arm cylinder connected to the first hydraulic pump; a bucket cylinder connected to the second hydraulic pump; an arm joystick and a bucket joystick configured to output control signals according to operation amounts thereof; a first arm control valve installed in a flow path between the first hydraulic pump and the arm cylinder and shifted to control a start, stop, and direction change of the arm cylinder in response to an operation of the arm joystick; a second arm control valve installed in a flow path between the second hydraulic pump and the arm cylinder and shifted to make discharged hydraulic fluid of the second hydraulic pump join hydraulic fluid of the arm cylinder to be supplied if the control signal according to the operation of the arm joystick exceeds a set value; a bucket control valve installed in a path between the second hydraulic pump and the bucket cylinder and shifted to control a start, stop, and direction change of the bucket cylinder in response to the operation of the bucket joystick; and a confluence cutoff proportional valve installed in a path between the second hydraulic pump and the second arm control valve and shifted to cut off confluence of the hydraulic fluid discharged from the second hydraulic pump with the discharged hydraulic fluid of the first hydraulic pump if discharge pressures of the first and second hydraulic pumps exceed a set value.

[0010] In accordance with another aspect of the present invention, there is provided a hydraulic control system including first and second variable displacement hydraulic pumps, an arm cylinder connected to the first hydraulic pump, a bucket cylinder connected to the second hydraulic pump, an arm joystick and a bucket joystick outputting control signals according to operation amounts thereof, a first arm control valve controlling hydraulic fluid supplied to the arm cylinder according to an operation of the arm joystick, a second arm control valve controlling the hydraulic fluid that is supplied from the second hydraulic pump to the arm cylinder if a control signal according to the operation of the arm joystick exceeds a set value, a bucket control valve controlling driving of the bucket cylinder according to an operation of the bucket joystick, and a confluence cutoff proportional valve making the hydraulic fluid of the second hydraulic pump join the hydraulic fluid of the first hydraulic pump if the arm cylinder is singly operated and cutting off a confluence function if the arm cylinder and the bucket cylinder are simultaneously operated, the hydraulic control system includes a first step of reading an arm-in control signal according to an operation amount of the arm joystick, a bucket-in control signal according to an operation amount of the bucket joystick, and discharge pressures of the first and second hydraulic pumps; a second step of determining whether the arm-in control signal exceeds one set value and whether the bucket-in control signal exceeds the one set value; a third step of determining whether the discharge pressure of the first hydraulic pump exceeds another set value and whether the discharge pressure of the second hydraulic pump exceeds the other set value; and a fourth step of releasing the confluence function by applying control signals that are in proportion to the arm-in control signal and the bucket-in control signal to the confluence cutoff proportional valve if the arm-in control signal and the bucket-in control signal exceed the one set value and the discharge pressures of the first and second hydraulic pumps exceed the other set value.

[0011] The confluence cutoff proportional valve may operate in a first state of cutting off a flow path when the arm joystick and the bucket joystick are simultaneously operated, and in a second state of connecting the flow path when the arm joystick is singly operated.

[0012] The confluence cutoff proportional valve may operate in a first section where movement amounts are controlled to be gradually increased in proportion to the operation amounts of the arm joystick and the bucket joystick to release the confluence function, in a second section where the confluence cutoff state is maintained according to the increase of the operation amounts of the arm joystick and the bucket joystick, and in a third section where movement amounts are controlled to be gradually decreased in reverse proportion to the operation amounts of the arm joystick and the bucket joystick to be shifted to the confluence function.

[0013] The confluence cutoff proportional valve may include a solenoid valve that is shifted to open/close the flow path in response to an input of an electric signal.

[0014] The confluence cutoff proportional valve may include an electro proportional control valve that is shifted to open/close the flow path according to an input of an electric signal.

ADVANTAGEOUS EFFECT

[0015] The hydraulic control system for a construction machine according to the aspects of the present invention as configured above has the following advantages.

[0016] When the excavating work is done by simultaneously operating the arm and the bucket, the hydraulic fluids are made to be supplied from the respective hydraulic pumps to the arm cylinder and the bucket cylinder, and thus pressure loss of the hydraulic pumps can be prevented to heighten the fuel efficiency.

BRIEF DESCRIPTION OF THE DRAWINGS

[0017] The above objects, other features and advantages of the present invention will become more apparent by describing the preferred embodiments thereof with reference to the accompanying drawings, in which:

- Fig. 1 is a hydraulic circuit diagram of a hydraulic control system for a construction machine in the related art;
 Fig. 2 is a hydraulic circuit diagram of a hydraulic control system for a construction machine according to an embodiment of the present invention;
 Fig. 3 is a flowchart illustrating a method for controlling a hydraulic control system for a construction machine according to an embodiment of the present invention; and
 Fig. 4 is a graph explaining the operation of a confluence cutoff proportional valve in a hydraulic control system for a construction machine according to an embodiment of the present invention.

BEST MODE

[0018] Hereinafter, preferred embodiments of the present invention will be described in detail with reference to the accompanying drawings. The matters defined in the description, such as the detailed construction and elements, are nothing but specific details provided to assist those of ordinary skill in the art in a comprehensive understanding of the invention, and the present invention is not limited to the embodiments disclosed hereinafter.

[0019] According to an embodiment of the present invention as illustrated in Fig. 2, a hydraulic control system for a construction machine includes first and second variable displacement hydraulic pumps (hereinafter referred to as "hydraulic pumps") 1 and 2; an arm cylinder 3 connected to the first hydraulic pump 1; a bucket cylinder (not illustrated) connected to the second hydraulic pump 2; an arm joystick 4 and a bucket joystick (not illustrated) outputting control signals according to operation amounts; a first arm control valve 5 installed in a flow path between the first hydraulic pump 1 and the arm cylinder 3 and shifted to control a start, stop, and direction change of the arm cylinder 3 in response to an operation of the arm joystick 4; a second arm control valve 6 installed in a flow path between the second hydraulic pump 2 and the arm cylinder 3 and shifted to make discharged hydraulic fluid of the second hydraulic pump 2 join the hydraulic fluid of the arm cylinder 3 to be supplied if the control signal according to the operation of the arm joystick 4 exceeds a set value; a bucket control valve (not illustrated) installed in a path between the second hydraulic pump 2 and the bucket cylinder and shifted to control a start, stop, and direction change of the bucket cylinder in response to the operation of the bucket joystick; and a confluence cutoff proportional valve 8 installed in a path 7 between the second hydraulic pump 2 and the second arm control valve 6 and shifted to cut off confluence of the hydraulic fluid discharged from the second hydraulic pump 2 with the discharged hydraulic fluid of the first hydraulic pump 1 if discharge pressures of the first and second hydraulic pumps 1 and 2 exceed a set value.

[0020] According to another embodiment of the present invention, there is provided a hydraulic control system including first and second variable displacement hydraulic pumps 1 and 2, an arm cylinder 3 connected to the first hydraulic pump 1, a bucket cylinder (not illustrated) connected to the second hydraulic pump 2, an arm joystick 4 and a bucket joystick (not illustrated) outputting control signals according to operation amounts thereof, a first arm control valve 5 controlling hydraulic fluid supplied to the arm cylinder 3 according to an operation of the arm joystick 4, a second arm control valve 6 controlling the hydraulic fluid that is supplied from the second hydraulic pump 2 to the arm cylinder 3 if a control signal according to the operation of the arm joystick 4 exceeds a set value, a bucket control valve (not illustrated) controlling driving of the bucket cylinder according to an operation of the bucket joystick, and a confluence cutoff proportional valve 8 making the hydraulic fluid of the second hydraulic pump 2 join the hydraulic fluid of the first hydraulic pump 1 if the arm cylinder 3 is singly operated and cutting off a confluence function if the arm cylinder 3 and the bucket cylinder are simultaneously operated, the hydraulic control system includes a first step S100 of reading an arm-in control signal according to an operation amount of the arm joystick 4, a bucket-in control signal according to an operation amount of the bucket joystick, and discharge pressures of the first and second hydraulic pumps 1 and 2; a second step S200 of determining whether the arm-in control signal exceeds one set value A_p and whether the bucket-in control signal exceeds the set value A_p ; a third step S300 of determining whether the discharge pressure of the first hydraulic pump 1 exceeds another set value B_p and whether the discharge pressure of the second hydraulic pump 2 exceeds the set value B_p ; and a fourth step S400 of releasing the confluence function by applying control signals that are in proportion to the arm-in control signal and the bucket-in control signal to the confluence cutoff proportional valve 8 if the arm-in control signal and the bucket-in control signal exceed the one set value A_p and the discharge pressures of the first and second hydraulic pumps 1 and 2 exceed the other set value B_p .

[0021] The confluence cutoff proportional valve 8 operates in a first state I of cutting off a flow path 7 when the arm joystick 4 and the bucket joystick are simultaneously operated, and in a second state II of connecting the flow path 7 when the arm joystick is singly operated.

[0022] The confluence cutoff proportional valve 8 operates in a first section (a) where movement amounts are controlled

to be gradually increased in proportion to the operation amounts of the arm joystick 4 and the bucket joystick to release the confluence function (the second state II of the confluence cutoff proportional valve 8), in a second section (b) where the confluence cutoff state (the first state I of the confluence cutoff proportional valve 8) is maintained according to the increase of the operation amounts of the arm joystick 4 and the bucket joystick, and in a third section (c) where movement amounts are controlled to be gradually decreased in reverse proportion to the operation amounts of the arm joystick 4 and the bucket joystick to be shifted to the confluence function (the second state II of the confluence cutoff proportional valve 8).

[0023] The confluence cutoff proportional valve 8 may include a solenoid valve that is shifted to open/close the flow path 7 in response to an input of an electric signal.

[0024] The confluence cutoff proportional valve 8 may include an electro proportional control valve that is shifted to open/close the flow path 7 according to an input of an electric signal.

[0025] Hereinafter, a use example of a hydraulic control system for a construction machine according to an embodiment of the present invention will be described.

[0026] As shown in Fig. 2, in the case where an arm is singly operated, the first arm control valve 5 is shifted in the rightward direction in the drawing in accordance with the control signal that is generated through the arm-in operation of the arm joystick 4, and thus hydraulic fluid Q1 that is discharged from the first hydraulic pump 1 in accordance with the operation amount of the arm joystick 4 is supplied to a large chamber 3a of the arm cylinder 3 via the shifted first arm control valve 5. At this time, the hydraulic fluid that returns from a small chamber 3b of the arm cylinder 3 is fed back to a hydraulic tank T via the first arm control valve 5.

[0027] If the operation amount of the arm joystick 4 exceeds a predetermined value, the second arm control valve 6 is shifted in the leftward direction in the drawing, and thus hydraulic fluid Q2 that is discharged from the second hydraulic pump 2 joins hydraulic fluid of a large chamber 2a of the arm cylinder 2 via the confluence cutoff proportional valve 8 and the second arm control valve 6 in order (in this case, the amount of hydraulic fluid that is supplied to the large chamber 3a of the arm cylinder 3 becomes $(Q1+Q2)$).

[0028] Accordingly, when the arm is singly operated, the hydraulic fluid Q2 that is supplied from the second hydraulic pump 2 joins the hydraulic fluid Q1 that is supplied from the first hydraulic pump 1 to the arm cylinder 3 ($Q1+Q2$), the operation speed of the arm cylinder 3 can be increased.

[0029] Although not illustrated in the drawing, the bucket cylinder may be driven by the hydraulic fluid that is supplied from the second hydraulic pump 2 due to the operation of the bucket joystick.

[0030] On the other hand, if the control signal according to the operation of the arm joystick 4 and the bucket joystick (not illustrated) is input and the discharge pressure values of the first and second hydraulic pumps 1 and 2 exceed the set value, it is considered that the actual excavating work is done, and a controller (not illustrated) outputs an electric control signal (a control signal for cutting off the confluence of the hydraulic fluids of the first and second hydraulic pumps 1 and 2) to the confluence cutoff proportional valve 8.

[0031] Through this, the confluence cutoff proportional valve 8 is shifted in the downward direction in the drawing to cut off the flow path (supply side flow path provided between the second hydraulic pump 2 and the second arm control valve 6, and thus the hydraulic fluid from the second hydraulic pump 2 becomes unable to join the hydraulic fluid of the first hydraulic pump 1. That is, the hydraulic fluid from the first hydraulic pump 1 is supplied to the arm cylinder 3 via the first arm control valve 5, and at the same time, the hydraulic fluid from the second hydraulic pump 2 is supplied to the bucket cylinder via a bucket control valve (not illustrated) (at this time, the hydraulic fluid that is supplied to the bucket cylinder is supplied without being interfered with the operation of the arm cylinder 3).

[0032] Hereinafter, a hydraulic control system for a construction machine according to another embodiment of the present invention, in which a confluence function is released through a confluence cutoff proportional valve, will be described with reference to the accompanying drawings.

[0033] In S100 of Fig. 3, an arm-in control signal according to an operation amount of the arm joystick 4, a bucket-in control signal according to an operation amount of the bucket joystick, and discharge pressures of the first and second hydraulic pumps 1 and 2 are read.

[0034] In S200, it is determined whether the arm-in control signal exceeds one set value A_p and whether the bucket-in control signal exceeds the set value A_p .

[0035] In S300, it is determined whether the discharge pressure of the first hydraulic pump 1 exceeds another set value B_p and whether the discharge pressure of the second hydraulic pump exceeds the other set value B_p .

[0036] In S400, if the arm-in control signal and the bucket-in control signal exceed the one set value A_p and the discharge pressures of the first and second hydraulic pumps 1 and 2 exceed the other set value B_p , it is determined that an actual excavating work is done through recognition of load occurrence in the arm cylinder 3 and the bucket cylinder.

[0037] Through this, an electric control signal that is in proportion to the arm-in control signal and the bucket-in control signal is applied from the controller to the confluence cutoff proportional valve 8 to shift the confluence cutoff proportional valve 8 to a first state I, and thus the flow path 7 between the second hydraulic pump 2 and the second arm control valve 6 is cut off.

[0038] At this time, the control signal S that is applied to the confluence cutoff proportional valve 8 may be expressed by the following equation.

$$S = (\text{arm-in operation amount} \times C) \text{ and } (\text{bucket-in operation amount} \times D)$$

[0039] Here, C and D are predetermined constants that are applied to works selected according to various excavating conditions.

[0040] As shown in Fig. 4, the confluence cutoff proportional valve 8 operates in a first section (a) where movement amounts are controlled to be gradually increased in proportion to the operation amounts of the arm joystick 4 and the bucket joystick to release the confluence function, in a second section (b) where the confluence cutoff state is maintained according to the increase of the operation amounts of the arm joystick 4 and the bucket joystick, and in a third section (c) where movement amounts are controlled to be gradually decreased in reverse proportion to the operation amounts of the arm joystick 4 and the bucket joystick to be shifted to the confluence function.

[0041] Accordingly, in the case of performing the excavating work through simultaneously operation of the arm cylinder 3 and the bucket cylinder, the confluence function is released by cutting off the flow path 7 through the confluence cutoff proportional valve 8, and thus the hydraulic fluid of the second hydraulic pump 2 becomes unable to join the hydraulic fluid discharged from the first hydraulic pump 1 any further.

[0042] That is, in the case of simultaneously operating the arm and the bucket to perform the excavating work, the hydraulic fluid from the first hydraulic pump 1 is supplied to the large chamber 3a of the arm cylinder 3 via the first arm control valve 5, and at the same time, the hydraulic fluid from the second hydraulic pump 2 is supplied to the large chamber of the bucket cylinder via the bucket control valve.

[0043] As described above, according to the hydraulic control system for a construction machine according to an embodiment of the present invention, in the case where the excavating work is done by simultaneously operating the arm and the bucket, the hydraulic fluids, which correspond to powers that are respectively required in the arm cylinder and the bucket cylinder, are supplied from the respective hydraulic pumps to the arm cylinder and the bucket cylinder, and thus pressure loss of the hydraulic pumps can be prevented to heighten the fuel efficiency.

INDUSTRIAL APPLICABILITY

[0044] As apparent from the above description, the hydraulic control system for a construction machine according to embodiments of the present invention can be used in an excavator or a loader, and in the case where the excavating work is done by simultaneously operating the arm and the bucket, the hydraulic fluids are made to be supplied from the respective hydraulic pumps to the arm cylinder and the bucket cylinder, and thus the pressure loss of the hydraulic pumps can be prevented to heighten the fuel efficiency.

Claims

1. A hydraulic control system for a construction machine, comprising:

- first and second variable displacement hydraulic pumps;
- an arm cylinder connected to the first hydraulic pump;
- a bucket cylinder connected to the second hydraulic pump;
- an arm joystick and a bucket joystick configured to output control signals according to operation amounts thereof;
- a first arm control valve installed in a flow path between the first hydraulic pump and the arm cylinder and shifted to control a start, stop, and direction change of the arm cylinder in response to an operation of the arm joystick;
- a second arm control valve installed in a flow path between the second hydraulic pump and the arm cylinder and shifted to make discharged hydraulic fluid of the second hydraulic pump join hydraulic fluid of the arm cylinder to be supplied if the control signal according to the operation of the arm joystick exceeds a set value;
- a bucket control valve installed in a path between the second hydraulic pump and the bucket cylinder and shifted to control a start, stop, and direction change of the bucket cylinder in response to the operation of the bucket joystick; and
- a confluence cutoff proportional valve installed in a path between the second hydraulic pump and the second arm control valve and shifted to cut off confluence of the hydraulic fluid discharged from the second hydraulic pump with the discharged hydraulic fluid of the first hydraulic pump if discharge pressures of the first and second hydraulic pumps exceed a set value.

2. A hydraulic control system including first and second variable displacement hydraulic pumps, an arm cylinder connected to the first hydraulic pump, a bucket cylinder connected to the second hydraulic pump, an arm joystick and a bucket joystick outputting control signals according to operation amounts thereof, a first arm control valve controlling hydraulic fluid supplied to the arm cylinder according to an operation of the arm joystick, a second arm control valve controlling the hydraulic fluid that is supplied from the second hydraulic pump to the arm cylinder if a control signal according to the operation of the arm joystick exceeds a set value, a bucket control valve controlling driving of the bucket cylinder according to an operation of the bucket joystick, and a confluence cutoff proportional valve making the hydraulic fluid of the second hydraulic pump join the hydraulic fluid of the first hydraulic pump if the arm cylinder is singly operated and cutting off a confluence function if the arm cylinder and the bucket cylinder are simultaneously operated, the hydraulic control system comprising:

a first step of reading an arm-in control signal according to an operation amount of the arm joystick, a bucket-in control signal according to an operation amount of the bucket joystick, and discharge pressures of the first and second hydraulic pumps;

a second step of determining whether the arm-in control signal exceeds one set value and whether the bucket-in control signal exceeds the one set value;

a third step of determining whether the discharge pressure of the first hydraulic pump exceeds another set value and whether the discharge pressure of the second hydraulic pump exceeds the other set value; and

a fourth step of releasing the confluence function by applying control signals that are in proportion to the arm-in control signal and the bucket-in control signal to the confluence cutoff proportional valve if the arm-in control signal and the bucket-in control signal exceed the one set value and the discharge pressures of the first and second hydraulic pumps exceed the other set value.

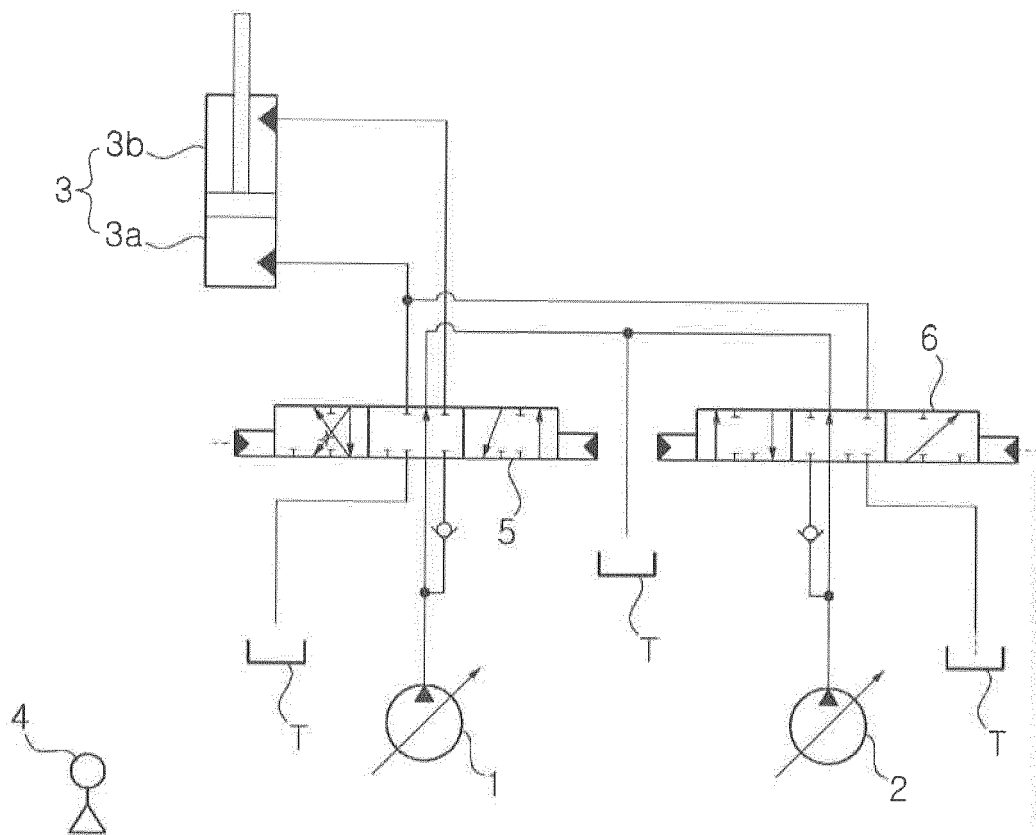
3. The hydraulic control system according to claim 1, wherein the confluence cutoff proportional valve operates in a first state of cutting off a flow path when the arm joystick and the bucket joystick are simultaneously operated, and in a second state of connecting the flow path when the arm joystick is singly operated.

4. The hydraulic control system according to claim 2, wherein the confluence cutoff proportional valve operates in a first section where movement amounts are controlled to be gradually increased in proportion to the operation amounts of the arm joystick and the bucket joystick to release the confluence function, in a second section where the confluence cutoff state is maintained according to the increase of the operation amounts of the arm joystick and the bucket joystick, and in a third section where movement amounts are controlled to be gradually decreased in reverse proportion to the operation amounts of the arm joystick and the bucket joystick to be shifted to the confluence function.

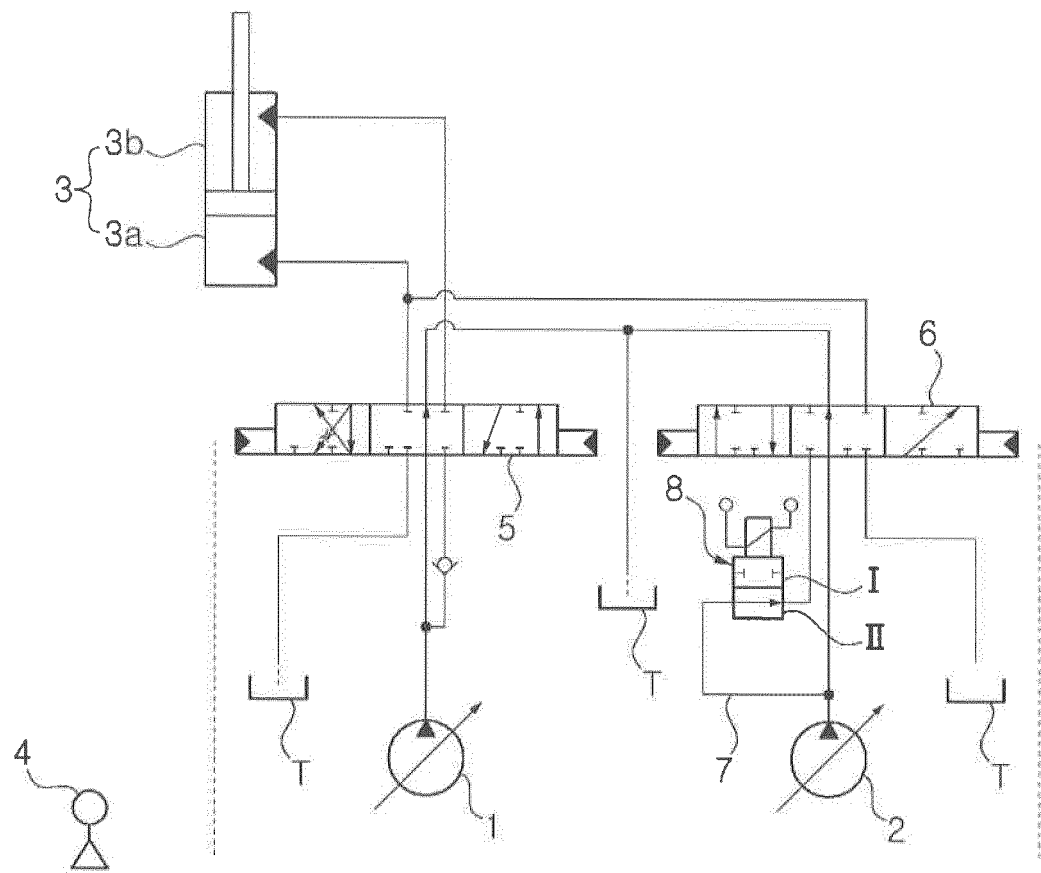
5. The hydraulic control system according to claim 1, wherein the confluence cutoff proportional valve comprises a solenoid valve that is shifted to open/close the flow path in response to an input of an electric signal.

6. The hydraulic control system according to claim 1, wherein the confluence cutoff proportional valve comprises an electro proportional control valve that is shifted to open/close the flow path according to an input of an electric signal.

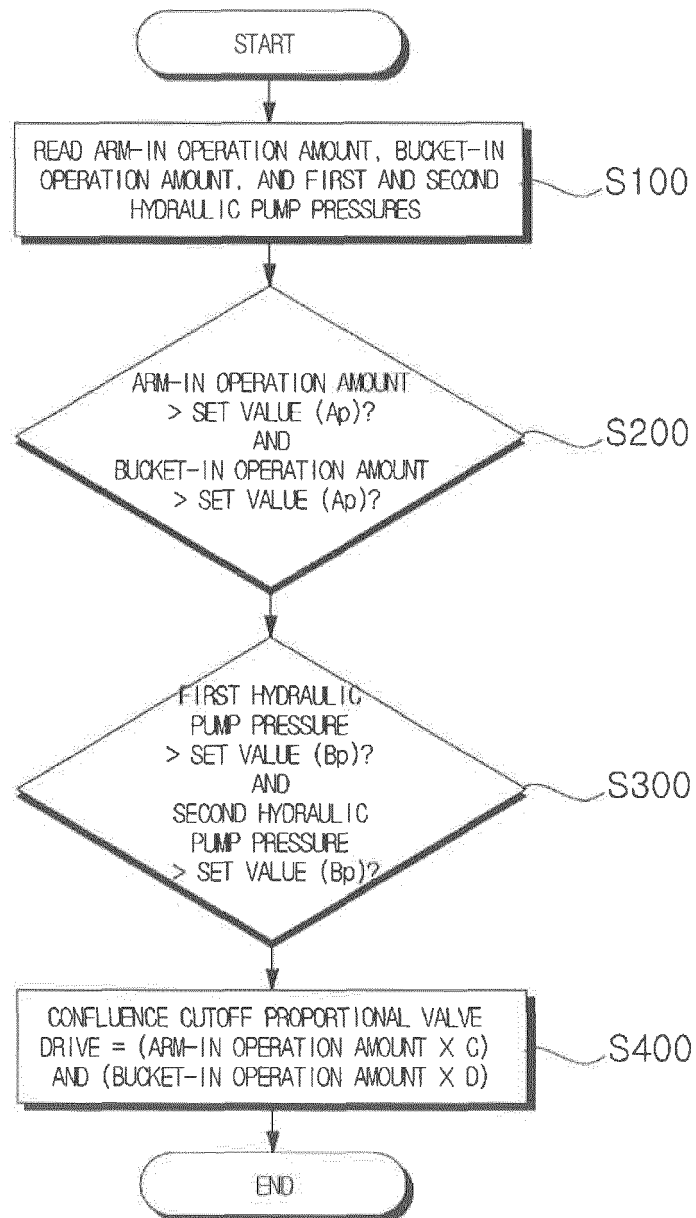
[Fig. 1]



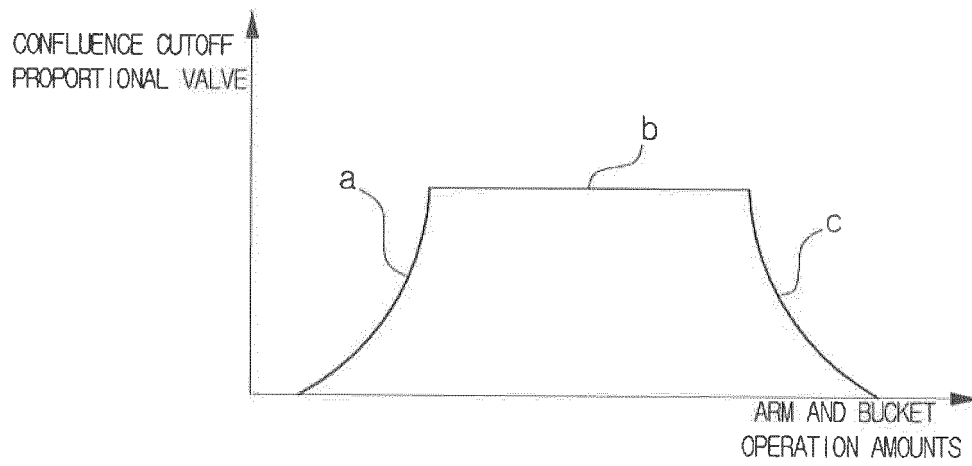
[Fig. 2]



[Fig. 3]



[Fig. 4]



INTERNATIONAL SEARCH REPORT

International application No.

PCT/KR2011/005790

A. CLASSIFICATION OF SUBJECT MATTER

F15B 13/044(2006.01)i, E02F 9/22(2006.01)i, F15B 13/02(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)

F15B 13/044; F15B 11/02; E02F 9/20; F15B 11/00; E02F 9/22; F15B 11/17

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

Korean Utility models and applications for Utility models: IPC as above

Japanese Utility models and applications for Utility models: IPC as above

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

eKOMPASS (KIPO internal) & Keywords: hydraulic pump, control valve, arm, bucket, combining

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	KR 10-2010-0041100 A (VOLVO CONSTRUCTION EQUIPMENT AB) 22 April 2010 See abstract and figure 2.	1-6
A	JP 2007-100779 A (KAYABA IND CO LTD et al.) 19 April 2007 See paragraphs [1]-[13] and figures 1, 3.	1-6
A	JP 2004-324741 A (KOBELCO CONSTRUCTION MACHINERY LTD) 18 November 2004 See paragraphs [63]-[66] and figures 1-3.	1-6
A	JP 2007-327526 A (KAYABA IND CO LTD) 20 December 2007 See paragraphs [18]-[21] and figures 1-4.	1-6

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

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

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Date of the actual completion of the international search

10 APRIL 2012 (10.04.2012)

Date of mailing of the international search report

12 APRIL 2012 (12.04.2012)

Name and mailing address of the ISA/KR


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INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.

PCT/KR2011/005790

Patent document cited in search report	Publication date	Patent family member	Publication date
KR 10-2010-0041100 A	22.04.2010	CN 101676495 A EP 2157245 A2 JP 2010-048417 A KR 10-0985031 B1 US 2010-0043420 A1	24.03.2010 24.02.2010 04.03.2010 04.10.2010 25.02.2010
JP 2007-100779 A	19.04.2007	NONE	
JP 2004-324741 A	18.11.2004	AT 347656 T CN 1540172 A CN 1540172 C0 DE 602004003516 D1 DE 602004003516 T2 EP 1471263 A1 EP 1471263 B1 JP 04-062160 B2 US 2004-0211471 A1 US 7131453 B2	15.12.2006 27.10.2004 02.04.2008 18.01.2007 26.04.2007 27.10.2004 06.12.2006 19.03.2008 28.10.2004 07.11.2006
JP 2007-327526 A	20.12.2007	NONE	