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lection switch when manipulating a boom operation lever for driving the boom up; a variable flow control valve that is placed on a flow channel between a first hydraulic pump and a spool for the swing device, and has an open area thereof that is variably matched proportional to the control signal pressure from the electronic proportional pressure control valve; and a controller having various types of operation modes previously set and stored thereon so as to control the flow being supplied to the spool for the swing device and a spool for the boom merge, according to the operation mode selected when manipulating the operation mode selection switch.

[illegible]

Description

[Field of the Invention]

[0001] The present invention relates to a hydraulic control system for a combined boom and swing operation of a construction machine such as an excavator. More particularly, the present invention relates to a hydraulic system for a construction machine, in which the driving speeds of the boom and the swing device are adjusted according to working conditions during a combined operation in which boom-up and swing manipulations are carried out to perform an excavating and loading work, thereby ensuring a smooth work.

[Background of the Invention]

[0002] A conventional hydraulic control system for a combined boom and swing operation of a construction machine in accordance with the prior art as shown in Fig. 1 includes:

first and second variable displacement hydraulic pumps (hereinafter, referred to as "first and second hydraulic pumps") 1 and 2 connected to an engine (not shown);

an actuator (referring to "arm cylinder") for a swing device and a work apparatus, which is connected to the first hydraulic pump 1;

an actuator for a work apparatus (referring to "boom cylinder") connected to the second hydraulic pump 2; and a flow rate control valve (MCV) 3 configured to control a flow rate of a hydraulic fluid supplied respectively to the actuators for the swing device and the work apparatus from the first and second hydraulic pumps 1 and 2.

[0003] In Fig. 1, a non-explained reference numeral 11 denotes a boom confluence spool that allows the hydraulic fluid discharged from the first hydraulic pump 1 to join the hydraulic fluid discharged from the second hydraulic pump 2 when a boom-up operation is performed.

[0004] Thus, an operator manipulates a boom manipulation lever 4 to shift a boom spool 5 and a boom confluence spool 11 so that the hydraulic fluid supplied to the boom cylinder via the boom spool 5 from the second hydraulic pump 2 and the hydraulic fluid supplied to the boom cylinder from the first hydraulic pump 1 via the boom confluence spool 11 join each other to cause the boom cylinder to be driven to perform a boom-up operation.

[0005] On the other hand, an operator manipulates a manipulation lever (not shown) for the swing device to shift a swing spool 6 so that the hydraulic fluid supplied to the arm cylinder from the first hydraulic pump 1 via the swing spool 6 causes the swing device to be driven to swivel the upper swing structure.

[0006] During a combined operation in which the boom

and the swing device are operated to perform an excavating and loading work, the hydraulic fluid discharged from the first hydraulic pump 1 is supplied to the boom cylinder via the boom spool 5 to drive the boom cylinder and the hydraulic fluid discharged from the first hydraulic pump 1 is distributively supplied to the boom cylinder and the swing device, respectively, due to a difference in the pressure between the front ends of the boom confluence spool 11 and the swing spool 6.

[0007] Meanwhile, in the case where the excavating and loading work is performed, there is required an adjustment of the driving speeds of the boom and the swing device depending on various kinds of working conditions such as the excavation depth or the height of a dump vehicle. That is, the distributed flow rate of the hydraulic fluid supplied to the boom confluence spool 11 and the swing spool 6 from the first hydraulic pump 1 needs to be controlled.

[0008] In the conventional hydraulic control system, since the flow rate of the hydraulic fluid distributively supplied to the boom confluence spool 11 and the swing spool 6 from the first hydraulic pump 1 is fixed to a constant level, the driving speeds of the boom and the swing device are inevitably adjusted to conform to only one kind of working condition. Thus, such a conventional hydraulic control system entails a problem in that an operator must perform a combined operation of the manipulation levers for the boom and the swing device based on the operator's manipulation experience in order to attain the smooth matching of the work apparatus (i.e., attachment of the upper swing structure), thereby resulting in a deterioration of manipulability and workability.

[Detailed Description of the Invention]

[Technical Problems]

[0009] Accordingly, the present invention was made to solve the aforementioned problem occurring in the prior art, and it is an object of the present invention to provide a hydraulic control system for a combined boom and swing operation of a construction machine, in which an operator can easily adjust the driving speeds of the boom and the swing device depending on various kinds of working conditions such as the excavation depth or the height of a dump vehicle during a combined operation in which the boom and the swing device are manipulated to smoothly perform an excavating and loading work.

[0010] Another object of the present invention to provide a hydraulic control system for a combined boom and swing operation of a construction machine, in which in the case where an operator selects a certain work mode needed for the working conditions within an operator cab during the excavating and loading work, the flow rate of the hydraulic fluid distributed to a boom confluence spool and a swing spool is controlled depending on the selected work mode so that the driving speeds of the boom and

the swing device can be adjusted under the working conditions needed by the operator.

[Technical Solution]

[0011] To accomplish the above object, in accordance with an embodiment of the present invention, there is provided a hydraulic control system for a combined boom and swing operation of a construction machine, which includes first and second variable displacement hydraulic pumps, an actuator for a swing device and a work apparatus, which is connected to the first hydraulic pump, an actuator for a work apparatus connected to the second hydraulic pump, and a flow rate control valve configured to control a low rate of a hydraulic fluid supplied respectively to the actuators for the swing device and the work apparatus from the first and second hydraulic pumps, the hydraulic control system including:

a work mode selection switch configured to select a preset work mode according to working conditions; an electronic proportional pressure control valve mounted in a pilot fluid path that discharges a pilot signal pressure according to a manipulation amount of a boom manipulation lever when the boom manipulation lever is manipulated to perform a boom-up operation, the electronic proportional pressure control valve being configured to output a control signal pressure that is in proportion to the manipulation of the work mode selection switch;

a variable flow rate control valve mounted in a flow path between the first hydraulic pump and a spool for the swing device, the variable flow rate control valve having an opening area variably adjusted in proportion to the control signal pressure of the electronic proportional pressure control valve; and a controller configured to previously set and store various kinds of work modes according to working conditions to control a flow rate of the hydraulic fluid supplied to the swing device spool and a boom confluence spool according to a work mode selected when the work mode selection switch is manipulated,

wherein in the case where an operator selects a certain work mode according to the working conditions during a combined operation in which boom-up and swing manipulations are carried out, the flow rate of the hydraulic fluid supplied to the swing device spool and the boom confluence spool is variably controlled according to the selected work mode to adjust the driving speeds of the boom and the swing device.

[0012] According to a more preferable embodiment, the electronic proportional pressure control valve is mounted inside the flow rate control valve.

[0013] The electronic proportional pressure control valve is mounted outside the flow rate control valve.

[0014] The variable flow rate control valve uses a var-

iable orifice whose opening area is variably adjusted in proportion to the control signal pressure from the electronic proportional pressure control valve.

5 [Advantageous Effect]

[0015] The hydraulic control system for a combined boom and swing operation of a construction machine in accordance with an embodiment of the present invention as constructed above has the following advantages.

[0016] An operator can easily adjust the driving speeds of the boom and the swing device depending on various kinds of working conditions such as the excavation depth or the height of a dump vehicle during a combined operation in which the boom and the swing device are manipulated to perform an excavating and loading work, thereby improving workability.

[0017] In the case where an operator selects a certain work mode needed for the working conditions within an operator cab during the excavating and loading work, the driving speeds of the boom and the swing device can be adjusted under the working conditions needed by the operator, thereby improving convenience of the operator.

25 [Brief Description of the Invention]

[0018] 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 block diagram showing the main elements of a hydraulic control system for a combined boom and swing operation of a construction machine in accordance with the prior art;

Fig. 2 is a block diagram showing the main elements of a hydraulic control system for a combined boom and swing operation of a construction machine in accordance with an embodiment of the present invention; and

Fig. 3 is a graph showing the effects of a hydraulic control system for a combined boom and swing operation of a construction machine in accordance with an embodiment of the present invention.

* Explanation on reference numerals of main elements in the drawings *

50 **[0019]**

- 1: first variable displacement hydraulic pump
- 2: second variable displacement hydraulic pump
- 3: flow rate control valve (MCV)
- 4: boom manipulation lever:
- 5: boom spool
- 6: spool for the swing device (i.e., swing spool)
- 7: pilot flow path
- 8: work mode selection switch

9: electronic proportional pressure control valve (EP-PRV)
 10: variable flow rate control valve
 11: boom confluence spool

[Preferred Embodiments of the Invention]

[0020] Now, 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.

[0021] A hydraulic control system for a combined boom and swing operation of a construction machine in accordance with an embodiment of the present invention as shown in Fig. 2 includes first and second variable displacement hydraulic pumps, an actuator for a swing device and a work apparatus, which is connected to the first hydraulic pump, an actuator for a work apparatus connected to the second hydraulic pump, and a flow rate control valve configured to control a flow rate of a hydraulic fluid supplied respectively to the actuators for the swing device and the work apparatus from the first and second hydraulic pumps.

[0022] The hydraulic control system includes:

a work mode selection switch 8 configured to select a preset work mode according to working conditions; an electronic proportional pressure control valve 9 mounted in a pilot fluid path 7 that discharges a pilot signal pressure according to a manipulation amount of a boom manipulation lever 4 when the boom manipulation lever 4 is manipulated to perform a boom-up operation, the electronic proportional pressure control valve 9 being configured to output a control signal pressure that is in proportion to a the manipulation of the work mode selection switch 8; a variable flow rate control valve 10 mounted in a flow path between the first hydraulic pump 1 and a spool 6 for the swing device, the variable flow rate control valve having an opening area variably adjusted in proportion to the control signal pressure of the electronic proportional pressure control valve 9; and a controller (not shown) configured to previously set and store various kinds of work modes according to working conditions to control a flow rate of the hydraulic fluid supplied to the swing device spool 6 and a boom confluence spool 11 according to a work mode selected when the work mode selection switch 8 is manipulated, wherein in the case where an operator selects a certain work mode according to the working conditions during a combined operation in which boom-up and swing manipulations are carried out to perform an

excavating and loading work, the flow rate of the hydraulic fluid supplied to the swing device spool 6 and the boom confluence spool 11 is variably controlled according to the selected work mode to adjust the driving speeds of the boom and the swing device.

[0023] Herein, the electronic proportional pressure control valve 9 is mounted inside the flow rate control valve (MCV) 3. The electronic proportional pressure control valve 9 may be constructed as an electro proportional pressure reducing valve (EPPRV), and may be mounted inside the flow rate control valve (MCV) 3.

[0024] The electronic proportional pressure control valve 9 is mounted outside the flow rate control valve.

[0025] The variable flow rate control valve 10 may use a variable orifice whose opening area is variably adjusted in proportion to the control signal pressure from the electronic proportional pressure control valve 9.

[0026] In Fig. 2, a non-explained reference numeral 11 denotes a boom confluence spool that allows the hydraulic fluid of the first hydraulic pump 1 to join the hydraulic fluid of the second hydraulic pump 2 when a boom-up operation is performed.

[0027] Hereinafter, a use example of the hydraulic control system for a combined boom and swing operation of a construction machine in accordance with the present invention will be described in detail with reference to the accompanying drawings.

[0028] As shown in Figs. 2 and 3, in the case where an operator within an operator cab manipulates the boom manipulation lever 4 to conduct a boom-up operation and drives the swing device to swivel an upper swing structure in order to perform an excavating and loading work, the operator manipulates the work mode selection switch 8 to select a certain work mode suitable for various kinds of working conditions such as the height of the ground surface of an excavation work site or the height of a dump vehicle.

[0029] A part of a pilot signal pressure passing by the boom manipulation lever 4 is supplied to a boom spool 5 to shift the boom spool according to the boom-up manipulation of the boom manipulation lever 4. Thus, the hydraulic fluid discharged from the second hydraulic pump 2 is supplied to a boom cylinder (not shown) after passing through the boom spool 5 to perform the boom-up operation.

[0030] On the other hand, a part of the pilot signal pressure passing by the boom manipulation lever 4 is supplied to the electronic proportional pressure control valve 9 mounted in the pilot flow path 7. At this time, the electronic proportional pressure control valve 9 outputs a pilot signal pressure in proportion to a select signal corresponding to a work mode selected according to the manipulation of the work mode selection switch 8.

[0031] By virtue of this operation, the signal pressure passing through the electronic proportional pressure control valve 9 is supplied to the variable flow rate control valve 10 so that the opening area of the variable flow rate

control valve 10 is controlled. That is, the opening diameter of the variable flow rate control valve 10 is controlled in proportion to the control signal pressure outputted from the electronic proportional pressure control valve 9 depending on the selected work mode.

[0032] Therefore, the flow rate of the hydraulic fluid discharged from the first hydraulic pump 1 and supplied to the spool 6 for the swing device is reduced to match the selected work mode, and the flow rate of the hydraulic fluid supplied to the boom confluence spool 11 is increased. In other words, since the flow rate of the hydraulic fluid supplied to the boom confluence spool 11 from the first hydraulic pump 1 is increased, the boom-up operation is performed at a relatively high speed as compared to the swing operation of the upper swing structure so that the loading work can be carried out safely.

[0033] For this reason, in the case where the manipulation lever of the boom-up device and the swing device is manipulated at a full stroke to perform a combined operation, the matching between the boom-up operation and the swing operation is accomplished so that the operator can conveniently perform the excavating and loading work in a desired direction.

[0034] As shown in Fig. 3, it can be seen that the hydraulic fluid discharged from the first hydraulic pump 1 is supplied to the boom cylinder in proportion to a pilot signal pressure P_{i1} outputted from the electronic proportional pressure control valve 9 to fit the work mode (meaning a line "a" on the graph of Fig. 3) selected by the manipulation of the work mode selection switch 8.

[0035] While the present invention has been described in connection with the specific embodiments illustrated in the drawings, they are merely illustrative, and the invention is not limited to these embodiments. It is to be understood that various equivalent modifications and variations of the embodiments can be made by a person having an ordinary skill in the art without departing from the spirit and scope of the present invention. Therefore, the true technical scope of the present invention should not be defined by the above-mentioned embodiments but should be defined by the appended claims and equivalents thereof.

[Industrial Applicability]

[0036] As described above, in the hydraulic control system for a combined boom and swing operation of a construction machine in accordance with an embodiment of the present invention, it is possible to adjust the driving speeds of the boom and the swing device depending on various kinds of working conditions such as the excavation depth or the height of a dump vehicle during a combined operation in which boom-up and swing manipulations are carried out to perform an excavating and loading work. In addition, in the case where an operator selects a certain work mode needed for the working conditions within an operator cab during the excavating and loading

work, the driving speeds of the boom and the swing device are adjusted under the working conditions needed by the operator, thereby improving convenience and manipulability.

Claims

1. A hydraulic control system for a combined boom and swing operation of a construction machine, which includes first and second variable displacement hydraulic pumps, an actuator for a swing device and a work apparatus, which is connected to the first hydraulic pump, an actuator for a work apparatus connected to the second hydraulic pump, and a flow rate control valve configured to control a flow rate of a hydraulic fluid supplied respectively to the actuators for the swing device and the work apparatus from the first and second hydraulic pumps, the hydraulic control system comprising:

a work mode selection switch configured to select a preset work mode according to working conditions;

an electronic proportional pressure control valve mounted in a pilot fluid path that discharges a pilot signal pressure according to a manipulation amount of a boom manipulation lever when the boom manipulation lever is manipulated to perform a boom-up operation, the electronic proportional pressure control valve being configured to output a control signal pressure that is in proportion to the manipulation of the work mode selection switch;

a variable flow rate control valve mounted in a flow path between the first hydraulic pump and a spool for the swing device, the variable flow rate control valve having an opening area variably adjusted in proportion to the control signal pressure of the electronic proportional pressure control valve; and

a controller configured to previously set and store various kinds of work modes according to working conditions to control a flow rate of the hydraulic fluid supplied to the swing device spool and a boom confluence spool according to a work mode selected when the work mode selection switch is manipulated,

wherein in the case where an operator selects a certain work mode according to the working conditions during a combined operation in which boom-up and swing manipulations are carried out, the flow rate of the hydraulic fluid supplied to the swing device spool and the boom confluence spool is variably controlled according to the selected work mode to adjust the driving speeds of the boom and the swing device.

2. The hydraulic control system according to claim 1,
wherein the electronic proportional pressure control
valve is mounted inside the flow rate control valve.
3. The hydraulic control system according to claim 1,
wherein the electronic proportional pressure control
valve is mounted outside the flow rate control valve.
4. The hydraulic control system according to claim 1,
wherein the variable flow rate control valve uses a
variable orifice whose opening area is variably ad-
justed in proportion to the control signal pressure
from the electronic proportional pressure control
valve.

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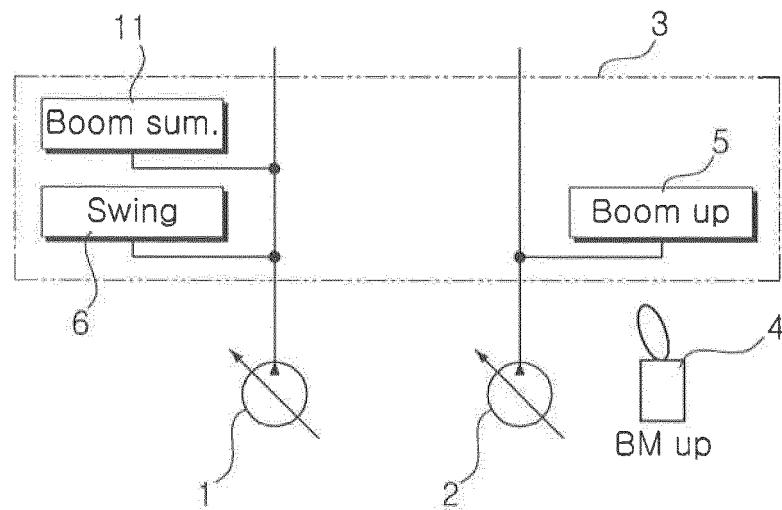
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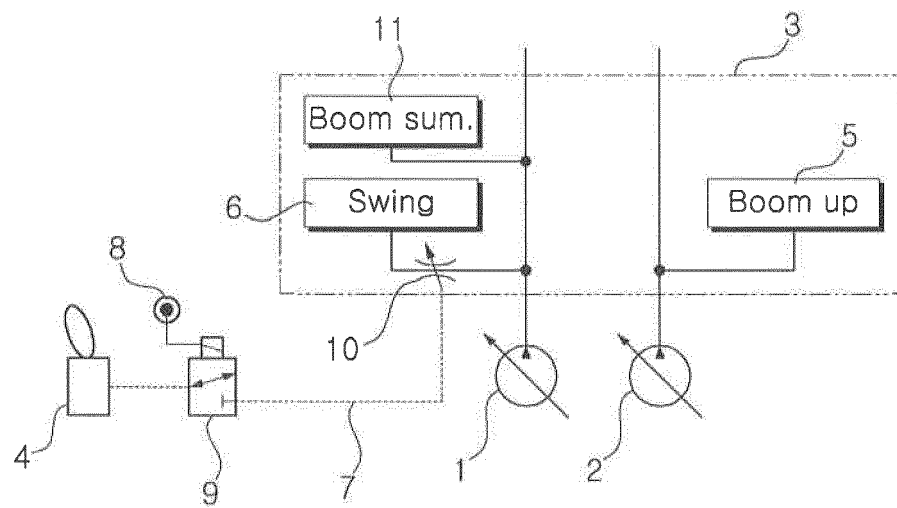
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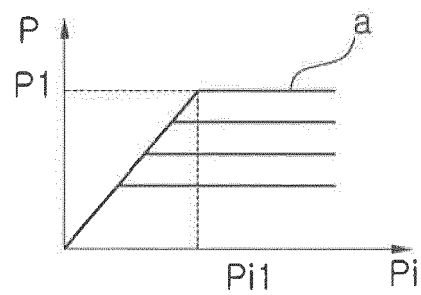
[Fig. 1]



[Fig.2]



[Fig.3]



INTERNATIONAL SEARCH REPORT

International application No.

PCT/KR2010/009361**A. CLASSIFICATION OF SUBJECT MATTER*****F15B 13/02(2006.01); E02F 9/22(2006.01); F15B 13/04(2006.01);***

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 13/02; F15B 11/08; F15C 1/02; F15B 11/04; E02F 9/20; F15B 11/06; B66C 13/20; B66C 13/22; B66C 13/12; E02F 9/22

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: "boom", "revolving", "work", "mode", "selection", "swing", "control", "flow rate", "controller", "pilot", "electro proportional", "valve", "velocity", "adjustment", "opening", "area"

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	KR 10-1996-0013596 B1 (HYUNDAI HEAVY INDUSTRIES CO., LTD.) 09 October 1996 See claims 1 - 2 and figures 1 - 5.	1-4
A	KR 10-1992-0010874 B1 (HITACHI KENKI KABUSHIKI KAISHA) 19 December 1992 See claims 1 - 7 and figures 1 - 7.	1-4
A	JP 2002-047691 A (KOMATSU LTD.) 15 February 2002 See claims 1 - 3 and figures 1 - 5.	1-4
A	JP 10-220411 A (HITACHI CONSTR. MACH. CO., LTD.) 21 August 1998 See claims 1 - 8 and figures 1 - 12.	1-4
A	JP 06-280814 A (KOBE STEEL LTD. et al.) 07 October 1994 See claims 1 - 6 and figures 1 - 3.	1-4

☐ 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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"P" document published prior to the international filing date but later than the priority date claimed

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"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search

29 AUGUST 2011 (29.08.2011)

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Name and mailing address of the ISA/KR


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INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/KR2010/009361

Patent document cited in search report	Publication date	Patent family member	Publication date
KR 10-1996-0013596 B1	09.10.1996	NONE	
KR 10-1992-0010874 B1	19.12.1992	EP 0362402 A1 EP 0362402 B1 JP 03-106164 B2 US 05074194A A WO 89-08200 A1	11.04.1990 03.09.1997 08.09.2000 24.12.1991 08.09.1989
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JP 10-220411 A	21.08.1998	NONE	
JP 06-280814 A	07.10.1994	DE 4410976 A1 DE 4410976 C2 JP 3078947 B2	06.10.1994 12.09.2002 21.08.2000

Form PCT/ISA/210 (patent family annex) (July 2009)