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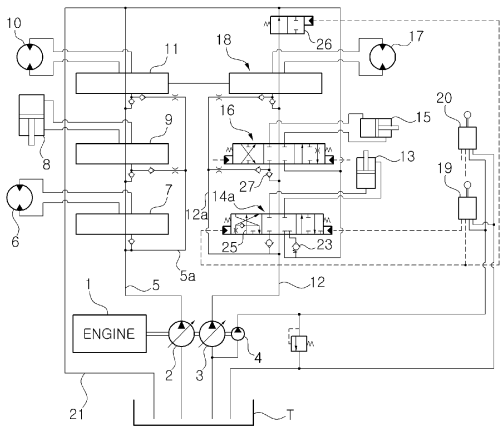
(54) CONTROL SYSTEM FOR OPERATING WORK DEVICE FOR CONSTRUCTION MACHINE

(57) Disclosed is a control system for controlling flow so as to allow simultaneous usage of a parallel flow path and a tandem flow path thereby reducing loss of pressure inside a control valve, when simultaneously operating work devices having different operating pressures. A control system for operating the work device, according to the present invention, provides the control system for operating the work device for a construction machine, comprising: first and second hydraulic pumps that are connected to an engine; a revolution control valve, an arm control valve, and a left driving control valve, which are installed on a first center bypass path of the first hydraulic pump, and each of which is connected via the parallel flow path; a boom control valve, a bucket control valve, and a right driving valve, which are installed on a second center bypass path of the second hydraulic pump, and each of which is connected via the parallel flow path; a pressure generation device; a bleed flow path, which is formed on a control spool at a lower side of a boom of the boom control valve, for maintaining an open state of the second center bypass path without closing same, when the boom control valve is switched so as to lower the boom; and a center bypass switch valve, which is installed on the lowermost side of the second center bypass path and is switched by means of a control signal for switching the boom control valve.

[Fig.3]



EP 2 772 653 A1

Description

Field of the Invention

[0001] The present invention relates to an attachment driving control system for a construction machine. More particularly, the present invention relates to an attachment driving control system for a construction machine, in which in the case where two attachments having different operating pressures are simultaneously driven (e.g., the case where a boom for performing a boom descending operation and an attachment such as a bucket are simultaneously driven), a flow rate of a hydraulic fluid is controlled to enable the simultaneous use of a parallel flow path and a tandem flow path, leading to a reduction in a pressure loss occurring in the control valve.

Background of the Invention

[0002] In general, a conventional boom driving control system for a construction machine in accordance with the prior art as shown in Fig. 1 includes:

an engine 1;
first and second variable displacement hydraulic pumps (hereinafter, referred to as "first and second hydraulic pumps") 2 and 3 that are connected to the engine 1 and a pilot pump 4;
a swing control valve 7 that controls the drive of a swing motor 6, an arm control valve 9 that controls the drive of an arm cylinder 8, and a traveling control valve 11 that controls the drive of a left traveling motor 10 wherein the swing control valve, the arm control valve, and the traveling control valve are installed in a first center bypass path 5 of the first hydraulic pump 2 so as to be connected to a parallel flow path 5a, respectively;
a boom control valve 14a that controls the drive of a boom cylinder 13, a bucket control valve 16 that controls the drive of a bucket cylinder 15, and a traveling control valve 18 that controls the drive of a right traveling motor 17 wherein the boom control valve, the bucket control valve, and the traveling control valve are installed in a second center bypass path 12 of the second hydraulic pump 3 and 2 so as to be connected to a parallel flow path 12a, respectively; and
pressure generation devices 19 and 20 that outputs a control signal corresponding to a manipulation amount.

[0003] When the pressure generation device 19 is in a neutral position, a hydraulic fluid discharged from the second hydraulic pump 3 returns to a hydraulic tank T through the second center bypass path 12 and the return flow path 21.

[0004] In the case where the pressure generation device 19 is manipulated to ascend a boom, a pilot signal pressure from a pilot pump 4 is supplied to the boom control valve 14 via the pressure generation device 19. For this reason, the boom control valve 14 is shifted to the left on the drawing sheet to cause the boom to ascend, and thus the hydraulic fluid discharged from the second hydraulic pump 3 is supplied to a large chamber of the boom cylinder 13 via a load check valve 22 and the boom control valve 14. At this same time, a hydraulic fluid flowing out of a small chamber of the boom cylinder 13 returns to the hydraulic tank T via the boom control valve 14. Thus, the boom cylinder 13 can be driven in a stretchable manner to cause the boom to ascend.

[0005] In the meantime, in the case where the pressure generation device 19 is manipulated to descend the boom, the pilot signal pressure from the pilot pump 4 is supplied to the boom control valve 14 via the pressure generation device 19. For this reason, the boom control valve 14 is shifted to the right on the drawing sheet to cause the boom to descend, and thus the hydraulic fluid discharged from the second hydraulic pump 3 is supplied to the small chamber of the boom cylinder 13 via the boom control valve 14. At this same time, the hydraulic fluid flowing out of the large chamber of the boom cylinder 13 returns to the hydraulic tank T via the boom control valve 14 and a back pressure check valve 23. Thus, the boom cylinder 13 can be driven in a retractable manner to cause the boom to descend.

[0006] In this case, the back pressure check valve 23 is mounted with a valve spring so that when a hydraulic fluid passes therethrough, a constant pressure is formed. In addition, a regeneration line is installed in the back pressure check valve 23 so that the hydraulic fluid flowing out of the large chamber of the boom cylinder 13 can be regenerated to the small chamber of boom cylinder 13 along the regeneration line during the descending of the boom.

[0007] As described above, when the boom descends, a lower pressure acts on the boom due to the descending operation by its own weight. Meantime, in the case where a boom for performing a boom descending operation and an attachment (e.g., referring to bucket) requiring having an operating pressure relatively higher than that of the boom are simultaneously driven, a throttle device is installed at a hydraulic fluid inlet side of a control spool (i.e., referring to the boom control valve 14) on a boom descending side so that simultaneous manipulability of the boom and the bucket can be maintained.

[0008] In the meantime, a throttle device is installed in the parallel flow path of each attachment that is operated at a relatively low pressure to produce a pressure causing the boom to ascend so that simultaneous manipulability of the boom for performing a boom ascending operation and another attachment can be implemented.

[0009] Besides, a tandem flow path is formed in the bucket control valve 16 and the traveling control valve 18 which are connected in parallel with the boom control valve 14 through the second center bypass path 12. That is, in the case where the drive of the bucket cylinder 15

is controlled alone, the hydraulic fluid from the second hydraulic pump 3 flows into the bucket control valve 16 through the parallel flow path 12a and the tandem flow path, thereby reducing an excessive pressure loss occurring when the hydraulic fluid from the second hydraulic pump 3 flows into the bucket control valve 16 through only the parallel flow path 12a.

[0010] Meanwhile, in the case where two different attachments such as the boom for performing a boom descending operation and the bucket are driven simultaneously, the second center bypass path 12 is blocked by the control spool on a boom descending side and the hydraulic fluid is supplied to the bucket cylinder 15 through only the parallel flow path 12a. In this case, there occurs a problem in that a sufficient flow path cannot be secured by a priority control valve installed in the parallel flow path 12a, thereby inducing an excessive pressure loss, and thus causing an energy loss.

[0011] In addition, a variable control valve as a throttle valve 24 (see Fig. 2) may be installed in the parallel flow path 12a, but there is a limitation in securing the flow path using the throttle device.

Detailed Description of the Invention

Technical Problems

[0012] Accordingly, the present invention has been made to solve the aforementioned problem occurring in the prior art, and it is an object of the present invention to provide an attachment driving control system for a construction machine, in which in the case where two attachments having different operating pressures are simultaneously driven as in a boom descending operation and a bucket operation, a hydraulic fluid from the second hydraulic pump is allowed to flow into the bucket control valve through a parallel flow path and a tandem flow path, leading to a reduction in an unnecessary pressure loss occurring in the control valve, thereby reducing an energy loss and thus increasing an efficiency of a hydraulic system.

Technical Solution

[0013] To accomplish the above object, there is provided an attachment driving control system for a construction machine in accordance with an embodiment of the present invention, including:

an engine;
first and second variable displacement hydraulic pumps connected to the engine and a pilot pump;
a swing control valve configured to control the drive of a swing motor, an arm control valve configured to control the drive of an arm cylinder, and a traveling control valve configured to control the drive of a left traveling motor wherein the swing control valve, the arm control valve, and the traveling control valve are installed in a first center bypass path of the first hydraulic pump so as to be connected to a parallel flow path, respectively;
a boom control valve configured to control the drive of a boom cylinder, a bucket control valve configured to control the drive of a bucket cylinder, and a traveling control valve configured to control the drive of a right traveling motor wherein the boom control valve, the bucket control valve, and the traveling control valve are installed in a second center bypass path of the second hydraulic pump so as to be connected to a parallel flow path, respectively;
pressure generation devices configured to output a control signal corresponding to a manipulation amount;
a bleed flow path formed on a control spool on a boom descending side of the boom control valve and configured to maintain the second center bypass path in an opened state instead of blocking the second center bypass path when the boom control valve is shifted to descend the boom through the manipulation of the pressure generation device; and
a center bypass shift valve installed on a lowermost downstream side of the second center bypass path and configured to be shifted by a control signal pressure for shifting the boom control valve,
wherein a hydraulic fluid from the second hydraulic pump flows into the boom control valve through the parallel flow path and a tandem flow path connected to the second center bypass path when a boom for performing a boom descending operation and an attachment requiring an operating pressure relatively higher than that of the boom are simultaneously driven.

[0014] In accordance with a preferred embodiment of the present invention, the attachment is a bucket, and the control valve that controls the attachment is the bucket control valve.

Advantageous Effect

[0015] The attachment driving control system for a construction machine in accordance with an embodiment of the present invention as constructed above has the following advantages.

[0016] In the case where two attachments having different operating pressures are simultaneously driven as in a boom descending operation and a bucket operation, a hydraulic fluid from the second hydraulic pump is allowed to flow into the bucket control valve through the parallel flow path and the tandem flow path (i.e., in this case, a flow path can secured as much as a flow rate of the hydraulic fluid passing through the tandem flow path), leading to a reduction in a pressure loss occurring in the control valve, thereby reducing an energy loss.

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 showing an attachment driving control system for a construction machine in accordance with the prior art;
Fig. 2 is an enlarged view showing of an main part of a variable control valve applied to an attachment driving control system for a construction machine in accordance with the prior art;
Fig. 3 is a hydraulic circuit diagram showing a attachment driving control system for a construction machine in accordance with an embodiment of the present invention; and
Fig. 4 is an enlarged view showing of a main part of a priority control valve applied to an attachment driving control system for a construction machine in accordance with an embodiment of the present invention.

[0018] *Explanation on reference numerals of main elements in the drawings *

1:	engine
2:	first hydraulic pump
3:	second hydraulic pump
4:	pilot pump
5:	first center bypass path
6:	swing motor
7,9,11,14,16,18:	control valve
8:	arm cylinder
10,17:	traveling motor
13:	boom cylinder
15:	bucket cylinder
19,20:	pressure generation device
25:	bleed flow path
26:	center bypass shift valve

Preferred Embodiments of the Invention

[0019] 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.

[0020] An attachment driving control system for a construction machine in accordance with an embodiment of the present invention as shown in Figs. 3 and 4 includes:

an engine 1;
first and second variable displacement hydraulic pumps (hereinafter, referred to as "first and second hydraulic pumps") 2 and 3 that are connected to the engine 1 and a pilot pump 4;
a swing control valve 7 that controls the drive of a swing motor 6, an arm control valve 9 that controls the drive of an arm cylinder 8, and a traveling control valve 11 that controls the drive of a left traveling motor 10 wherein the swing control valve, the arm control valve, and the traveling control valve are installed in a first center bypass path 5 of the first hydraulic pump 2 so as to be connected to a parallel flow path 5a, respectively;
a boom control valve 14a that controls the drive of a boom cylinder 13, a bucket control valve 16 that controls the drive of a bucket cylinder 15, and a traveling control valve 18 that controls the drive of a right traveling motor 17 wherein the boom control valve, the bucket control valve, and the traveling control valve are installed in a second center bypass path 12 of the second hydraulic pump 3 and 2 so as to be connected to a parallel flow path 12a, respectively;
pressure generation devices 19 and 20 that outputs a control signal corresponding to a manipulation amount;
a bleed flow path 25 that is formed on a control spool on a boom descending side of the boom control valve 14a and maintains the second center bypass path 12 in an opened state instead of blocking the second center bypass path when the boom control valve 14a is shifted to descend the boom through the manipulation of the pressure generation device 19; and
a center bypass shift valve 26 that is installed on a lowermost downstream side of the second center bypass path 12 and is shifted by a control signal pressure for shifting the boom control valve 14a.

[0021] Thus, a hydraulic fluid from the second hydraulic pump 3 flows into the bucket control valve 16 through the parallel flow path 12a and a tandem flow path connected to the second center bypass path 12 when a boom for performing a boom descending operation and an attachment (i.e., referring to a bucket) having an operating pressure relatively higher than that of the boom are simultaneously driven.

[0022] In this case, the configuration of the attachment driving control system shown in Fig. 1 is the same as that of the attachment driving control system shown in Fig. 1 except the bleed flow path 25 that is formed on a control spool on a boom descending side of the boom control valve 14a and maintains the second center bypass path 12 in an opened state instead of blocking the second center bypass path 12 when the boom control valve 14a is shifted to descend the boom through the manipulation of the pressure generation device 19, and the center bypass shift valve 26 that is installed on the lowermost downstream side of the second center bypass path 12 and is shifted by a control signal pressure for shifting the boom control valve 14a. Thus, the detailed description

of the same configuration and operation thereof will be omitted to avoid redundancy, and the same elements are denoted by the same reference numerals.

[0023] Hereinafter, a use example of the attachment driving control system for a construction machine in accordance with an embodiment of the present invention will be described in detail with reference to the accompanying drawings.

[0024] As shown in Figs. 3 and 4, in the case where a boom descending operation and a bucket operation are simultaneously performed, the boom control valve 14a is shifted to the right on the drawing sheet in response to a pilot signal pressure from the pilot pump 4, which passes through the pressure generation device 19, by the manipulation of the pressure generation device 19. Thus, a hydraulic fluid discharged from the second hydraulic pump 3 is supplied to a small chamber of the boom cylinder 13 via a load check valve 22 and the boom control valve 14a. At the same time, a hydraulic fluid flowing out of a large chamber of the boom cylinder 13 returns to a hydraulic tank T via the boom control valve 14a and a back pressure check valve 23. As a result, the boom cylinder 13 is driven in a retractable manner to cause the boom to descend.

[0025] In this case, the hydraulic fluid flowing out of the large chamber of the boom cylinder 13 is partially regenerated to the small chamber of the boom cylinder 13 through a regeneration line formed on a control spool (i.e., referring to the boom control valve 14a) on a boom descending side.

[0026] In the meantime, the hydraulic fluid discharged from the second hydraulic pump 3 is supplied to an inlet side of the bucket control valve 16 via the second center bypass path 12 and the bleed flow path 25 formed on a control spool on a boom descending side of the boom control valve 14a. Thus, the bleed flow path 25 is connected to a spool path of the bucket control valve 16 via a load check valve 27 of the bucket control valve 16. Meanwhile, a hydraulic fluid passing through a priority control valve installed on a parallel flow path 12a joins a hydraulic fluid passing through the load check valve 27, and then flows into a spool of the bucket control valve 16.

[0027] When the boom and the bucket having different operating pressures are driven simultaneously, a hydraulic fluid from the second hydraulic pump 3 flows into the spool of the bucket control valve 16 through the parallel flow path 12a. At the same time, the hydraulic fluid from the second hydraulic pump 3 also flows into the spool of the spool of the bucket control valve 16 through the second center bypass path 12. For this reason, a pressure loss is reduced as much as a flow rate of a hydraulic fluid flowing into the spool of bucket control valve 16 through the second center bypass path 12. Likewise, the reduction in the pressure loss can also be applied to the traveling control valve 18.

[0028] 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

[0029] As described above, the attachment driving control system for a construction machine in accordance with an embodiment of the present invention is advantageous in that in the case where two attachments having different operating pressures are simultaneously driven as in a boom descending operation and a bucket operation, a hydraulic fluid from the second hydraulic pump is allowed to flow into the bucket control valve through the parallel flow path and the tandem flow path, leading to a reduction in a pressure loss occurring in the control valve, thereby increasing energy efficiency of the hydraulic system.

Claims

1. An attachment driving control system for a construction machine, comprising:

   an engine;
   first and second variable displacement hydraulic pumps connected to the engine and a pilot pump;
   a swing control valve configured to control the drive of a swing motor, an arm control valve configured to control the drive of an arm cylinder, and a traveling control valve configured to control the drive of a left traveling motor wherein the swing control valve, the arm control valve, and the traveling control valve are installed in a first center bypass path of the first hydraulic pump so as to be connected to a parallel flow path, respectively;
   a boom control valve configured to control the drive of a boom cylinder, a bucket control valve configured to control the drive of a bucket cylinder, and a traveling control valve configured to control the drive of a right traveling motor wherein the boom control valve, the bucket control valve, and the traveling control valve are installed in a second center bypass path of the second hydraulic pump so as to be connected to a parallel flow path, respectively;
   pressure generation devices configured to output a control signal corresponding to a manipulation amount;

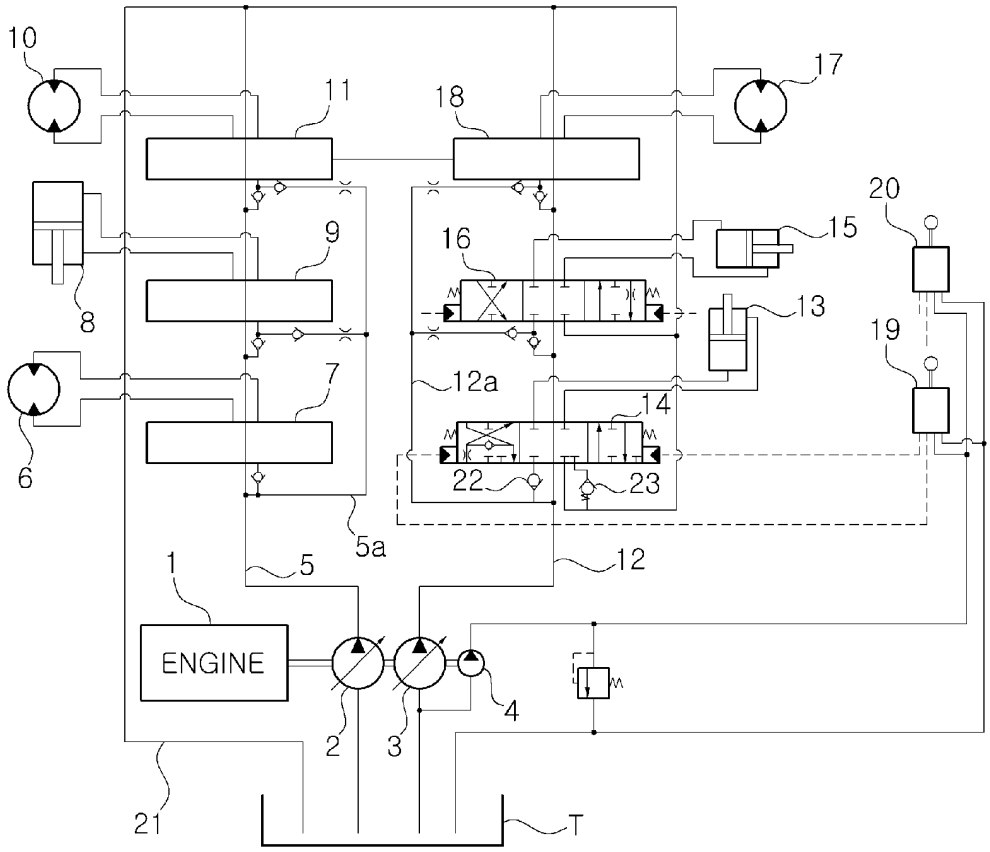
a bleed flow path formed on a control spool on a boom descending side of the boom control valve and configured to maintain the second center bypass path in an opened state instead of blocking the second center bypass path when the boom control valve is shifted to descend the boom through the manipulation of the pressure generation device; and

a center bypass shift valve installed on a lowermost downstream side of the second center bypass path and configured to be shifted by a control signal pressure for shifting the boom control valve,

wherein a hydraulic fluid from the second hydraulic pump flows into the bucket control valve through the parallel flow path and a tandem flow path connected to the second center bypass path when a boom for performing a boom descending operation and an attachment requiring an operating pressure relatively higher than that of the boom are simultaneously driven.

2. The attachment driving control system according to claim 1, wherein the attachment is a bucket, and the control valve that controls the attachment is the bucket control valve.

[Fig.1]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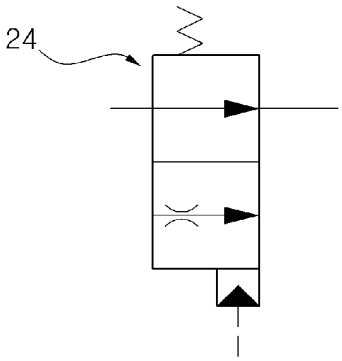
[Fig. 2]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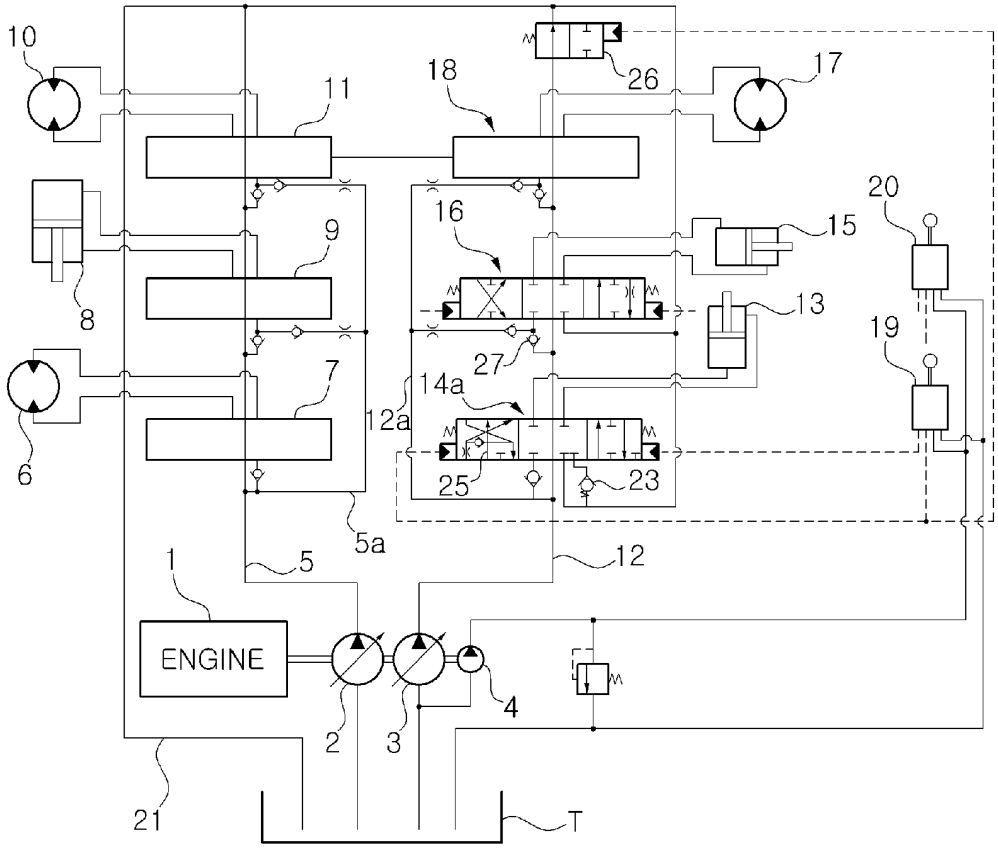
[Fig.3]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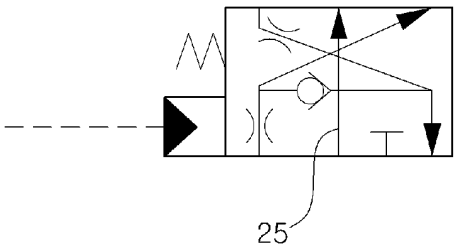
[Fig. 4]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INTERNATIONAL SEARCH REPORT

International application No.
PCT/KR2011/007439

A. CLASSIFICATION OF SUBJECT MATTER

F15B 13/043(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 13/043; E02F 9/20; F15B 11/16; F15B 11/05; 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, construction equipment, bleed flowpath, tandem flowpath, control valve

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	JP 57-184136 A (HITACHI CONSTRUCTION MACHINERY CO LTD) 12 November 1982 See column 2, line 4 - column 4, line 1 and figure 2	2
A	JP 08-239865 A (HITACHI CONSTRUCTION MACHINERY CO LTD) 17 September 1996 See abstract and figures 1, 5	2
A	JP 11-082413 A (KOMATSU LTD) 26 March 1999 See abstract and paragraphs [19] - [29] and figures 1, 5	2
A	JP 2004-324208 A (HITACHI CONSTRUCTION MACHINERY CO LTD) 18 November 2004 See abstract and paragraphs [63] - [69] and figures 1, 5	2

☐ 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

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

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

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"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	Date of mailing of the international search report
15 MAY 2012 (15.05.2012)	**17 MAY 2012 (17.05.2012)**

Name and mailing address of the ISA/KR	Authorized officer
Korean Intellectual Property Office Government Complex-Daejeon, 139 Seonsa-ro, Daejeon 302-701, Republic of Korea Facsimile No. 82-42-472-7140	Telephone No.

Form PCT/ISA/210 (second sheet) (July 2009)

INTERNATIONAL SEARCH REPORT

International application No.
PCT/KR2011/007439

Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:

2. ☒ Claims Nos.: **1**
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

The feature of claim 1 is a hydraulic fluid of a second hydraulic pump which flows in a "control valve" through a parallel flow path and a tandem flow path connected to a second center bypass path, however, control valves controlling a plurality of operating devices are indicated prior to these features. Thus, the matter indicated by the "control valves" delimited from the feature of claim 1 is not clearly defined.

3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.

2. ☐ As all searchable claims could be searched without effort justifying additional fees, this Authority did not invite payment of additional fees.

3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:

4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

☐ The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.

☐ The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.

☐ No protest accompanied the payment of additional search fees.

Form PCT/ISA/210 (continuation of first sheet (2)) (July 2009)

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/KR2011/007439

Patent document cited in search report	Publication date	Patent family member	Publication date
JP 57-184136 A	12.11.1982	JP 1543079 C JP 57-184136 A	15.02.1990 12.11.1982
JP 08-239865 A	17.09.1996	JP 3403538 B2	06.05.2003
JP 11-082413 A	26.03.1999	JP 11-082414 A US 6209321 B1	26.03.1999 03.04.2001
JP 2004-324208 A	18.11.2004	NONE	

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