



(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
10.10.2018 Bulletin 2018/41

(51) Int Cl.:
E02F 9/20 (2006.01) E02F 9/22 (2006.01)

(21) Application number: **18166095.2**

(22) Date of filing: **06.04.2018**

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR
Designated Extension States:
BA ME
Designated Validation States:
KH MA MD TN

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(30) Priority: **06.04.2017 KR 20170044905**

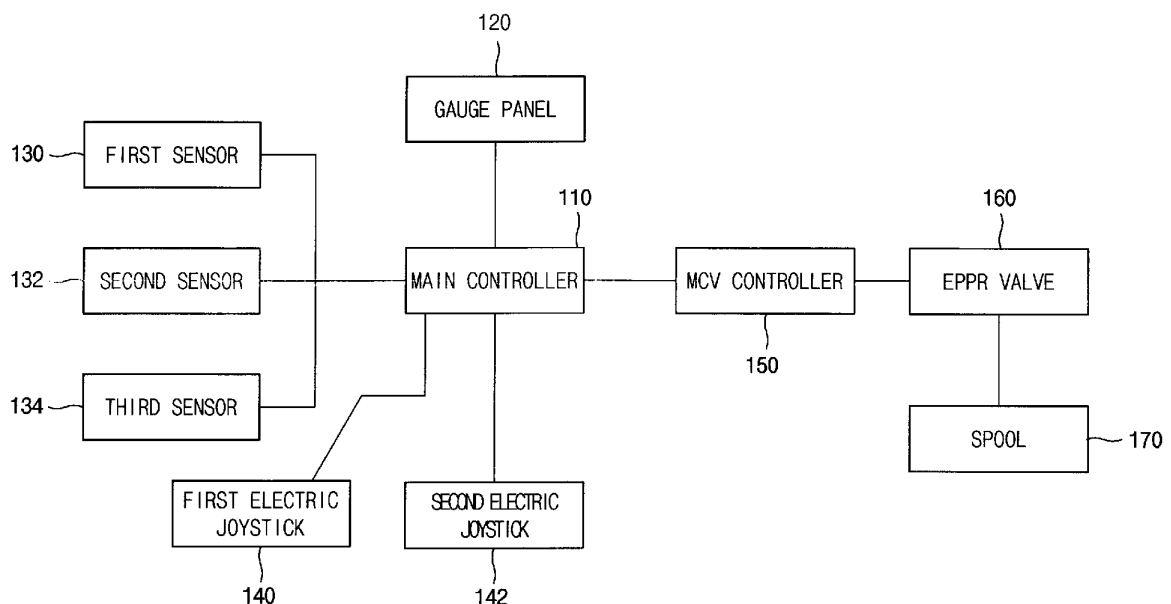
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(54) **METHOD OF CONTROLLING A FLOW RATE OF A CONSTRUCTION MACHINE AND SYSTEM FOR PERFORMING THE SAME**

(57) In a method of controlling a flow rate of a construction machine, a rotation position of at least one of working devices in the construction machine including a boom, an arm and an attachment may be detected. Whether the rotation position of the working device may reach to a maximum position of the working device or

not may be determined. When the rotation position of the working device may reach to the maximum position, a flow rate supplied to the working device may be cut off. Thus, the flow rate may not be supplied to the working device located at the maximum position so that the flow rate may not be wasted.

FIG. 1



Description

BACKGROUND

1. Field

[0001] Example embodiments relate to a method of controlling a flow rate of a construction machine and a system for performing the same. More particularly, example embodiments relate to a method of controlling a flow rate supplied to working devices of an excavator, and a system for performing the method.

2. Description of the Related Art

[0002] Generally, an excavator may include working devices such as a boom, an arm, an attachment, etc. The boom may be operated by a boom cylinder. The arm may be pivotally connected with the boom. The arm may be operated by an arm cylinder. The attachment may be pivotally connected with an end of the arm. The attachment may be operated by an attachment cylinder. The cylinders may be operated by a hydraulic pressure.

[0003] According to related arts, the boom, the arm and the attachment may have maximum rotation angles. Thus, the boom, the arm and the attachment may have maximum positions, respectively. For example, when the attachment may reach to the maximum position, the attachment may not be rotated any more although a flow rate may be continuously supplied to the attachment. Therefore, an unnecessary flow rate may be continuously supplied to the attachment located at the maximum position so that the flow rate may be wasted.

SUMMARY

[0004] Example embodiments provide a method of controlling a flow rate of a construction machine that may be capable of preventing a flow rate from being wasted.

[0005] Example embodiments also provide a system for performing the above-mentioned method.

[0006] According to example embodiments, there may be provided a method of controlling a flow rate of a construction machine. In the method of controlling the flow rate of a construction machine, a rotation position of at least one of working devices in the construction machine including a boom, an arm and an attachment may be detected. Whether the rotation position of the working device may reach to a maximum position or not may be determined. When the rotation position of the working device may reach to the maximum position, a flow rate supplied to the working devices may be cut off.

[0007] In example embodiments, detecting the rotation position of the working device may include detecting an angle of the working device or detecting a displacement of a cylinder configured to drive the working device.

[0008] In example embodiments, cutting off the flow rate supplied to the working device may include control-

ling a spool of an electronic proportional pressure reducing (EPPR) valve regardless of an output voltage of an electric joystick configured to control operations of the working device.

[0009] In example embodiments, the method may further include gradually reducing the flow rate supplied to the working device before the working device may reach to the maximum position.

[0010] In example embodiments, the method may further include reducing a discharge amount of a pump corresponding to a cut-off flow rate.

[0011] In example embodiments, the method may further include supplying the cut-off flow rate to at least one of other working devices that may not reach to the maximum position.

[0012] In example embodiments, the construction machine may include an excavator.

[0013] According to example embodiments, there may be provided a system for controlling a flow rate of a construction machine. The system may include a detection unit, an operation unit, a main control valve (MCV) controller and a main controller. The detection unit may be configured to detect a rotation position of at least one of working devices in the construction machine including a boom, an arm and an attachment. The operation unit may be configured to generate operational signals for operation the working devices. The MCV controller may move a spool of a MCV in accordance with the operational signals of the operation unit to control a hydraulic pressure of a cylinder configured to drive the working device. When the rotation position of the working device may reach to the maximum position, the main controller may cut off a flow rate supplied to the working device.

[0014] In example embodiments, the detection unit may include an angle sensor configured to detect rotation angles of the working devices or a displacement sensor configured to detect a displacement of the cylinder.

[0015] In example embodiments, the main controller may transmit a control signal to the MCV controller configured to control the spool of an electronic proportional pressure reducing (EPPR) valve regardless of an output voltage of an electric joystick configured to control operations of the working device.

[0016] In example embodiments, the main controller may gradually reduce the flow rate supplied to the working device before the working device may reach to the maximum position.

[0017] In example embodiments, the main controller may reduce a discharge amount of a pump corresponding to a cut-off flow rate.

[0018] In example embodiments, the main controller may supply the cut-off flow rate to at least one of other working devices that may not reach to the maximum position.

[0019] In example embodiments, the construction machine may include an excavator.

[0020] According to example embodiments, the flow rate may not be supplied to the working device located

at the maximum position so that the flow rate may not be wasted. Further, the discharge amount of the pump corresponding to the cut-off flow rate may be decreased so that loads applied to an engine of the construction machine may be reduced. Furthermore, the cut-off flow rate may be supplied to the other working devices to increase a working speed of the other working devices so that the construction machine may have improved operational capacity.

BRIEF DESCRIPTION OF THE DRAWINGS

[0021] Example embodiments will be more clearly understood from the following detailed description taken in conjunction with the accompanying drawings. FIGS. 1 to 6 represent non-limiting, example embodiments as described herein.

FIG. 1 is a block diagram illustrating a system for controlling a flow rate of a construction machine in accordance with example embodiments;

FIG. 2 is a perspective view illustrating works of an excavator located at maximum positions to which the system in FIG. 1 is applied;

FIG. 3 is a graph showing relations between an output voltage and strokes of an electric joystick in the construction machine;

FIG. 4 is a graph showing relations between a flow rate and an output voltage of the electric joystick;

FIG. 5 is a graph showing relations between a flow rate and an angle of a working device controlled by the system in FIG. 1; and

FIG. 6 is a flow chart illustrating a method of controlling a flow rate of a construction machine using the system in FIG. 1.

DETAILED DESCRIPTION OF THE EMBODIMENTS

[0022] Hereinafter, example embodiments will be explained in detail with reference to the accompanying drawings.

System for Controlling a flow rate of a Construction Machine

[0023] FIG. 1 is a block diagram illustrating a system for controlling a flow rate of a construction machine in accordance with example embodiments, and FIG. 2 is a perspective view illustrating working devices of an excavator located at maximum positions to which the system in FIG. 1 is applied.

[0024] Referring to FIGS. 1 and 2, a system for controlling a flow rate of a construction machine in accordance with example embodiments may include a detection unit, an operation unit, a main control valve (MCV) controller 150 and a main controller 110.

[0025] In example embodiments, the construction machine may include an excavator. The excavator may in-

clude rotary parts and working devices operated by hydraulic pressures. The working devices may include a boom B, an arm A and an attachment T. The boom B may have a first end pivotally combined with the rotary part with respect to a first rotation axis. The boom B may be operated by a boom cylinder. The arm A may have a first end pivotally combined with a second end of the boom B opposite to the first end with respect to a second rotation axis. The arm A may be operated by an arm cylinder. The attachment T may have a first end pivotally combined with a second end of the arm A opposite to the first end with respect to a third rotation axis to perform an excavation. The first, second and third rotation axes may be oriented toward substantially the same direction. Alternatively, two rotation axes among the first to third rotation axes may be oriented toward substantially the same direction and a remaining rotation axis may be oriented toward a direction different from that of the two rotation axes. Further, the first to third rotation axes may be oriented toward different directions. The attachment T may be operated by an attachment cylinder. The attachment T may include a bucket. Alternatively, the construction machine may include a wheel loader, fork lift, etc.

[0026] The detection unit may be configured to detect a rotation position of at least one among the working devices including the boom B, the arm A and the attachment T. In example embodiments, the detection unit may include a first sensor 130, a second sensor 132 and a third sensor 134.

[0027] The first sensor 130 may detect a rotation position of the boom B. The boom B may be rotated from a maximum descent position B1 to a maximum ascent position B2. When the boom B may reach to the maximum descent position B1, the boom B may not be rotated downwardly. In contrast, when the boom B may reach to the maximum ascent position B2, the boom B may not be rotated upwardly. Thus, the maximum descent position B1 and the maximum ascent position B2 may correspond to a maximum position of the boom B.

[0028] In example embodiments, the first sensor 130 may include an angle sensor configured to detect the rotation angle of the boom B. Alternatively, the first sensor 130 may include a displacement sensor configured to detect a displacement of the boom cylinder configured to drive the boom B.

[0029] The second sensor 132 may detect a rotation position of the arm A. The arm A may be rotated from a maximum descent position A1 to a maximum ascent position A2. When the arm A may reach to the maximum descent position A1, the arm A may not be rotated downwardly. In contrast, when the arm A may reach to the maximum ascent position A2, the arm A may not be rotated upwardly. Thus, the maximum descent position A1 and the maximum ascent position A2 may correspond to a maximum position of the arm A.

[0030] In example embodiments, the second sensor 132 may include an angle sensor configured to detect

the rotation angle of the arm A. Alternatively, the second sensor 132 may include a displacement sensor configured to detect a displacement of the arm cylinder configured to drive the arm A.

[0031] The third sensor 134 may detect a rotation position of the attachment T. The attachment T may be rotated from a maximum descent position T1 to a maximum ascent position T2. When the attachment T may reach to the maximum descent position T1, the attachment T may not be rotated downwardly. In contrast, when the attachment T may reach to the maximum ascent position T2, the attachment T may not be rotated upwardly. Thus, the maximum descent position T1 and the maximum ascent position T2 may correspond to a maximum position of the attachment T.

[0032] In example embodiments, the third sensor 134 may include an angle sensor configured to detect the rotation angle of the attachment T. Alternatively, the third sensor 134 may include a displacement sensor configured to detect a displacement of the attachment cylinder configured to drive the attachment T.

[0033] The rotation position of the boom B detected by the first sensor 130, the rotation position of the arm A detected by the second sensor 132, and the rotation position of the attachment T detected by the third sensor 134 may be transmitted to the main controller 110.

[0034] The operation unit may be configured to generate operational signals for driving the working devices including the boom B, the arm A and the attachment T. In example embodiments, the operation unit may include a first electric joystick 140 and a second electric joystick 142.

[0035] The main controller 110 may receive output voltages in accordance with strokes of the first electric joystick 140 and/or the second electric joystick 142. The main controller 110 may transmit control signals in accordance with the output voltages to the MCV controller 150. The MCV controller 150 may move a spool 170 of an EPPR valve 160 to control the flow rate supplied to the working devices. A worker may control the operations of the main controller 110 using a gauge panel.

[0036] The main controller 110 may determine any one of the boom B, the arm A and the attachment T located at the maximum position based on the information transmitted from the first to third sensors 130, 132 and 134. The main controller 110 may cut off the flow rate supplied to the working device located at the maximum position. That is, the main controller 110 may set the flow rate, which may be supplied to the working device located at the maximum position, as zero. Thus, the flow rate may not be supplied to the working device located at the maximum position to prevent the flow rate from being wasted.

[0037] FIG. 3 is a graph showing relations between an output voltage and strokes of an electric joystick in the construction machine, FIG. 4 is a graph showing relations between a flow rate and an output voltage of the electric joystick, and FIG. 5 is a graph showing relations between a flow rate and an angle of a working device controlled

by the system in FIG. 1.

[0038] As shown in FIG. 3, the output voltages of the first and second electric joysticks 140 and 142 may be increased in proportion to the strokes of the first and second electric joysticks 140 and 142. As shown in FIG. 4, the main controller 110 may receive the output voltages of the first and second electric joysticks 140 and 142. The main controller 110 may increase the supplies of the flow rate to the working devices.

[0039] As shown in FIG. 5, when the working device may reach to the maximum position, the main controller 110 may cut off the flow rate to the working device located at the maximum position. Particularly, when the system of this example embodiment may be operated, the main controller 110 may cut off the flow rate supplied to the working device located at the maximum position regardless of the output voltages of the first and second electric joysticks 140 and 142. Thus, although the worker may operate the first electric joystick 140 and/or the second electric joystick 142 in operating the system, the main controller 110 may control the flow rate regardless of the output voltages in accordance with the strokes of the first and second electric joysticks 140 and 142.

[0040] Further, the main controller 110 may gradually reduce the flow rate before the working device may reach to the maximum position. When the working device may reach to the maximum position, the main controller 110 may completely cut off the flow rate supplied to the working device. That is, the flow rate supplied to the working device located at the maximum position may be about zero.

[0041] The system may include a capacity improvement mode and a fuel reduction mode. The capacity improvement mode and the fuel reduction mode may be represented on the gauge panel 120.

[0042] When the worker may select the capacity improvement mode, the main controller 110 may supply a flow rate corresponding to the cut-off flow rate, which may not be supplied to the working device located at the maximum position, to any one of other working devices. Particularly, the flow rate corresponding to the cut-off flow rate may be supplied to any one of other working devices requiring a rapid working speed.

[0043] When the worker may select the fuel reduction mode, the main controller 110 may reduce a discharge amount of a pump corresponding to the cut-off flow rate, which may not be supplied to the working device located at the maximum position. Therefore, because the cut-off flow rate may not be discharged from the pump, the fuel may be reduced.

[0044] For example, when the boom B may reach to the maximum descent position B1 or the maximum ascent position B2, the boom B may not be rotated although the flow rate may be supplied to the boom B. The main controller 110 may cut off the flow rate supplied to the boom B located at the maximum position. Thus, the flow rate supplied to the boom B may be about zero.

[0045] When the worker may select the capacity im-

provement mode, the main controller 110 may supply the flow rate corresponding to the cut-off flow rate, which may not be supplied to the boom B located at the maximum position, to the arm A or the attachment T requiring the rapid working speed.

[0046] When the worker may select the fuel reduction mode, the main controller 110 may reduce the discharge amount of the pump corresponding to the cut-off flow rate, which may not be supplied to the boom B located at the maximum position. Therefore, because the cut-off flow rate may not be discharged from the pump, the fuel may be reduced.

[0047] When the arm A may reach to the maximum descent position A1 or the maximum ascent position A2, the arm A may not be rotated although the flow rate may be supplied to the arm A. The main controller 110 may cut off the flow rate supplied to the arm A located at the maximum position. Thus, the flow rate supplied to the arm A may be about zero.

[0048] When the worker may select the capacity improvement mode, the main controller 110 may supply the flow rate corresponding to the cut-off flow rate, which may not be supplied to the arm A located at the maximum position, to the boom B or the attachment T requiring the rapid working speed.

[0049] When the worker may select the fuel reduction mode, the main controller 110 may reduce the discharge amount of the pump corresponding to the cut-off flow rate, which may not be supplied to the arm A located at the maximum position. Therefore, because the cut-off flow rate may not be discharged from the pump, the fuel may be reduced.

[0050] When the attachment T may reach to the maximum descent position T1 or the maximum ascent position T2, the attachment T may not be rotated although the flow rate may be supplied to the attachment T. The main controller 110 may cut off the flow rate supplied to the attachment T located at the maximum position. Thus, the flow rate supplied to the attachment T may be about zero.

[0051] When the worker may select the capacity improvement mode, the main controller 110 may supply the flow rate corresponding to the cut-off flow rate, which may not be supplied to the attachment T located at the maximum position, to the boom B or the arm A requiring the rapid working speed.

[0052] When the worker may select the fuel reduction mode, the main controller 110 may reduce the discharge amount of the pump corresponding to the cut-off flow rate, which may not be supplied to the attachment T located at the maximum position. Therefore, because the cut-off flow rate may not be discharged from the pump, the fuel may be reduced.

Method of Controlling a flow rate of a Construction Machine

[0053] FIG. 6 is a flow chart illustrating a method of

controlling a flow rate of a construction machine using the system in FIG. 1.

[0054] Referring to FIGS. 1 and 6, in step S210, the first sensor 130 may detect the rotation position of the boom B. The second sensor 132 may detect the rotation position of the arm A. The third sensor 134 may detect the rotation position of the attachment T.

[0055] The rotation position of the boom B detected by the first sensor 130, the rotation position of the arm A detected by the second sensor 132 and the rotation position of the attachment T detected by the third sensor 134 may be transmitted to the main controller 110.

[0056] In step S220, the main controller 110 may determine any one of the boom B, the arm A and the attachment T located at the maximum position based on the information from the first to third sensors 130, 132 and 134.

[0057] When the boom B, the arm A and the attachment T may not reach to the maximum position, in step S210, the first to third sensors 130, 132 and 134 may again detect the rotation positions of the boom B, the arm A and the attachment T.

[0058] When any one of the boom B, the arm A and the attachment T may reach to the maximum position, in step S230, the main controller 110 may cut off the flow rate supplied to the working device located at the maximum position. That is, the main controller 110 may set the flow rate supplied to the working device, which may be located at the maximum position, as about zero. Thus, the flow rate may not be supplied to the working device located at the maximum position to prevent the flow rate from being wasted. The cut-off flow rate supplied to the working device may include reducing the flow rate to a predetermined ratio or a maximumly zero. That is, the flow rate supplied to the working device may be maximumly reduced to the predetermined ratio based on errors of the sensors or flow rate controls.

[0059] Further, when the method of this example embodiment may be operated, the main controller 110 may cut off the flow rate supplied to the working device located at the maximum position regardless of the output voltages of the first and second electric joysticks 140 and 142. Thus, although the worker may operate the first electric joystick 140 and/or the second electric joystick 142 in operating the system, the main controller 110 may control the flow rate regardless of the output voltages in accordance with the strokes of the first and second electric joysticks 140 and 142. Furthermore, the main controller 110 may gradually reduce the flow rate before the working device may reach to the maximum position. When the working device may reach to the maximum position, the main controller 110 may completely cut off the flow rate supplied to the working device. That is, the flow rate supplied to the working device located at the maximum position may be about zero.

[0060] For example, when the boom B may reach to the maximum descent position B1 or the maximum ascent position B2, the boom B may not be rotated although

the flow rate may be supplied to the boom B. The main controller 110 may cut off the flow rate supplied to the boom B located at the maximum position. Thus, the flow rate supplied to the boom B may be about zero.

[0061] When the arm A may reach to the maximum descent position A1 or the maximum ascent position A2, the arm A may not be rotated although the flow rate may be supplied to the arm A. The main controller 110 may cut off the flow rate supplied to the arm A located at the maximum position. Thus, the flow rate supplied to the arm A may be about zero.

[0062] When the attachment T may reach to the maximum descent position T1 or the maximum ascent position T2, the attachment T may not be rotated although the flow rate may be supplied to the attachment T. The main controller 110 may cut off the flow rate supplied to the attachment T located at the maximum position. Thus, the flow rate supplied to the attachment T may be about zero.

[0063] In step S240, whether the fuel reduction mode may be selected or not may be identified. When the worker may select the fuel reduction mode, in step S250, the main controller 110 may reduce a discharge amount of a pump corresponding to the cut-off flow rate, which may not be supplied to the working device located at the maximum position. Therefore, because the cut-off flow rate may not be discharged from the pump, the fuel may be reduced.

[0064] For example, when the boom B may reach to the maximum position, the main controller 110 may reduce the discharge amount of the pump corresponding to the cut-off flow rate, which may not be supplied to the boom B located at the maximum position. Therefore, because the cut-off flow rate may not be discharged from the pump, the fuel may be reduced.

[0065] When the arm B may reach to the maximum position, the main controller 110 may reduce the discharge amount of the pump corresponding to the cut-off flow rate, which may not be supplied to the arm A located at the maximum position. Therefore, because the cut-off flow rate may not be discharged from the pump, the fuel may be reduced.

[0066] When the attachment T may reach to the maximum position, the main controller 110 may reduce the discharge amount of the pump corresponding to the cut-off flow rate, which may not be supplied to the attachment T located at the maximum position. Therefore, because the cut-off flow rate may not be discharged from the pump, the fuel may be reduced.

[0067] When the worker may not select the fuel reduction mode, in step ST260, whether the capacity improvement mode may be selected or not may be identified.

[0068] When the worker may select the capacity improvement mode, in step S270, the main controller 110 may supply a flow rate corresponding to the cut-off flow rate, which may not be supplied to the working device located at the maximum position, to any one of other working devices. Particularly, the flow rate corresponding

to the cut-off flow rate may be supplied to any one of other working devices requiring a rapid working speed.

[0069] For example, when the boom B may reach to the maximum position, the main controller 110 may supply the flow rate corresponding to the cut-off flow rate, which may not be supplied to the boom B located at the maximum position, to the arm A or the attachment T requiring the rapid working speed. The working device requiring the rapid working speed may be identified from the strokes of the joysticks 140 and 142.

[0070] When the arm A may reach to the maximum position, the main controller 110 may supply the flow rate corresponding to the cut-off flow rate, which may not be supplied to the arm A located at the maximum position, to the boom B or the attachment T requiring the rapid working speed. The working device requiring the rapid working speed may be identified from the strokes of the joysticks 140 and 142.

[0071] When the attachment T may reach to the maximum position, the main controller 110 may supply the flow rate corresponding to the cut-off flow rate, which may not be supplied to the attachment T located at the maximum position, to the boom B or the arm A requiring the rapid working speed. The working device requiring the rapid working speed may be identified from the strokes of the joysticks 140 and 142.

[0072] According to example embodiments, the flow rate may not be supplied to the working device located at the maximum position so that the flow rate may not be wasted. Further, the discharge amount of the pump corresponding to the cut-off flow rate may be decreased so that loads applied to an engine of the construction machine may be reduced. Furthermore, the cut-off flow rate may be supplied to the other working devices to increase a working speed of the other working devices so that the construction machine may have improved operational capacity.

[0073] The foregoing is illustrative of example embodiments and is not to be construed as limiting thereof. Although a few example embodiments have been described, those skilled in the art will readily appreciate that many modifications are possible in the example embodiments without materially departing from the novel teachings and advantages of the present invention. Accordingly, all such modifications are intended to be included within the scope of the present invention as defined in the claims. In the claims, means-plus-function clauses are intended to cover the structures described herein as performing the recited function and not only structural equivalents but also equivalent structures. Therefore, it is to be understood that the foregoing is illustrative of various example embodiments and is not to be construed as limited to the specific example embodiments disclosed, and that modifications to the disclosed example embodiments, as well as other example embodiments, are intended to be included within the scope of the appended claims.

Claims

1. A method of controlling a flow rate of a construction machine, the method comprising:

detecting a rotation position of at least one of working devices including a boom, an arm and an attachment of the construction machine; determining whether the detected working device reaches to a maximum position or not; and cutting off a flow rate supplied to the detected working device when the detected working device reaches to the maximum position.

2. The method of claim 1, wherein detecting the rotation position of the working device comprises detecting an angle of the working device or detecting a displacement of a cylinder configured to drive the working device.

3. The method of claim 1, wherein cutting off the flow rate comprises controlling a spool of an electronic proportional pressure reducing (EPPR) valve regardless of an output voltage of an electric joystick configured to control the working devices.

4. The method of claim 1, further comprising gradually reducing the flow rate, which is supplied to the detected working device, before the detected working device reaches to the maximum position.

5. The method of claim 1, further comprising reducing a discharge amount of a pump corresponding to a cut-off flow rate.

6. The method of claim 1, further comprising supplying a cut-off flow rate to at least one of the working devices that do not reach to the maximum position.

7. The method of claim 1, wherein the construction machine comprises an excavator.

8. A system for controlling a flow rate of a construction machine, the system comprising:

a detection unit configured to detect a rotation position of at least one of working devices including a boom, an arm and an attachment of the construction machine;

an operation unit configured to generate operational signals for driving the working devices;

a main control valve (MCV) controller configured to control a hydraulic pressure of a cylinder, which is configured to drive the working devices, by moving a spool of an electronic proportional pressure reducing (EPPR) valve in accordance with the operational signals of the operation unit; and

a main controller configured to cut off a flow rate supplied to any one of the working devices when the working device reaches to the maximum position.

9. The system of claim 8, wherein the detection unit comprises an angle sensor configured to detect an angle of the working device or a displacement sensor configured to detect a displacement of the cylinder.

10. The system of claim 8, wherein the main controller transmits a control signal for controlling the spool of the EPPR valve regardless of an output voltage of an electric joystick configured to control the working devices.

11. The system of claim 8, wherein the main controller gradually reduces the flow rate, which is supplied to the working device located at the maximum position, before the working device reaches to the maximum position.

12. The system of claim 8, wherein the main controller reduces a discharge amount of a pump corresponding to a cut-off flow rate.

13. The system of claim 8, wherein the main controller supplies a cut-off flow rate to at least one of the working devices that do not reach to the maximum position.

14. The system of claim 1, wherein the construction machine comprises an excavator.

FIG. 1

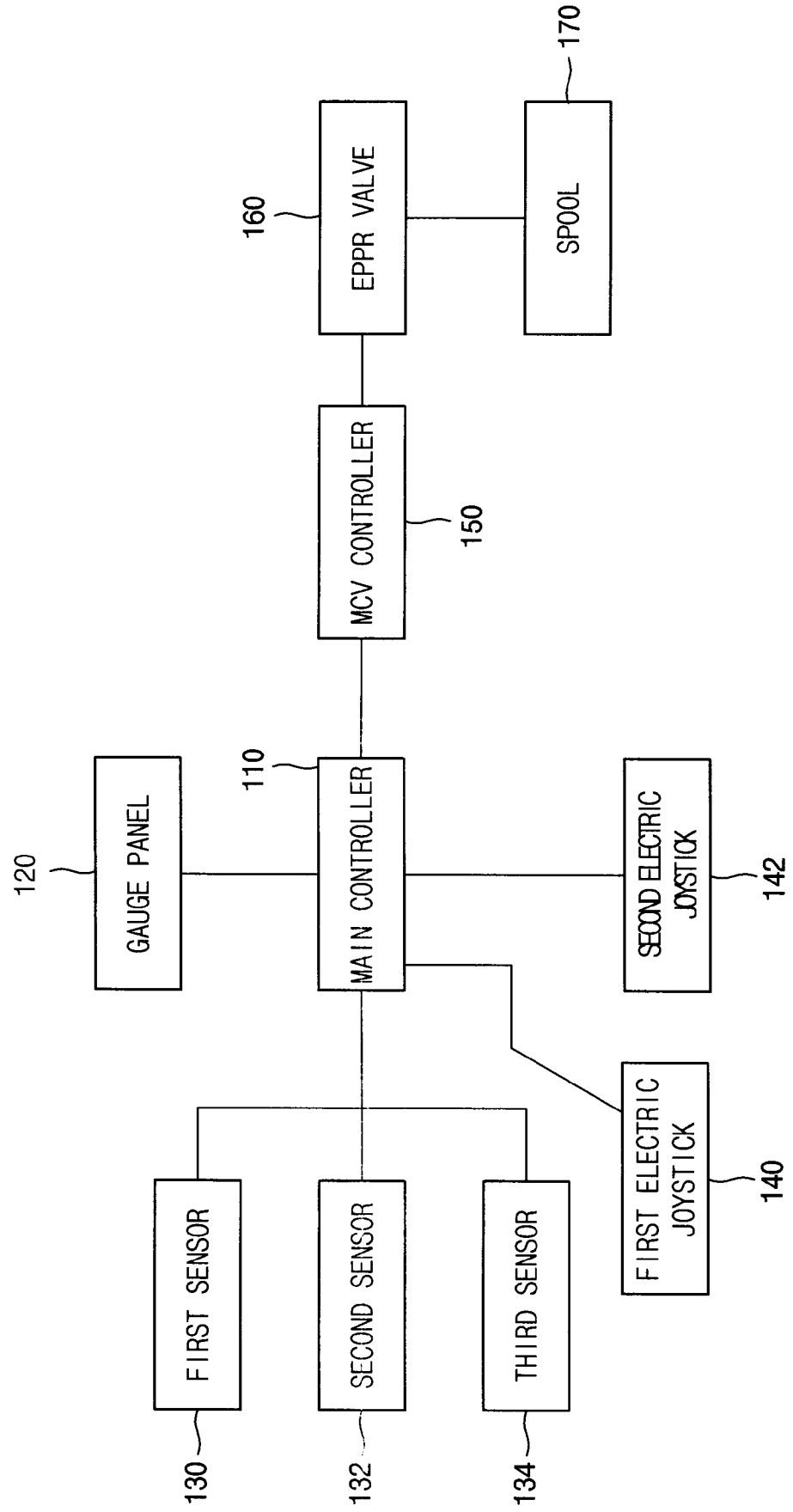


FIG. 2

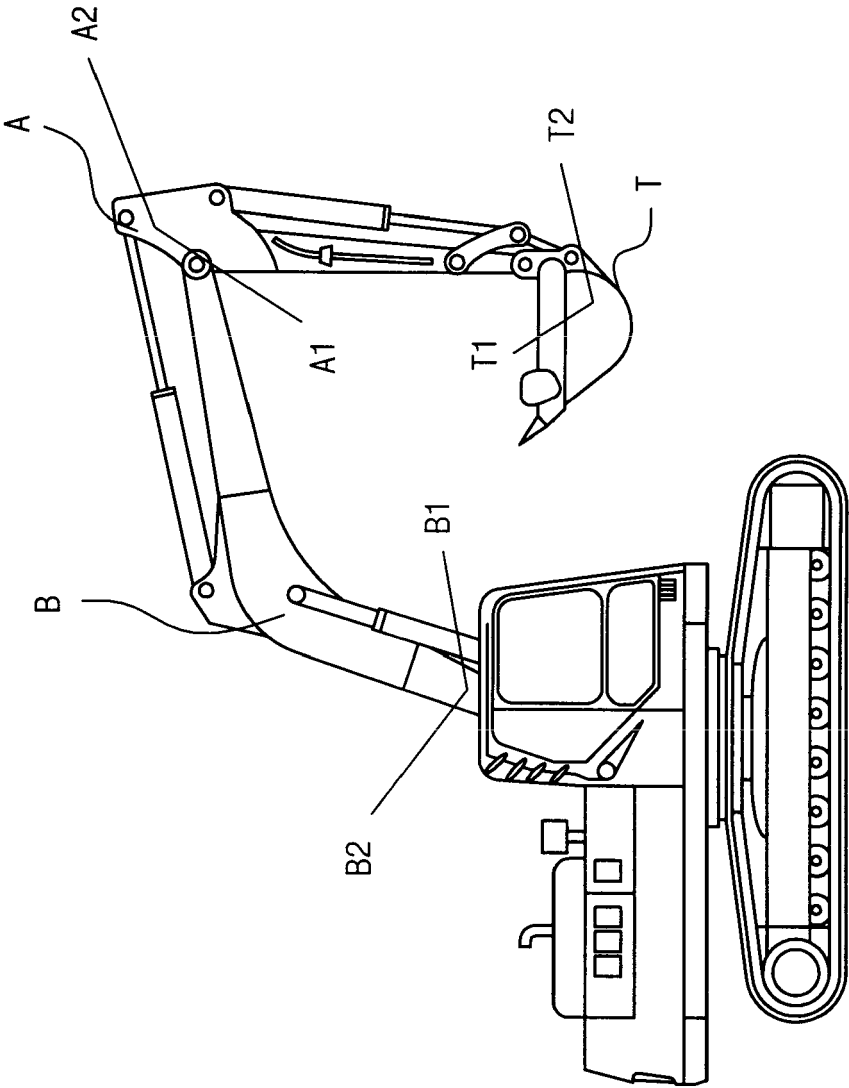


FIG. 3

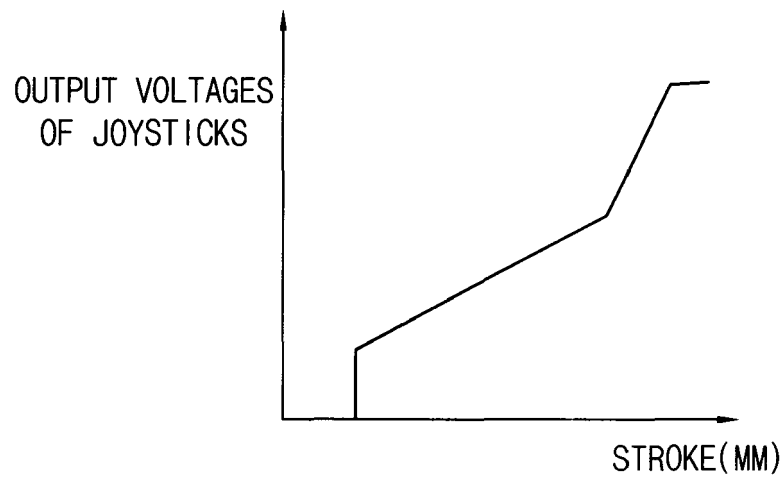


FIG. 4

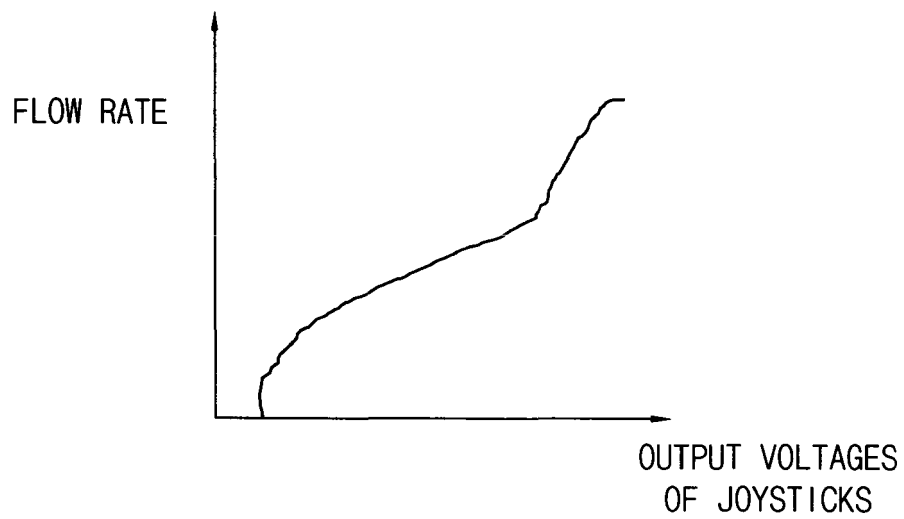


FIG. 5

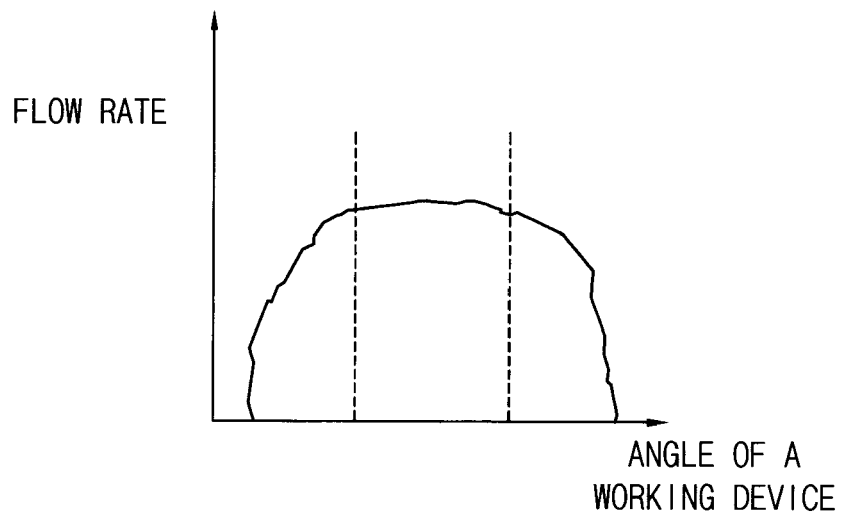
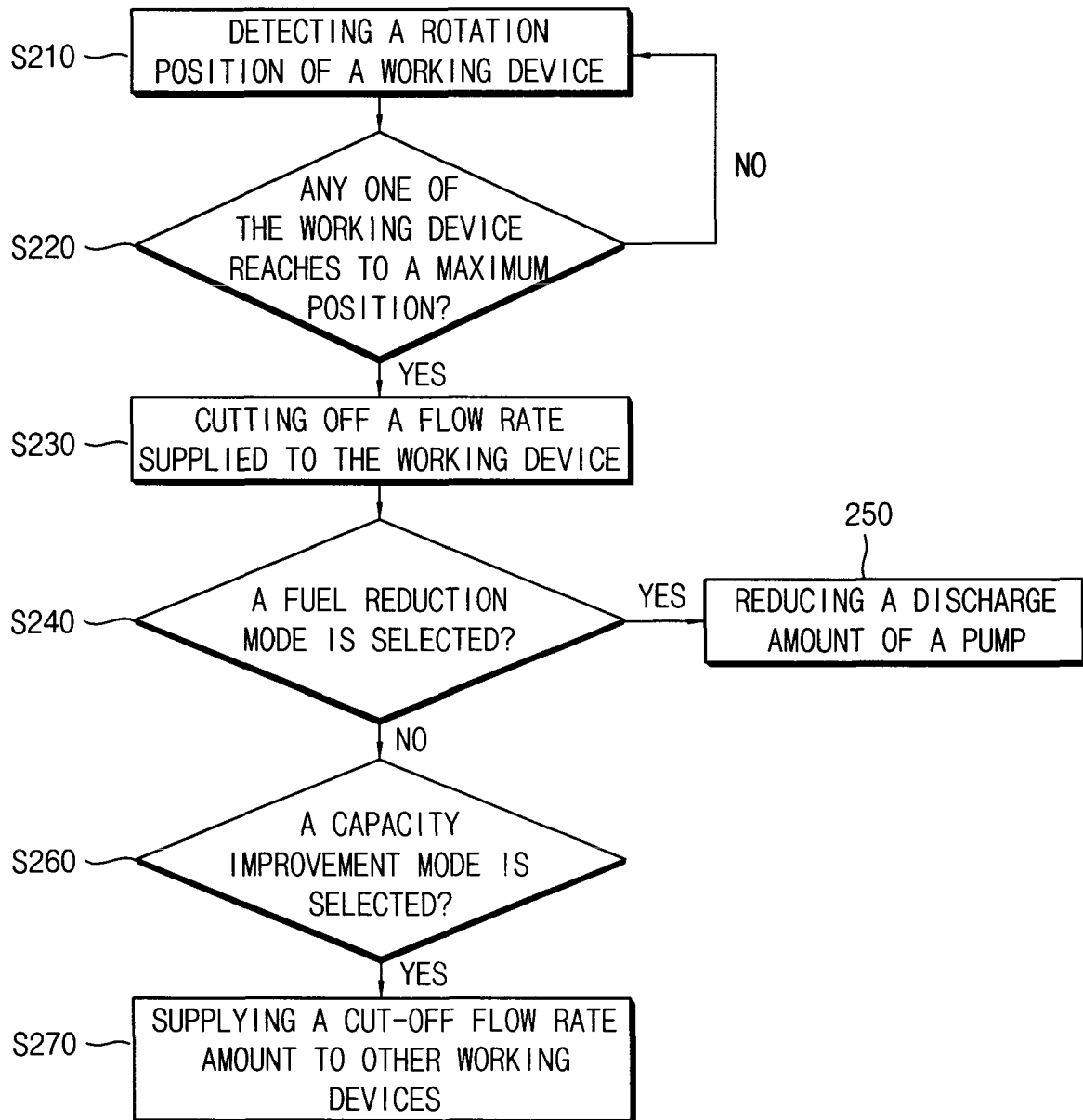


FIG. 6





EUROPEAN SEARCH REPORT

 Application Number
 EP 18 16 6095

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DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	EP 1 752 664 A2 (KOBLECO CONSTRUCTION MACHINERY CO LTD [JP]) 14 February 2007 (2007-02-14)	1-5, 7-12,14	INV. E02F9/20 E02F9/22
Y	* paragraphs [0012] - [0014], [0026], [0032], [0033], [0051]; figure 2 *	6,13	
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The present search report has been drawn up for all claims			TECHNICAL FIELDS SEARCHED (IPC)
			E02F
Place of search		Date of completion of the search	Examiner
Munich		12 July 2018	Pedersen, Henrik
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