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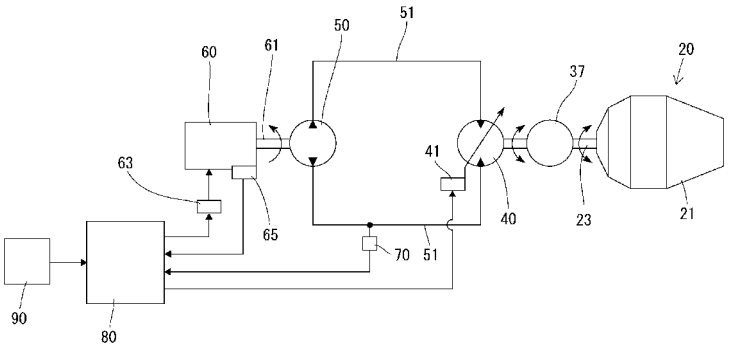
(54) **Title**: READY-MIXED CONCRETE MANUFACTURING APPARATUS OR TRANSPORTING APPARATUS AND METHOD FOR CONTROLLING SAME

(54) 発明の名称 : レディミクストコンクリート製造装置又は輸送装置、及びその制御方法



(57) **Abstract**: Provided is a manufacturing apparatus or a transporting apparatus capable of satisfactorily manufacturing ready-mixed concrete. A concrete mixer truck (1) includes a mixing drum (20), a hydraulic motor (40), a hydraulic pump (50), an engine (60), a pressure sensor (70), and a control device (80). The hydraulic motor (40) is a two-speed type and rotates the mixing drum (20). The pressure sensor (70) detects a driving pressure of the hydraulic motor (40). When the pressure sensor (70) detects a pressure value less than or equal to a first pressure value, the control device (80) performs a first rotation step of driving the engine (60) at a first rotational speed while putting the hydraulic motor (40) into a second speed to rotate the mixing drum. In addition, when the pressure sensor (70) detects a pressure value greater than the first pressure value, the control device (80) performs a second rotation step of driving the engine (60) at a second rotational speed higher than the first rotational speed while putting the hydraulic motor (40) into a first speed to rotate the mixing drum.

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— 国際調査報告（条約第 21 条(3)）

レディミクストコンクリートを良好に製造することができる製造装置又は輸送装置を提供する。 ミキサ車（１）は、ミキサドラム（２０）、油圧モーター（４０）、油圧ポンプ（５０）、エンジン（６０）、圧力センサ（７０）、及び制御装置（８０）を備えている。油圧モーター（４０）は２速式でありミキサドラム（２０）を回転させる。圧力センサ（７０）は油圧モーター（４０）の駆動圧力を検出する。制御装置（８０）は、圧力センサ（７０）が第１圧力値以下の圧力値を検出すると、油圧モーター（４０）を２速にしつつエンジン（６０）を第１回転数で駆動してミキサドラムを回転させる第１回転工程を実行させる。また、制御装置（８０）は、圧力センサ（７０）が第１圧力値よりも大きい圧力値を検出すると、油圧モーター（４０）を１速にしつつエンジン（６０）を第１回転数よりも高い第２回転数で駆動してミキサドラムを回転させる第２回転工程を実行させる。

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DESCRIPTION

Title of the Invention: READY-MIXED CONCRETE MANUFACTURING APPARATUS OR TRANSPORTING APPARATUS AND METHOD OF CONTROLLING THE APPARATUS

Technical Field

[0001] The present invention relates to a ready-mixed concrete manufacturing apparatus or transporting apparatus and a method of controlling the apparatus.

Background Art

[0002] Patent Document 1 discloses a conventional ready-mixed concrete transporting apparatus. This ready-mixed concrete transporting apparatus includes a mixing drum mounted on a mount of a vehicle body, and a hydraulic motor. The mixing drum is rotated by the hydraulic motor to knead raw materials of ready-mixed concrete and water all put into the mixing drum. The raw materials of ready-mixed concrete include cement, aggregate and admixture. The hydraulic motor is rotated by circulation of a hydraulic fluid between a hydraulic motor and the hydraulic pump. The hydraulic pump is normally driven by an engine. Thus, the hydraulic pump of this ready-mixed concrete transporting apparatus is rotated according to a rotational speed of the engine. Accordingly, in this ready-mixed concrete transporting apparatus, the raw materials of ready-mixed concrete and water put into the mixing drum are kneaded while the rotational speed of the mixing drum is controlled by the rotational speed of the engine, whereby the ready-mixed concrete is manufactured.

Prior Art Document

Patent Documents

[0003] Patent Document 1: Japanese Patent Application Publication No. 2013-248859

[0003a] Any discussion of the prior art throughout the specification should in no way be considered as an admission that such prior art is widely known or forms part of common general knowledge in the field.

Summary of the Invention

Problem to Be Overcome by the Invention

[0004] In the above-described ready-mixed concrete transporting apparatus, however, no consideration is paid to changes in a kneaded state such as viscosity in the process of kneading the raw materials of ready-mixed concrete and water while putting them into the mixing drum. As a result, there is a possibility that load applied to the hydraulic motor would be changed due to the changes in the kneaded state of the raw materials of ready-mixed concrete and water so that the rotational speed of the mixing drum would be fluctuated. Furthermore, this ready-mixed concrete transporting apparatus requires time and effort to adjust the rotational speed of the engine according to the kneaded state of the raw materials of ready-mixed concrete and water thereby to appropriately rotate the mixing drum. Still furthermore, this ready-mixed concrete transporting apparatus has no choice but to increase the rotational speed of the engine in order to increase the rotational speed of the mixing drum, which would result in consumption of a large amount of fuel and production of large noise.

[0005] The present invention was made in view of the

above-described circumstances in the conventional art and has an object to provide a ready-mixed concrete manufacturing apparatus or transporting apparatus which can successfully manufacture ready-mixed concrete and a method of controlling the apparatus.

[0005a] It is an object of the present invention to overcome or ameliorate at least one of the disadvantages of the prior art, or to provide a useful alternative.

Means for Overcoming the Problem

[0006] A ready-mixed concrete manufacturing apparatus or transporting apparatus in accordance with the invention includes a mixing drum, a fluid-pressure motor, a fluid-pressure pump, a drive unit, a pressure detecting device, and a control device. The mixing drum kneads raw materials of ready-mixed concrete and water all put thereinto. The raw materials of ready-mixed concrete include cement, aggregate and admixture. The fluid-pressure motor rotates the mixing drum. The fluid-pressure motor has a variable discharge capacity of an operating liquid. The fluid-pressure pump circulates the operating liquid between the fluid-pressure pump and the fluid-pressure motor. The drive unit rotates and drives the fluid-pressure pump. The pressure detecting device detects a driving pressure of the fluid-pressure motor. When a pressure value detected by the pressure detecting device is not more than a first pressure value, the control device executes a first rotation process in which the drive unit is driven at a first rotational speed while the discharge capacity of the fluid-pressure motor is reduced

whereby the mixing drum is rotated. When the pressure value detected by the pressure detecting device is larger than the first pressure value, the control device executes a second rotation process in which the drive unit is driven at a second rotational speed higher than the first rotational speed while the discharge capacity of the fluid-pressure motor is increased whereby the mixing drum is rotated.

[0007] A method of controlling a ready-mixed concrete manufacturing apparatus or transporting apparatus in accordance with the invention, includes a first rotation process and a second rotation process when a fluid-pressure motor rotated by circulation of an operating liquid between the fluid-pressure motor and a fluid-pressure pump driven by a drive unit rotates a mixing drum into which raw materials of ready-mixed concrete including cement, aggregate and admixture, and water are put, thereby kneading the raw materials and the water. In the first rotation process, when a pressure detecting device detecting a driving pressure of the fluid-pressure motor detects a pressure value of not more than a first pressure value, a drive unit is driven at a first rotational speed while a discharge capacity of a fluid-pressure motor is reduced whereby the mixing drum is rotated. In the second rotation process, when the pressure value is larger than the first pressure value, the drive unit is driven at a second rotational speed higher than the first rotational speed while the discharge capacity of the fluid-pressure motor is increased whereby the mixing drum is rotated.

[0008] The control device of the ready-mixed concrete manufacturing apparatus or transporting apparatus and the method

of controlling the apparatus in accordance with the invention may reduce the discharge capacity of the fluid-pressure motor when a pressure value detected by the pressure detecting device at a time when the driving pressure of the fluid-pressure motor is stable is not more than the first pressure value, and may increase the discharge capacity of the fluid-pressure motor when the pressure value detected by the pressure detecting device is larger than the first pressure value. Here, the state that the driving pressure of the fluid-pressure motor is stable refers to a state that the driving pressure is within a set range for a predetermined time period (the same shall apply hereinafter).

[0009] In the ready-mixed concrete manufacturing apparatus or transporting apparatus and the method of controlling the apparatus in accordance with the invention, the drive unit may be driven at the first rotational speed until a pressure value detected by the pressure detecting device during execution of the first rotation process becomes not less than a second pressure value larger than the first pressure value, and the second rotation process may be executed when the pressure value detected by the pressure detecting device becomes not less than the second pressure value.

[0010] In the ready-mixed concrete manufacturing or transporting apparatus in accordance with the invention, the first and second pressure values may have respective threshold values.

[0010a] In one aspect, the present invention provides a ready-mixed concrete manufacturing apparatus or transporting apparatus comprising:

a mixing drum kneading raw materials of ready-mixed

concrete and water all put thereinto, the raw materials including cement, aggregate and admixture;

a fluid-pressure motor having a variable discharge capacity of an operating liquid and rotating the mixing drum;

a fluid-pressure pump circulating the operating liquid between the fluid-pressure pump and the fluid-pressure motor;

a drive unit rotating and driving the fluid-pressure pump;

a pressure detecting device detecting a driving pressure of the fluid-pressure motor; and

a control device configured to execute a first rotation process when a pressure value detected by the pressure detecting device at a time when the driving pressure is stable is not more than a first pressure value, in which the drive unit is driven at a first rotational speed while the discharge capacity of the fluid-pressure motor is reduced whereby the mixing drum is rotated, the control device also being configured to execute a second rotation process when the pressure value is larger than the first pressure value, in which the drive unit is driven at a second rotational speed higher than the first rotational speed while the discharge capacity of the fluid-pressure motor is increased whereby the mixing drum is rotated.

[0010b] In another aspect, the present invention provides a ready-mixed concrete manufacturing apparatus or transporting apparatus, comprising:

a mixing drum kneading raw materials of ready-mixed concrete and water all put thereinto, the raw materials including cement, aggregate and admixture;

a fluid-pressure motor having a variable discharge capacity

of an operating liquid and rotating the mixing drum;

a fluid-pressure pump circulating the operating liquid between the fluid-pressure pump and the fluid-pressure motor;

a drive unit rotating and driving the fluid-pressure pump;

a pressure detecting device detecting a driving pressure of the fluid-pressure motor; and

a control device configured to execute a first rotation process when a pressure value detected by the pressure detecting device is not more than a first pressure value, in which the drive unit is driven at a first rotational speed while the discharge capacity of the fluid-pressure motor is reduced whereby the mixing drum is rotated, the control device also being configured to execute a second rotation process when the pressure value is larger than the first pressure value, in which the drive unit is driven at a second rotational speed higher than the first rotational speed while the discharge capacity of the fluid-pressure motor is increased whereby the mixing drum is rotated,

wherein the control device drives the drive unit at the first rotational speed until the pressure value detected by the pressure detecting device during execution of the first rotation process becomes not less than a second pressure value, the second pressure value being larger than the first pressure value, and the control device executes the second rotation process when the pressure value detected by the pressure detecting device becomes not less than the second pressure value.

[0010c] In another aspect, the present invention provides a ready-mixed concrete manufacturing apparatus or transporting

apparatus, comprising:

a mixing drum kneading raw materials of ready-mixed concrete and water all put thereinto, the raw materials including cement, aggregate and admixture;

a fluid-pressure motor having a variable discharge capacity of an operating liquid and rotating the mixing drum;

a fluid-pressure pump circulating the operating liquid between the fluid-pressure pump and the fluid-pressure motor;

a drive unit rotating and driving the fluid-pressure pump;

a pressure detecting device detecting a driving pressure of the fluid-pressure motor; and

a control device configured to execute a first rotation process when a pressure value detected by the pressure detecting device is not more than a first pressure value, in which the drive unit is driven at a first rotational speed while the discharge capacity of the fluid-pressure motor is reduced whereby the mixing drum is rotated, the control device also being configured to execute a second rotation process when the pressure value is larger than the first pressure value, in which the drive unit is driven at a second rotational speed higher than the first rotational speed while the discharge capacity of the fluid-pressure motor is increased whereby the mixing drum is rotated,

wherein the first pressure value has an upper threshold and a lower threshold;

wherein the control device determines that the pressure value is not more than the first pressure value when the pressure value is not more than the lower threshold; and

wherein the control device determines that the pressure value is not less than the first pressure value when the pressure value is not less than the upper threshold.

[0010d] In another aspect, the present invention provides a method of controlling a ready-mixed concrete manufacturing apparatus or transporting apparatus, comprising a first rotation process and a second rotation process when a fluid-pressure motor rotated by circulation of an operating liquid between the fluid-pressure motor and a fluid-pressure pump rotated and driven by a drive unit rotates a mixing drum into which raw materials of ready-mixed concrete including cement, aggregate and admixture, and water are put, thereby kneading the raw materials and the water,

wherein in the first rotation process, when a pressure detecting device detecting a driving pressure of a fluid-pressure motor detects a pressure value of not more than a first pressure value at a time when the driving pressure is stable, a drive unit is driven at a first rotational speed while a discharge capacity of the fluid-pressure motor is reduced whereby the mixing drum is rotated, and

wherein in the second rotation process, when the pressure detecting device detects the pressure value larger than the first pressure value at a time when the driving pressure is stable, the drive unit is driven at a second rotational speed higher than the first rotational speed while the discharge capacity of the fluid-pressure motor is increased whereby the mixing drum is rotated.

[0010e] In another aspect, the present invention provides

a method of controlling a ready-mixed concrete manufacturing apparatus or transporting apparatus, comprising a first rotation process and a second rotation process when a fluid-pressure motor rotated by circulation of an operating liquid between the fluid-pressure motor and a fluid-pressure pump rotated and driven by a drive unit rotates a mixing drum into which raw materials of ready-mixed concrete including cement, aggregate and admixture, and water are put, thereby kneading the raw materials and the water,

wherein in the first rotation process, when a pressure detecting device detecting a driving pressure of a fluid-pressure motor detects a pressure value of not more than a first pressure value, a drive unit is driven at a first rotational speed while a discharge capacity of the fluid-pressure motor is reduced whereby the mixing drum is rotated,

wherein in the second rotation process, when the pressure detecting device detects the pressure value larger than the first pressure value, the drive unit is driven at a second rotational speed higher than the first rotational speed while the discharge capacity of the fluid-pressure motor is increased whereby the mixing drum is rotated, and

wherein the drive unit is driven at the first rotational speed until the pressure value detected by the pressure detecting device during execution of the first rotation process becomes not less than a second pressure value, the second pressure value being larger than the first pressure value, and the second rotation process is executed when the pressure value detected

by the pressure detecting device becomes not less than the second pressure value.

[1101f] Unless the context clearly requires otherwise, throughout the description and the claims, the words "comprise", "comprising", and the like are to be construed in an inclusive sense as opposed to an exclusive or exhaustive sense; that is to say, in the sense of "including, but not limited to".

Brief Description of the Drawings

[0011] Fig. 1 is a diagrammatic view of a mixer vehicle of an embodiment;

Fig. 2 is a system chart of the mixer vehicle of the embodiment; and

Fig. 3 is a flowchart illustrating a process of manufacturing ready-mixed concrete of the embodiment.

Best Mode for Carrying Out the Invention

[0012] An embodiment of the ready-mixed concrete manufacturing apparatus or transporting apparatus and the method of controlling the apparatus in accordance with the invention will be described with reference to the drawings.

<Embodiment>

As illustrated in Figs. 1 and 2, a ready-mixed concrete transporting apparatus of the embodiment includes a vehicle body 10, a mixing drum 20, a hopper 30, a chute 35, a hydraulic motor 40 serving as a fluid-pressure motor, a hydraulic pump 50 serving as a fluid-pressure pump, an engine 60 serving as a drive unit, a pressure sensor 70 serving as a pressure detecting device, and a control device 80.

[0013] The vehicle body 10 includes a cabin 11, a mount 13 and an engine 60. The cabin 11 is provided on a front side of the vehicle body 10. The mount 13 is provided on the vehicle body 10 to be located in the rear of the cabin 11. The engine 60 runs the vehicle body 10 and also rotates and drives the hydraulic pump 50, as will be described later. The engine 60 is disposed below the cabin 11.

[0014] The mixing drum 20 includes a drum body 21, a drive shaft 23 and two drum blades 25. The drum body 21 is cylindrical in shape. The drum body 21 has two ends one of which has an opening 27. The other end of the drum body 21 which is located at an inner side as viewed at the one end is closed by a closure 29. The mixing drum 20 is rotatably mounted on the mount 13 in a forward inclined posture such that the opening 27 of the drum body 21 is located high at a rear end of the vehicle body 10 and the opening 27 of the drum body 21 is raised to be located higher than the closure 29.

[0015] The drive shaft 23 is connected to a central part of the closure 29 and extends outward from the drum body 21. The drive shaft 23 extends on the center line of the rotation axis of the mixing drum 20. The drum blades 25 are fixed along an inner peripheral surface of the drum body 21 in a spiral manner while being spaced from each other. The drum blades 25 are rotated together with the drum body 21.

[0016] The hopper 30 has an inlet 31 which is open while being upwardly spread. The hopper 30 has a lower end which is open forwardly downward thereby to be formed into an outlet 33. The outlet 33 faces a central part of the opening 27 of the mixing

drum 20. Raw materials of the ready-mixed concrete and the like put through the inlet 31 of the hopper 30 is further put through an outlet 33 and the opening 27 into the drum body 21.

[0017] The chute 35 is semi-cylindrical in shape and extends long with an inner surface thereof being directed upward. The chute 35 has a proximal end located below the opening 27 of the drum body 21. The chute 35 is supported so that a distal end thereof is rotatable about the proximal end thereof in a horizontal direction and in an up-down direction. The ready-mixed concrete discharged from the opening 27 can be guided to a desired location by the chute 35.

[0018] The hydraulic motor 40 is mounted on the mount 13. The hydraulic motor 40 is coupled via a speed reducer 37 to the drive shaft 23 of the mixing drum 20 as illustrated in Figs. 1 and 2. The hydraulic motor 40 is of a two-speed type capable of switching a hydraulic fluid discharge capacity in large and small two stages. The hydraulic motor 40 is provided with a motor regulator 41 switching the discharge capacity.

[0019] The hydraulic pump 50 is also mounted on the mount 13. The hydraulic pump 50 is coupled to a power take-off shaft 61 of the engine 60. The hydraulic pump 50 has two inlet/outlet ports, and the hydraulic motor 40 also has two inlet/outlet ports. Two flow paths 51 respectively communicate with the inlet/outlet ports of the hydraulic pump 50 and the hydraulic motor 40, so that a hydraulic circuit as a closed circuit is formed by the hydraulic pump 50, the hydraulic motor 40 and the flow paths 51. The hydraulic circuit is capable of circulating the hydraulic fluid in two directions by changing supply and discharge

directions of the hydraulic pump 50 and the hydraulic motor 40.

[0020] The engine 60 includes a throttle regulator 63 regulating output of the engine 60 and an engine rotation detection sensor 65 detecting a rotational speed of the engine 60, as illustrated in Fig. 2.

[0021] The pressure sensor 70 is attached to the flow path 51 forming the hydraulic circuit. The pressure sensor 70 detects a driving pressure of the hydraulic motor 40 in the case where the mixing drum 20 is rotated in the normal direction. When the mixing drum 20 is rotated in the normal direction, the raw materials of ready-mixed concrete and water kneaded in the drum body 21 are moved inward from the opening 27 of the drum body 21.

[0022] The following will describe a ready-mixed concrete manufacturing process by use of the mixer vehicle 1.

[0023] First, raw materials of ready-mixed concrete are prepared according to an amount and properties of ready-mixed concrete to be manufactured. Similarly, an amount of water according to the amount and the properties of the ready-mixed concrete is put through the opening 27 into the drum body 21 thereby to be stored therein. The engine 60 is then started and the operating device 90 is operated to start rotation of the mixing drum 20. The prepared raw materials of ready-mixed concrete are gradually put into the inlet 31 of the hopper 30 to be kneaded with the water in the drum body 21. At this time, the hydraulic motor 40 is put in a first gear. The control device 80 determines whether or not the engine 60 is idling and gives the hydraulic pump 50 an instruction of a predetermined discharge amount according to the

rotational speed of the engine 60.

[0024] When the mixing drum 20 has reached a predetermined rotational speed, the control device 80 controls the pressure sensor 70 so that the pressure sensor 70 detects a driving pressure of the hydraulic motor 40 (step S1) as illustrated in Fig. 3. When the driving pressure detected by the pressure sensor 70 is not more than a first pressure value, the control device 80 changes the hydraulic motor 40 from the first gear to a second gear (step S2). In other words, the discharge capacity of the hydraulic motor 40 is reduced so that the torque of the hydraulic motor 40 is reduced. The control device 80 then controls the engine 60 so that the engine 60 is driven at a first rotational speed A (that is a rotational speed suitable to rotate the mixing drum 20 at a predetermined rotational speed when the hydraulic motor 40 is put in the second gear) (step S3) thereby executing a first rotation process. Furthermore, when the driving pressure detected by the pressure sensor 70 (step S1) is larger than the first pressure value, the control device 80 puts the hydraulic motor 40 into the first gear (step S6).

[0025] The first pressure value has an upper threshold and a lower threshold. Accordingly, at step S1, when the pressure detected by the pressure sensor 70 is not more than the lower threshold of the first pressure value, it is determined that the detected pressure is not more than the first pressure value. When the detected pressure is not less than the upper threshold of the first pressure value, it is determined that the detected pressure is not less than the first pressure value (the same shall apply hereinafter).

[0026] During the first rotation process, the kneaded state of the raw materials of the ready-mixed concrete and water changes when the amount of the raw materials of the ready-mixed concrete put from the inlet 31 of the hopper 30 into the drum body 21 is increased. In other words, since the viscosity rises, the torque required for rotation of the mixing drum 20 is increased, with the result that the driving pressure of the hydraulic motor 40 is increased.

[0027] When the driving pressure of the hydraulic motor 40 detected by the pressure sensor 70 (step S4) is less than the second pressure value for such a reason that the kneaded state has a low viscosity with a large amount of water or an amount of ready-mixed concrete to be manufactured is small, the first rotation process is continued until a predetermined time elapses (that is a kneading time previously determined according to the amount and the properties of ready-mixed concrete to be manufactured) (step S5). When the predetermined amount of water is finally put into the drum body 21 and the driving pressure of the hydraulic motor 40 becomes stable upon elapse of the predetermined time (step S5), the kneading is completed and the pressure sensor 70 detects the driving pressure of the hydraulic motor 40 (step S9).

[0028] When the driving pressure of the hydraulic motor 40 detected by the pressure sensor 70 during the first pressure process (step S4) becomes not less than the second pressure value, the control device 80 puts the hydraulic motor 40 into the first gear (step S6). In other words, the discharge capacity of the hydraulic motor 40 is increased thereby to increase the torque

thereof. The control device 80 then controls the engine 60 so that the rotational speed thereof is increased to a second rotational speed B (that is a rotational speed suitable to rotate the mixing drum 20 at a predetermined rotational speed when the hydraulic motor 40 is put in the second gear) (step S7) thereby executing the second rotation process.

[0029] The second pressure value has an upper threshold and a lower threshold. Accordingly, at step S5, when the pressure detected by the pressure sensor 70 is not more than the lower threshold of the second pressure value, it is determined that the detected pressure is not more than the second pressure value. When the detected pressure is not less than the upper threshold of the second pressure value, it is determined that the detected pressure is not less than the second pressure value (the same shall apply hereinafter).

[0030] Until a predetermined time elapses (that is a kneading time previously determined according to the amount and the properties of ready-mixed concrete to be manufactured) (step S8), steps S1 and S6 to S8 are repeated when the driving pressure of the hydraulic motor 40 detected by the pressure sensor 70 (step S1) is larger than the first pressure value (the upper threshold of the first pressure value). Furthermore, when the driving pressure of the hydraulic motor 40 detected by the pressure sensor 70 (step S1) becomes not more than the first pressure value (the lower threshold of the first pressure value) for such a reason that water is added during the kneading or the like, the aforementioned first rotation process is executed, and thereafter the control device 80 controls the mixing drum 20 so

that the mixing drum 20 is rotated according to the driving pressure of the hydraulic motor 40 (the kneaded state) detected by the pressure sensor 70.

[0031] When the predetermined amount of water is finally put into the drum body 21 and the driving pressure of the hydraulic motor 40 becomes stable upon elapse of the predetermined time (step S8), the kneading is completed and the pressure sensor 70 detects the driving pressure of the hydraulic motor 40 (step S9). When the driving pressure detected by the pressure sensor 70 is not more than the first pressure value (the lower threshold of the first pressure value), the control device 80 puts the hydraulic motor 40 into the second gear (step S10). Furthermore, when the driving pressure detected by the pressure sensor 70 is larger than the first pressure value (the upper threshold of the first pressure value), the control device 80 puts the hydraulic motor 40 into the first gear (step S11). The control device 80 then returns the engine 60 to the idling (step S12) so that the discharge of the hydraulic fluid from the hydraulic pump 50 is stopped (step S13). Thus, the manufacture of ready-mixed concrete by the mixing drum 20 is completed.

[0032] As described above, the mixer vehicle 1 includes the mixing drum 20, the hydraulic motor 40, the hydraulic pump 50, the engine 60, the pressure sensor 70 and the control device 80. The mixing drum 20 kneads the raw materials of ready-mixed concrete and water all put thereinto. The raw materials of ready-mixed concrete include cement, aggregate and admixture. The hydraulic motor 40 rotates the mixing drum 20. The hydraulic motor 40 is of a two-speed type capable of switching a discharge capacity of the

hydraulic fluid in large and small two stages. The hydraulic pump 50 circulates the hydraulic fluid between the hydraulic pump and the hydraulic motor 40. The engine 60 rotates and drives the hydraulic pump 50. The pressure sensor 70 detects the driving pressure of the hydraulic motor 40. When the pressure value detected by the pressure sensor 70 is not more than the first pressure value (the lower threshold of the first pressure value), the control device 80 executes the first rotation process in which the engine 60 is driven at the first rotational speed while the hydraulic motor 40 is put in the second gear whereby the mixing drum 20 is rotated. Furthermore, when the pressure value detected by the pressure sensor 70 is larger than the first pressure value (the upper threshold of the first pressure value), the control device 80 executes the second rotation process in which the engine 60 is driven at the second rotational speed higher than the first rotational speed while the hydraulic motor 40 is put in the first gear whereby the mixing drum 20 is rotated.

[0033] The rotational load of the mixing drum 20 is small when the raw materials of ready-mixed concrete and water are in the kneaded state such that the mixture contains a large amount of water thereby to have a low viscosity or when an amount of ready-mixed concrete to be manufactured is small. When the pressure value detected by the pressure sensor 70 is not more than the first pressure value (the lower threshold of the first pressure value), the mixer vehicle 1 executes the first rotation process in which the engine 60 is driven at the first rotational speed while the hydraulic motor 40 is put in the second gear whereby the mixing drum 20 is rotated. In the first rotation

process, even when the engine 60 is driven at the first rotational speed lower than the second rotational speed, the mixing drum 20 can be rotated at a maximum rotational speed since the hydraulic motor 40 is put in the second gear. Furthermore, in the first rotation process, since the engine 60 is driven at the first rotational speed lower than the second rotational speed, an amount of fuel consumed to drive the engine 60 can be reduced and noise can also be reduced in the mixer vehicle 1.

[0034] Furthermore, the rotational load of the mixing drum 20 is large when the raw materials of ready-mixed concrete and water are in a kneaded state such that the mixture contains a small amount of water thereby to have a high viscosity or when an amount of ready-mixed concrete to be manufactured is large. When the pressure value detected by the pressure sensor 70 is larger than the first pressure value (the upper threshold of the first pressure value), the mixer vehicle 1 executes the second rotation process in which the engine 60 is driven at the second rotational speed higher than the first rotational speed while the hydraulic motor 40 is put in the first gear. As a result, even when the rotational load of the mixing drum 20 is rendered large, the mixing drum 20 can reliably be rotated in the mixer vehicle 1 with the result that the raw materials of ready-mixed concrete and water can be kneaded.

[0035] Accordingly, the mixer vehicle 1 in accordance with the invention can successfully manufacture the ready-mixed concrete.

[0036] Furthermore, the hydraulic motor 40 is put into the second gear when the pressure value detected by the pressure sensor 70

at a time when the driving pressure of the hydraulic motor 40 is stable is not more than the first pressure value (the lower threshold of the first pressure value), and the hydraulic motor 40 is put into the first gear when the detected pressure value is larger than the first pressure value (the upper threshold of the first pressure value). When the predetermined amount of water is put into the mixing drum 20 at the final stage of kneading of the raw materials of ready-mixed concrete and water so that the driving pressure of the hydraulic motor 40 becomes stable, the kneaded state is considered to indicate that the kneading of the ready-mixed concrete materials and water has been completed. Accordingly, the hydraulic motor 40 is put into the first or second gear in this mixer vehicle 1 according to the kneaded state at the time when the driving pressure of the hydraulic motor 40 is stable and the kneading is completed.

[0037] In other words, when the pressure value detected by the pressure sensor 70 is not more than the first pressure value (the lower threshold of the first pressure value) for such a reason that the ready-mixed concrete at the time of completion of the kneading has a low viscosity or an amount of ready-mixed concrete is small , the mixing drum 20 is rotated with the hydraulic motor 20 being put in the second gear without changing the rotational speed of the engine 60 (the first rotational speed or the second rotational speed). Furthermore, when the pressure value detected by the pressure sensor 70 is larger than the first pressure value (the upper threshold of the first pressure value) for such a reason that the ready-mixed concrete at the time of completion of the kneading has a high viscosity or an amount of ready-mixed

concrete is large, the mixing drum 20 is rotated with the hydraulic motor 20 being put in the first gear without changing the rotational speed of the engine 60 (the first rotational speed or the second rotational speed). Thus, the mixing drum 20 can efficiently be rotated in this mixer vehicle 1 according to the kneaded state of the ready-mixed concreate the kneading of which has been completed.

[0038] Furthermore, in this mixer vehicle 1, the engine 60 is driven at the first rotational speed until the pressure value detected by the pressure sensor 70 during execution of the first rotation process becomes not less than the second pressure value (the upper threshold of the second pressure value) larger than the first pressure value (the upper threshold of the first pressure value), and the second rotation process is executed when the detected pressure value becomes not less than the second pressure value (the upper threshold of the second pressure value). The rotational load of the mixing drum 20 is increased when the mixture of the raw materials of ready-mixed concrete and water becomes a kneaded state in which a viscosity is high according to an additional input of the raw materials of ready-mixed concrete into the mixing drum 20 or for another reason. When the pressure value detected by the pressure sensor 70 becomes not less than the second pressure value (the upper threshold of the second pressure value) that is larger than the first pressure value (the upper threshold of the first pressure value), the second rotation process is executed in this mixer vehicle 1. As a result, the mixing drum 20 can reliably be rotated in this mixer vehicle 1 according to the rotational load of the mixing drum

20 so that the ready-mixed concrete materials and water can be kneaded. Furthermore, an amount of fuel consumed to drive the engine 60 can be reduced and noise can also be reduced in the mixer vehicle 1.

[0039] Furthermore, the first and second pressure values have respective thresholds. As a result, when the pressure sensor 70 detects the first or second pressure value, influences of noise in a range that is not more than the upper threshold and not less than the lower threshold can be eliminated since each of the first and second pressure values has the upper and lower thresholds. This can suppress fluctuation of the rotational speed of the engine 60 and can reduce fuel consumption.

[0040] The present invention should not be limited to the embodiment described above with reference to the drawings, but the technical scope of the invention encompasses the following embodiments, for example.

(1) Although the invention is applied to the mixer vehicle 1 in the foregoing embodiment, the invention may be applied to a ready-mixed concrete manufacturing apparatus without a vehicle body.

(2) Although the engine running the vehicle body also serves to rotate and drive the hydraulic pump in the foregoing embodiment, the hydraulic pump may be rotated and driven by another engine instead of the engine running the vehicle body. In this case, since the rotational speed of the engine rotating and driving the hydraulic pump can be adjusted irrespective of the running condition of the vehicle body, ready-mixed concrete can be manufactured while running the vehicle body.

(3) Although the hydraulic motor is of the two-speed type in the foregoing embodiment, the hydraulic motor may be of a type that the discharge capacity is changeable in three or more steps or a stepless manner.

(4) In the foregoing embodiment, the hydraulic motor is put into the first or second gear according to the pressure value detected by the pressure sensor at a time when the driving pressure is stable after elapse of the predetermined time. However, without depending upon detection by the pressure sensor, the worker may manually switch the hydraulic motor while confirming the kneaded state.

(5) Although the apparatus of the embodiment includes the hydraulic motor and the hydraulic pump both using the hydraulic fluid as the driving fluid, the apparatus may include a fluid pressure motor and a fluid pressure pump both using a fluid other than the hydraulic fluid.

(6) In the foregoing embodiment, the driving pressure of the hydraulic motor detected by the pressure sensor is compared with the first pressure value at step S1 and compared with the second pressure value larger than the first pressure value at step S4. However, the pressure values compared at steps S1 and S4 may be the same value.

(7) Although the first and second pressure values have respective thresholds in the foregoing embodiment, the pressure values may not have any respective thresholds.

(8) In the foregoing embodiment, when the driving pressure of the hydraulic motor becomes stable after elapse of the predetermined time and the kneading is completed (step S5 or step

S8), the driving pressure of the hydraulic motor is detected so that it is determined whether or not the detected pressure is not more than the first pressure value (step S9). However, without detecting the driving pressure of the hydraulic motor, the manufacture of ready-mixed concrete may be completed by putting the hydraulic motor into the first gear, returning the engine to the idling, and stopping the discharge of the hydraulic fluid from the hydraulic pump.

Explanation of Reference Symbols

[0041] 20 ... mixing drum, 40 ... hydraulic motor (fluid-pressure motor), 50 ... hydraulic pump (fluid-pressure pump), 60 ... engine (drive unit), 70 ... pressure sensor (pressure detecting device), and 80 ... control device.

2017243822 26 Sep 2019

CLAIMS

1. A ready-mixed concrete manufacturing apparatus or transporting apparatus comprising:

a mixing drum kneading raw materials of ready-mixed concrete and water all put thereinto, the raw materials including cement, aggregate and admixture;

a fluid-pressure motor having a variable discharge capacity of an operating liquid and rotating the mixing drum;

a fluid-pressure pump circulating the operating liquid between the fluid-pressure pump and the fluid-pressure motor;

a drive unit rotating and driving the fluid-pressure pump;

a pressure detecting device detecting a driving pressure of the fluid-pressure motor; and

a control device configured to execute a first rotation process when a pressure value detected by the pressure detecting device at a time when the driving pressure is stable is not more than a first pressure value, in which the drive unit is driven at a first rotational speed while a discharge capacity of the fluid-pressure motor is reduced whereby the mixing drum is rotated, the control device also being configured to execute a second rotation process when the pressure value is larger than the first pressure value, in which the drive unit is driven at a second rotational speed higher than the first rotational speed while the discharge capacity of the fluid-pressure motor is increased whereby the mixing drum is rotated.

2. A ready-mixed concrete manufacturing apparatus or

transporting apparatus, comprising:

a mixing drum kneading raw materials of ready-mixed concrete and water all put thereinto, the raw materials including cement, aggregate and admixture;

a fluid-pressure motor having a variable discharge capacity of an operating liquid and rotating the mixing drum;

a fluid-pressure pump circulating the operating liquid between the fluid-pressure pump and the fluid-pressure motor;

a drive unit rotating and driving the fluid-pressure pump;

a pressure detecting device detecting a driving pressure of the fluid-pressure motor; and

a control device configured to execute a first rotation process when a pressure value detected by the pressure detecting device is not more than a first pressure value, in which the drive unit is driven at a first rotational speed while the discharge capacity of the fluid-pressure motor is reduced whereby the mixing drum is rotated, the control device also being configured to execute a second rotation process when the pressure value is larger than the first pressure value, in which the drive unit is driven at a second rotational speed higher than the first rotational speed while the discharge capacity of the fluid-pressure motor is increased whereby the mixing drum is rotated,

wherein the control device drives the drive unit at the first rotational speed until the pressure value detected by the pressure detecting device during execution of the first rotation process becomes not less than a second pressure value, the second pressure value being larger than the first pressure value, and

the control device executes the second rotation process when the pressure value detected by the pressure detecting device becomes not less than the second pressure value.

3. A ready-mixed concrete manufacturing apparatus or transporting apparatus, comprising:

a mixing drum kneading raw materials of ready-mixed concrete and water all put thereinto, the raw materials including cement, aggregate and admixture;

a fluid-pressure motor having a variable discharge capacity of an operating liquid and rotating the mixing drum;

a fluid-pressure pump circulating the operating liquid between the fluid-pressure pump and the fluid-pressure motor;

a drive unit rotating and driving the fluid-pressure pump;

a pressure detecting device detecting a driving pressure of the fluid-pressure motor; and

a control device configured to execute a first rotation process when a pressure value detected by the pressure detecting device is not more than a first pressure value, in which the drive unit is driven at a first rotational speed while the discharge capacity of the fluid-pressure motor is reduced whereby the mixing drum is rotated, the control device also being configured to execute a second rotation process when the pressure value is larger than the first pressure value, in which the drive unit is driven at a second rotational speed higher than the first rotational speed while the discharge capacity of the fluid-pressure motor is increased whereby the mixing drum is rotated,

wherein the first pressure value has an upper threshold and a lower threshold;

wherein the control device determines that the pressure value is not more than the first pressure value when the pressure value is not more than the lower threshold; and

wherein the control device determines that the pressure value is not less than the first pressure value when the pressure value is not less than the upper threshold.

4. A method of controlling a ready-mixed concrete manufacturing apparatus or transporting apparatus, comprising a first rotation process and a second rotation process when a fluid-pressure motor rotated by circulation of an operating liquid between the fluid-pressure motor and a fluid-pressure pump rotated and driven by a drive unit rotates a mixing drum into which raw materials of ready-mixed concrete including cement, aggregate and admixture, and water are put, thereby kneading the raw materials and the water,

wherein in the first rotation process, when a pressure detecting device detecting a driving pressure of a fluid-pressure motor detects a pressure value of not more than a first pressure value at a time when the driving pressure is stable, a drive unit is driven at a first rotational speed while a discharge capacity of the fluid-pressure motor is reduced whereby the mixing drum is rotated, and

wherein in the second rotation process, when the pressure detecting device detects the pressure value larger than the first pressure value at a time when the driving pressure is stable,

the drive unit is driven at a second rotational speed higher than the first rotational speed while the discharge capacity of the fluid-pressure motor is increased whereby the mixing drum is rotated.

5. A method of controlling a ready-mixed concrete manufacturing apparatus or transporting apparatus, comprising a first rotation process and a second rotation process when a fluid-pressure motor rotated by circulation of an operating liquid between the fluid-pressure motor and a fluid-pressure pump rotated and driven by a drive unit rotates a mixing drum into which raw materials of ready-mixed concrete including cement, aggregate and admixture, and water are put, thereby kneading the raw materials and the water,

wherein in the first rotation process, when a pressure detecting device detecting a driving pressure of a fluid-pressure motor detects a pressure value of not more than a first pressure value, a drive unit is driven at a first rotational speed while a discharge capacity of the fluid-pressure motor is reduced whereby the mixing drum is rotated,

wherein in the second rotation process, when the pressure detecting device detects the pressure value larger than the first pressure value, the drive unit is driven at a second rotational speed higher than the first rotational speed while the discharge capacity of the fluid-pressure motor is increased whereby the mixing drum is rotated, and

wherein the drive unit is driven at the first rotational

speed until the pressure value detected by the pressure detecting device during execution of the first rotation process becomes not less than a second pressure value, the second pressure value being larger than the first pressure value, and the second rotation process is executed when the pressure value detected by the pressure detecting device becomes not less than the second pressure value.

Fig. 1

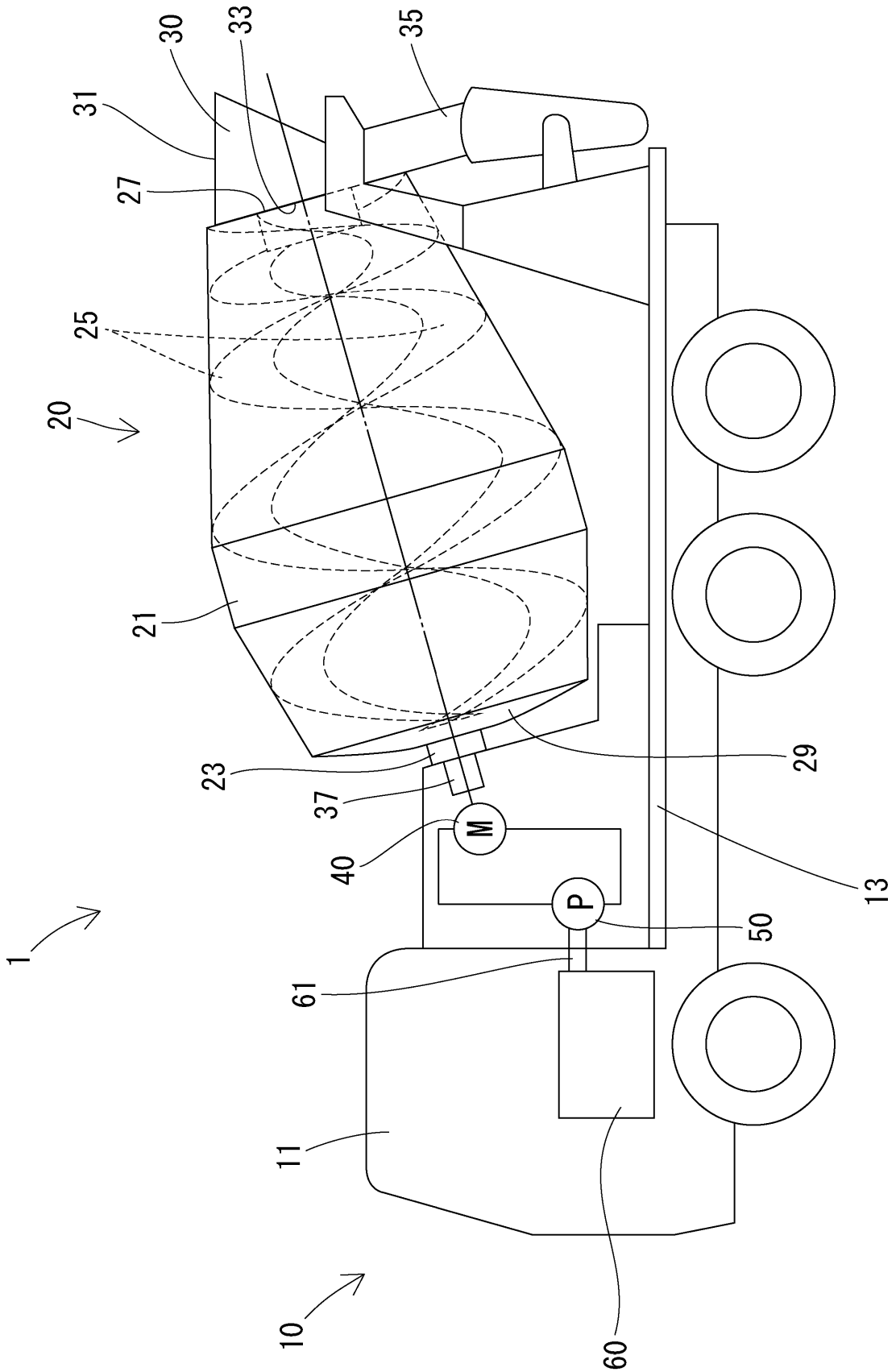


Fig. 2

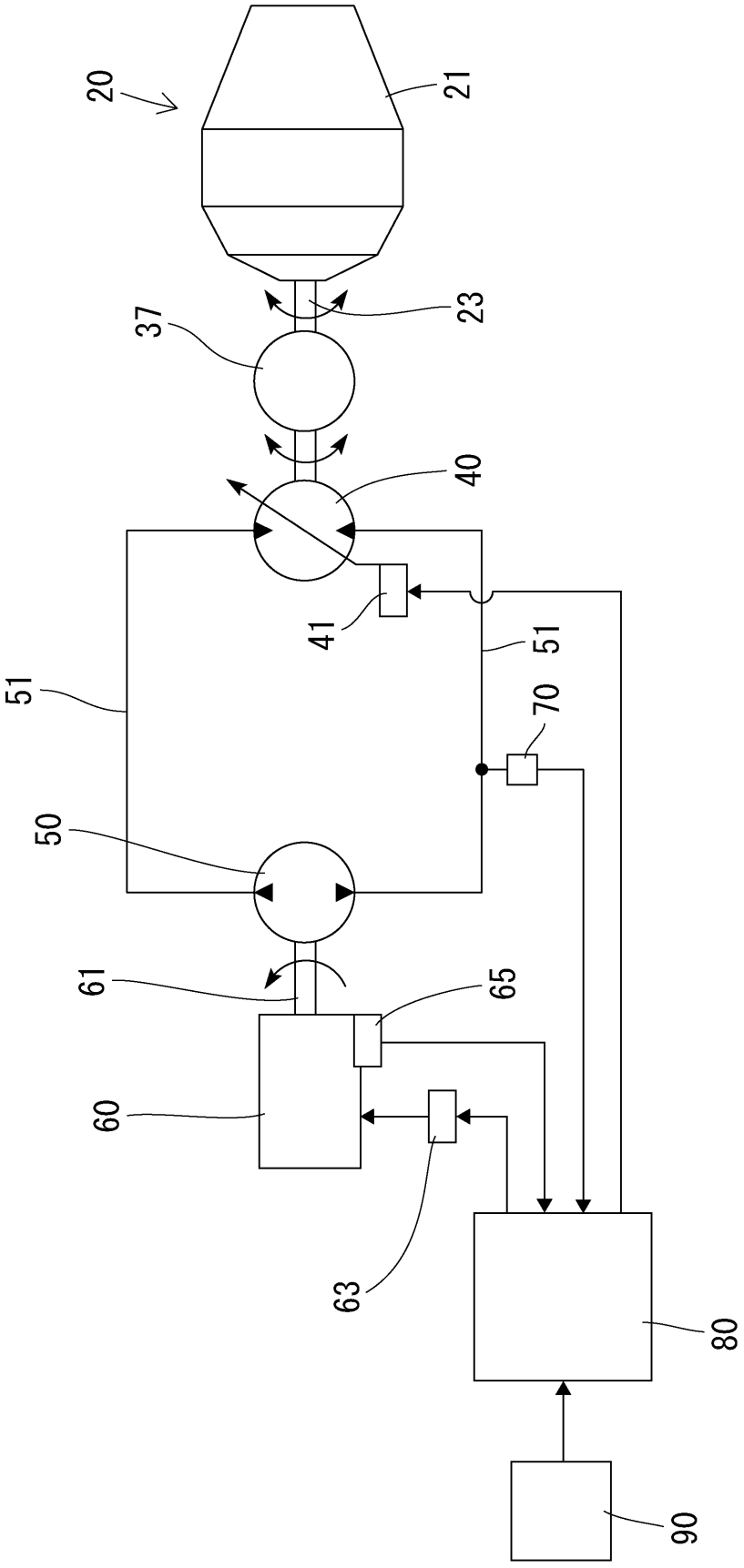
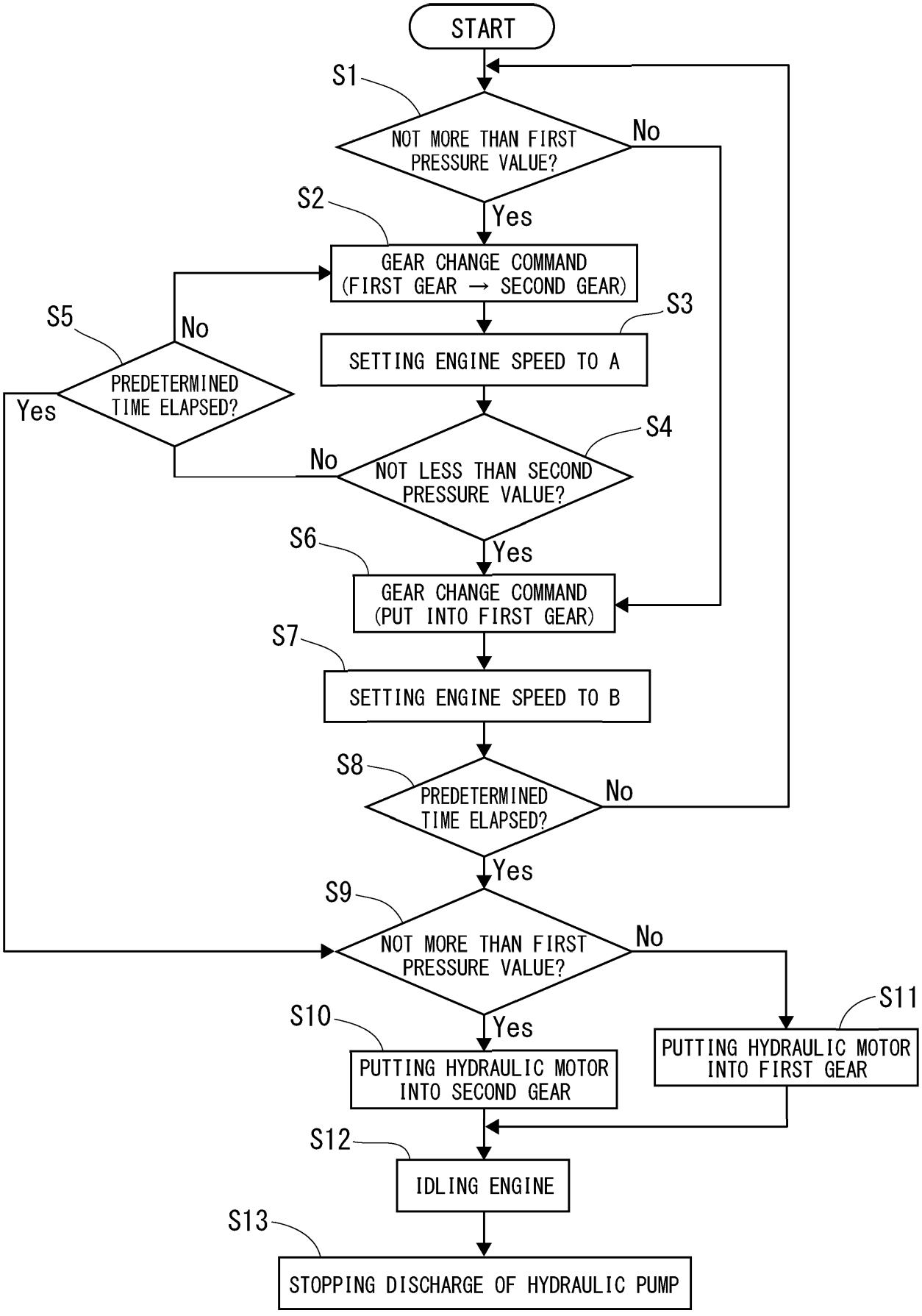


Fig. 3


START
S1
NOT MORE THAN FIRST PRESSURE VALUE?
No
Yes
S2
GEAR CHANGE COMMAND (FIRST GEAR → SECOND GEAR)
S3
SETTING ENGINE SPEED TO A
S4
NOT LESS THAN SECOND PRESSURE VALUE?
No
Yes
S5
PREDETERMINED TIME ELAPSED?
No
Yes
S6
GEAR CHANGE COMMAND (PUT INTO FIRST GEAR)
S7
SETTING ENGINE SPEED TO B
S8
PREDETERMINED TIME ELAPSED?
No
Yes
S9
NOT MORE THAN FIRST PRESSURE VALUE?
No
Yes
S10
PUTTING HYDRAULIC MOTOR INTO SECOND GEAR
S11
PUTTING HYDRAULIC MOTOR INTO FIRST GEAR
S12
IDLING ENGINE
S13
STOPPING DISCHARGE OF HYDRAULIC PUMP