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(54) **HYDRAULIC POWER SYSTEM, WORK MACHINE, AND CONTROL METHOD FOR HYDRAULIC POWER SYSTEM**

(57) A hydraulic power system and a work machine. The hydraulic power system includes a hydraulic oil tank (3), an engine (1), a motor (2), a first pump set, and a second pump set. The engine (1) is connected to the first pump set, and the motor (2) is connected to the second pump set. The first pump set includes a first load-sensitive pump (101), and the second pump set includes a second load-sensitive pump (201). An oil outlet pipeline of the first load-sensitive pump (101) and an oil outlet pipeline of the second load-sensitive pump (201) are connected in parallel, and a feedback pipeline of the first load-sensitive pump (101) and a feedback pipeline of the second load-sensitive pump (201) are connected in parallel by a reversing valve. Each of the engine (1) and the motor (2) is disposed to be connected to a pump set, and the first pump set and the second pump set are arranged in parallel, so that switching between two power sources of the engine (1) and the motor (2) can be implemented. Moreover, the motor (2) may be flexibly arranged without being limited to a connection to a gearbox power take-off, and the motor (2) and the second pump set are not limited to being mounted on a chassis, thereby improving mounting universality and convenience.

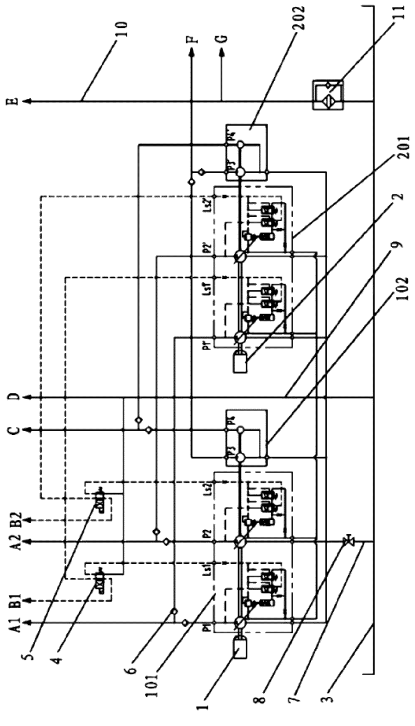

FIG. 1

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Description

TECHNICAL FIELD

[0001] This application relates to the field of engineering machinery technologies, and in particular, to a hydraulic power system, a work machine, and a control method of a hydraulic power system.

BACKGROUND

[0002] At present, most cranes use a form of single diesel engine drive. The running costs of a crane driven by a diesel engine are relatively high. The emission of diesel engines of some old models does not meet requirements of new environmental protection laws. In addition, diesel engines have high running and maintenance costs as well as high failure rates. With the development of mechanics-electronics-hydraulic technology, the automation of engineering machinery becomes the trend of future development. To meet various environmental working demands and environmental protection emission requirements of cranes, it is also necessary to develop corresponding mechanics-electronics-hydraulic technology. In dual power technology of engineering machinery such as cranes, currently a motor is mostly connected in series to a gearbox power take-off (PTO) connected to a diesel engine, and a shared pump set provides an oil source for an overall hydraulic system.

[0003] In existing engineering machinery with an oil-electric dual power source, a motor is connected in series to a power take-off shaft of a gearbox PTO, a large space is occupied, an axial space is limited, and it is difficult to meet layout space demands for some models, especially oil-electric dual power cranes or other related machinery with an insufficient axial mounting space.

SUMMARY OF THE INVENTION

[0004] This application provides a hydraulic power system, a work machine, and a control method of a hydraulic power system, to resolve deficiencies that a large space is occupied to mount a power source, an axial space is limited, and it is difficult to meet layout space demands for some models in engineering machinery with an oil-electric dual power source in the prior art, so that the universality and convenience of mounting a power system can be improved.

[0005] This application provides a hydraulic power system, including a hydraulic oil tank, an engine, a motor, a first pump set, and a second pump set, where the engine is connected to the first pump set, the motor is connected to the second pump set, the first pump set and the second pump set are respectively connected to the hydraulic oil tank, the first pump set includes a first load-sensitive pump, the second pump set includes a second load-sensitive pump, an oil outlet pipeline of the first load-sensitive pump and an oil outlet pipeline of the second load-sensitive pump are connected in parallel, and a feedback pipeline of the first load-sensitive pump and a feedback pipeline of the second load-sensitive pump are connected in parallel by a reversing valve.

[0006] According to the hydraulic power system provided in this application, the first load-sensitive pump and the second load-sensitive pump are both duplex load-sensitive pumps, a first oil outlet pipeline of the first load-sensitive pump and a first oil outlet pipeline of the second load-sensitive pump are connected in parallel, and a second oil outlet pipeline of the first load-sensitive pump and a second oil outlet pipeline of the second load-sensitive pump are connected in parallel; and a first feedback pipeline of the first load-sensitive pump and a first feedback pipeline of the second load-sensitive pump are connected in parallel by a first reversing valve, and a second feedback pipeline of the first load-sensitive pump and a second feedback pipeline of the second load-sensitive pump are connected in parallel by a second reversing valve.

[0007] According to the hydraulic power system provided in this application, the first feedback pipeline of the first load-sensitive pump and the first feedback pipeline of the second load-sensitive pump are connected to two oil ports at one end of the first reversing valve in a one-to-one correspondence, one oil port of two oil ports at the other end of the first reversing valve is connected to a first feedback port, and the other oil port of the two oil ports at the other end of the first reversing valve is connected to the hydraulic oil tank; and the second feedback pipeline of the first load-sensitive pump and the second feedback pipeline of the second load-sensitive pump are connected to two oil ports at one end of the second reversing valve in a one-to-one correspondence, one oil port of two oil ports at the other end of the second reversing valve is connected to a second feedback port, and the other oil port of the two oil ports at the other end of the second reversing valve is connected to the hydraulic oil tank.

[0008] According to the hydraulic power system provided in this application, the first oil outlet pipeline of the first load-sensitive pump and the first oil outlet pipeline of the second load-sensitive pump are connected in parallel to a first inlet of a main valve, the second oil outlet pipeline of the first load-sensitive pump and the second oil outlet pipeline of the second load-sensitive pump are connected in parallel to a second inlet of the main valve, and the main valve is configured to be connected to an execution mechanism.

[0009] According to the hydraulic power system provided in this application, the first pump set further includes a first gear pump, the second pump set further includes a second gear pump, and an oil outlet pipeline of the first gear pump and an oil outlet pipeline of the second gear pump are connected in parallel.

[0010] According to the hydraulic power system provided in this application, the first gear pump and the second gear pump are both duplex gear pumps, and a first

oil outlet pipeline of the first gear pump and a first oil outlet pipeline of the second gear pump are connected in parallel to an undercarriage multi-way valve inlet; and a second oil outlet pipeline of the first gear pump and a second oil outlet pipeline of the second gear pump are connected in parallel to an air-conditioning heat-dissipation motor.

[0011] According to the hydraulic power system provided in this application, each oil outlet pipeline of the first pump set and each oil outlet pipeline of the second pump set are respectively provided with a one-way valve.

[0012] According to the hydraulic power system provided in this application, the hydraulic oil tank is connected to an oil inlet pipeline, and an oil inlet of the first pump set and an oil inlet of the second pump set are respectively connected to the oil inlet pipeline; and the oil inlet pipeline is provided with a cutoff valve.

[0013] According to the hydraulic power system provided in this application, the hydraulic oil tank is further connected to an oil drain pipeline, and the oil drain pipeline is configured to be connected to an oil drain port.

[0014] According to the hydraulic power system provided in this application, the hydraulic oil tank is further connected to an oil return pipeline, the oil return pipeline is configured to be connected to an oil return port, and the oil return pipeline is provided with an oil return filter.

[0015] This application further provides a work machine, including the foregoing hydraulic power system.

[0016] This application further provides a control method of a hydraulic power system, being based on any foregoing hydraulic power system, where the control method includes: detecting a rotational speed of a motor when the hydraulic power system is switched to a mode of an engine; when the rotational speed of the motor is zero, adjusting a reversing valve to enable a first load-sensitive pump to be connected to a feedback port, and connecting the engine to a first pump set; and running the mode of the engine.

[0017] According to the control method provided in this application, the control method further includes: when the hydraulic power system is switched to a mode of the motor, disconnecting the engine from the first pump set; adjusting the reversing valve to enable a second load-sensitive pump to be connected to the feedback port; and running the mode of the motor.

[0018] In the technical solution provided in this application, each of the engine and the motor is disposed to be connected to a pump set, and the first pump set and the second pump set are arranged in parallel, so that switching between two power sources of the engine and the motor can be implemented, which helps to reduce the oil consumption of the engine, reduce running and maintenance costs, and meet environmental protection requirements. Moreover, the motor and the engine do not need to share a pump set, and the motor may be flexibly arranged without being limited to a connection to a gearbox power take-off, and the motor and the second pump set are not limited to being mounted on a chassis, thereby improving mounting universality and convenience.

BRIEF DESCRIPTION OF THE DRAWINGS

[0019] To describe the technical solutions in this application or the prior art more clearly, the following briefly introduces the accompanying drawings required for describing the embodiments or the prior art. Apparently, the accompanying drawings in the following description show some embodiments of this application, and a person of ordinary skill in the art may still derive other drawings from these accompanying drawings without creative efforts.

FIG. 1 is a schematic diagram of a hydraulic power system provided in this application; and

FIG. 2 is a schematic diagram of a control method of a hydraulic power system provided in this application.

Reference numerals:

[0020] 1: engine; 2: motor; 3: hydraulic oil tank; 4: first reversing valve; 5: second reversing valve; 6: one-way valve; 7: oil inlet pipeline; 8: cutoff valve; 9: oil drain pipeline; 10: oil return pipeline; 11: oil return filter; 101: first load-sensitive pump; 102: first gear pump; 201: second load-sensitive pump; 202: second gear pump; A1: first inlet of a main valve; A2: second inlet of the main valve; B1: first feedback port; B2: second feedback port; C: air-conditioning heat-dissipation motor; D: superstructure oil drain port; E: superstructure oil return port; F: undercarriage multi-way valve inlet; and G: undercarriage multi-way valve oil return port.

DETAILED DESCRIPTION

[0021] To make the objectives, technical solutions, and advantages of this application clearer, the following clearly and completely describes the technical solutions in this application with reference to the accompanying drawings in this application. It is clear that the described embodiments are merely some rather than all of embodiments of this application. All other embodiments obtained by persons of ordinary skill in the art based on the embodiments of the present application without creative efforts fall within the protection scope of the present application.

[0022] A hydraulic power system, a work machine, and a control method of a hydraulic power system of this application are described below with reference to FIG. 1.

[0023] FIG. 1 is a schematic diagram of a hydraulic power system provided in this application. Referring to FIG. 1, the hydraulic power system includes a hydraulic oil tank 3, an engine 1, a motor 2, a first pump set, and a second pump set. The engine 1 is connected to the first pump set, and the motor 2 is connected to the second pump set. The first pump set and the second pump set

are connected to the hydraulic oil tank 3 respectively. The hydraulic oil tank 3 supplies oil to the first pump set and the second pump set. The first pump set includes a first load-sensitive pump 101, and the second pump set includes a second load-sensitive pump 201. An oil outlet pipeline of the first load-sensitive pump 101 and an oil outlet pipeline of the second load-sensitive pump 201 are connected in parallel, and a feedback pipeline of the first load-sensitive pump 101 and a feedback pipeline of the second load-sensitive pump 201 are connected in parallel by a reversing valve.

[0024] In this embodiment, two power sources, that is, the engine 1 and the motor 2, are disposed, and each power source is connected to one pump set. The two pump sets have a parallel connection structure, so that a power source mode can be flexibly switched, that is, driving of the engine 1 can be implemented, or driving of the motor 2 can be implemented. Specifically, the first load-sensitive pump 101 may be driven by the engine 1, and oil is supplied to the execution mechanism through the oil outlet pipeline of the first load-sensitive pump 101; or the second load-sensitive pump 201 may be driven by the motor 2, and oil is supplied to the execution mechanism through the oil outlet pipeline of the second load-sensitive pump 201.

[0025] The disposed load-sensitive pumps can sense pressure and flow rate demands of the system, and the running of the pumps is adaptively adjusted according to changes in the flow rate and pressure demands. Specifically, in a mode of the engine 1, that is, when the engine 1 is the power source, the reversing valve may be adjusted to enable the feedback pipeline of the first load-sensitive pump 101 to be communicated, so as to sense the pressure and flow rate demands in the system and adapt to the running of the first load-sensitive pump 101. In a mode of the motor 2, that is, when the motor 2 is the power source, the reversing valve may be adjusted to enable the feedback pipeline of the second load-sensitive pump 201 to be communicated, so as to sense the pressure and flow rate demands in the system, and adapt to the running of the second load-sensitive pump 201.

[0026] In the hydraulic power system provided in this embodiment, each of the engine 1 and the motor 2 is disposed to be connected to a pump set, and the first pump set and the second pump set are arranged in parallel, so that switching between two power sources of the engine 1 and the motor 2 can be implemented, which helps to reduce the oil consumption of the engine 1, reduce running and maintenance costs, and meet environmental protection requirements. Moreover, the motor 2 and the engine 1 do not need to share a pump set, and the motor 2 may be flexibly arranged without being limited to a connection to a gearbox power take-off, and the motor 2 and the second pump set are not limited to being mounted on a chassis, thereby improving mounting universality and convenience.

[0027] Based on the foregoing embodiment, further, the first load-sensitive pump 101 and the second load-sensitive pump 201 may both be duplex load-sensitive pumps, a first oil outlet pipeline P1 of the first load-sensitive pump 101 and a first oil outlet pipeline P 1' of the second load-sensitive pump 201 are connected in parallel, and a second oil outlet pipeline P2 of the first load-sensitive pump 101 and a second oil outlet pipeline P2' of the second load-sensitive pump 201 are connected in parallel.

[0028] In this embodiment, the first load-sensitive pump 101 and the second load-sensitive pump 201 may be disposed as duplex piston load-sensitive pumps, that is, duplex variable displacement piston pumps. A duplex piston load-sensitive pump is provided with two oil outlet pipelines and two feedback pipelines, and may be connected to two oil use interfaces, which helps to reduce a space occupied by mounting and improves overall efficiency. The first load-sensitive pump 101 is provided with the two oil outlet pipelines: the first oil outlet pipeline P1 and the second oil outlet pipeline P2; and the second load-sensitive pump 201 is provided with the two oil outlet pipelines: the first oil outlet pipeline P1' and the second oil outlet pipeline P2'. The two oil outlet pipelines of the first load-sensitive pump 101 and the two oil outlet pipelines of the second load-sensitive pump 201 are connected in parallel in a one-to-one correspondence, and the switching of two power source modes may be implemented by controlling the running of the engine 1 and the running of the motor 2.

[0029] A first feedback pipeline Ls1 of the first load-sensitive pump 101 and a first feedback pipeline Ls1' of the second load-sensitive pump 201 are connected in parallel by a first reversing valve 4, and a second feedback pipeline Ls2 of the first load-sensitive pump 101 and a second feedback pipeline Ls2' of the second load-sensitive pump 201 are connected in parallel by a second reversing valve 5. The first load-sensitive pump 101 is provided with the two feedback pipelines: the first feedback pipeline Ls1 and the second feedback pipeline Ls2, and the two feedback pipelines of the first load-sensitive pump 101 and the two oil outlet pipelines of the first load-sensitive pump 101 have a one-to-one correspondence. The second load-sensitive pump 201 is provided with the two feedback pipelines: the first feedback pipeline Ls1' and the second feedback pipeline Ls2', and the two feedback pipelines of the second load-sensitive pump 201 and the two oil outlet pipelines of the second load-sensitive pump 201 have a one-to-one correspondence.

[0030] The two feedback pipelines of the first load-sensitive pump 101 and the two feedback pipelines of the second load-sensitive pump 201 are also connected in parallel in a one-to-one correspondence. The first reversing valve 4 and the second reversing valve 5 may be controlled according to a specific power source mode to be communicated with a corresponding feedback pipeline.

[0031] Based on the foregoing embodiment, further, referring to FIG. 1, the first reversing valve 4 in this embodiment may be a two-position four-way reversing

valve. One end of the first reversing valve 4 is provided with two oil ports, and the other end is also provided with two oil ports. The first feedback pipeline Ls1 of the first load-sensitive pump 101 and the first feedback pipeline Ls1' of the second load-sensitive pump 201 are connected to two oil ports at one end of the first reversing valve 4 in a one-to-one correspondence, one oil port of two oil ports at the other end of the first reversing valve 4 is connected to a first feedback port B1, and the other oil port of the two oil ports at the other end of the first reversing valve 4 is connected to the hydraulic oil tank 3.

[0032] Dotted lines in FIG. 1 represent the feedback pipeline. When the first reversing valve 4 is in the state shown in FIG. 1, the first feedback port B1 is communicated with the first feedback pipeline Ls1 of the second load-sensitive pump 201. In this case, this is the state of the mode of the motor 2. When the mode of the engine 1 needs to be adjusted, a valve position of the first reversing valve 4 may be switched, so that the first feedback port B1 can be communicated with the first feedback pipeline Ls1 of the first load-sensitive pump 101. The first reversing valve 4 may be adjusted to adapt to switching between the two power source modes of the engine 1 and the motor 2.

[0033] Referring to FIG. 1, the second reversing valve 5 in this embodiment may be alternatively a two-position four-way reversing valve. One end of the second reversing valve 5 is provided with two oil ports, and the other end is also provided with two oil ports. The second feedback pipeline Ls2 of the second load-sensitive pump 101 and the second feedback pipeline Ls2' of the second load-sensitive pump 201 are connected to two oil ports at one end of the second reversing valve 5 in a one-to-one correspondence, one oil port of two oil ports at the other end of the second reversing valve 5 is connected to a second feedback port B2, and the other oil port of the two oil ports at the other end of the second reversing valve 5 is connected to the hydraulic oil tank 3.

[0034] When the second reversing valve 5 is in the state shown in FIG. 1, the second feedback port B2 is communicated with the second feedback pipeline Ls2' of the second load-sensitive pump 201. In this case, this is the state of the mode of the motor 2. When the mode of the engine 1 needs to be adjusted, a valve position of the second reversing valve 5 may be switched, so that the second feedback port B2 can be communicated with the second feedback pipeline Ls2 of the first load-sensitive pump 101. The second reversing valve 5 may be adjusted to adapt to switching between the two power source modes of the engine 1 and the motor 2.

[0035] Based on the foregoing embodiment, further, referring to FIG. 1, the first oil outlet pipeline P1 of the first load-sensitive pump 101 and the first oil outlet pipeline P1' of the second load-sensitive pump 201 are connected in parallel to a first inlet A1 of a main valve, the second oil outlet pipeline P2 of the first load-sensitive pump 101 and the second oil outlet pipeline P2' of the second load-sensitive pump 201 are connected in parallel to a second inlet A2 of the main valve, and the main valve is configured to be connected to an execution mechanism.

[0036] Specifically, the main valve may be provided with the first inlet and the second inlet. Each inlet is connected to the first load-sensitive pump 101 and the second load-sensitive pump 201. That is, by controlling the running of the engine 1 and the motor 2, the supply of oil to the two inlets of the main valve through the engine 1 can be implemented and the supply of oil to the two inlets of the main valve through the motor 2 can be implemented, so that the two power source modes can be implemented. The main valve may be configured to be connected to an execution mechanism with a heavy load. The hydraulic power system is used for a work machine with a superstructure and an undercarriage. For example, in the case of a crane, an excavator, a dynamic compactor, or the like, the main valve may be configured to be connected to a superstructure rotary mechanism. The execution mechanism to which the main valve is specifically connected is not limited in this application.

[0037] Further, the first oil outlet pipeline P1 of the first load-sensitive pump 101 and the first oil outlet pipeline P1' of the second load-sensitive pump 201 may further be connected in parallel to a first valve, and the second oil outlet pipeline P2 of the first load-sensitive pump 101 and the second oil outlet pipeline P2' of the second load-sensitive pump 201 may be connected in parallel to a second valve. The first valve and the second valve may be two independent valves. The first valve and the second valve are respectively configured to be connected to the execution mechanism. Specific connection positions of the two oil outlet pipelines of the duplex load-sensitive pump are not limited in this application, and may be flexibly set according to a specific application environment.

[0038] Based on the foregoing embodiment, further, the first pump set further includes a first gear pump 102, and the second pump set further includes a second gear pump 202. The disposed first gear pump 102 and second gear pump 202 may be configured to be connected to more execution mechanisms. The oil outlet pipeline of the first gear pump 102 and the oil outlet pipeline of the second gear pump 202 are connected in parallel, so that switching of oil output between the first gear pump 102 and the second gear pump 202 can be implemented, that is, switching between the two power sources, that is, the engine 1 and the motor 2, is implemented.

[0039] Based on the foregoing embodiment, further, the first gear pump 102 and the second gear pump 202 are both duplex gear pumps, and a first oil outlet pipeline P3 of the first gear pump 102 and a first oil outlet pipeline P3' of the second gear pump 202 are connected in parallel to an undercarriage multi-way valve inlet F; and a second oil outlet pipeline P4 of the first gear pump 102 and a second oil outlet pipeline P4' of the second gear pump 202 are connected in parallel to an air-conditioning heat-dissipation motor C.

[0040] That is, the hydraulic power system in this embodiment is used for a work machine with a superstructure hydraulic system and an undercarriage leg system, for example, a crane, an excavator, a dynamic compactor, or the like. The gear pumps may be configured to be connected to the undercarriage multi-way valve inlet F, to drive the undercarriage leg system, and specifically drive a leg oil cylinder or the like to work. When the gear pumps are duplex gear pumps, the air-conditioning heat-dissipation motor C may be further connected. The first gear pump 102 and the oil outlet pipeline of the second gear pump 202 are in parallel disposed, so that the power sources can be switched.

[0041] Based on the foregoing embodiment, further, each oil outlet pipeline of the first pump set and each oil outlet pipeline of the second pump set are respectively provided with a one-way valve 6. The one-way valve 6 on each oil outlet pipeline of the first pump set is configured to keep oil in the pipeline from flowing to the first pump set. The one-way valve 6 on each oil outlet pipeline of the second pump set is configured to be keep oil in the pipeline from flowing to the second pump set. Specifically, each of the oil outlet pipeline of the first load-sensitive pump 101 and the oil outlet pipeline of the second load-sensitive pump 201 is provided with a one-way valve 6; and each of the oil outlet pipeline of the first gear pump 102 and the oil outlet pipeline of the second gear pump 202 is also provided with a one-way valve 6.

[0042] Referring to FIG. 1, when the first load-sensitive pump 101 and the second load-sensitive pump 201 are duplex load-sensitive pumps, each of the first oil outlet pipeline P1 of the first load-sensitive pump 101, the second oil outlet pipeline P2 of the first load-sensitive pump 101, the first oil outlet pipeline P1' of the second load-sensitive pump 201, and the second oil outlet pipeline P2' of the second load-sensitive pump 201 is provided with a one-way valve 6. When the first gear pump 102 and the second gear pump 202 are duplex gear pumps, each of the first oil outlet pipeline P3 of the first gear pump 102, the second oil outlet pipeline P4 of the first gear pump 102, the first oil outlet pipeline P3' of the second gear pump 202, and the second oil outlet pipeline P4' of the second gear pump 202 is provided with a one-way valve 6. The one-way valves 6 are disposed on the oil outlet pipelines, so that oil in the pipelines of the system can be kept from flowing away through pipelines of power sources that are not running to release pressure.

[0043] Based on the foregoing embodiment, further, referring to FIG. 1, the hydraulic oil tank 3 is connected to an oil inlet pipeline 7, and an oil inlet of the first pump set and an oil inlet of the second pump set are respectively connected to the oil inlet pipeline 7; and the oil inlet pipeline 7 is provided with a cutoff valve 8. Specifically, each of the oil inlets of the first load-sensitive pump 101, the first gear pump 102, the second load-sensitive pump 201, and the second gear pump 202 is communicated with the oil inlet pipeline 7 through a pipeline, to be communicated with the hydraulic oil tank 3.

[0044] When the first load-sensitive pump 101 and the second load-sensitive pump 201 are duplex load-sensitive pumps, each of two oil inlets of the first load-sensitive pump 101 and two oil inlets of the second load-sensitive pump 201 is communicated with the oil inlet pipeline 7. The cutoff valve 8 may control on or off of the oil inlet pipeline 7.

[0045] Referring to FIG. 1, an oil drain port of the first pump set and an oil drain port of the second pump set are respectively connected to the hydraulic oil tank 3. Specifically, an oil drain port of the first load-sensitive pump 101 and an oil drain port of the second load-sensitive pump 201 are respectively connected to the hydraulic oil tank 3, to implement oil drainage. When the first load-sensitive pump 101 and the second load-sensitive pump 201 are duplex load-sensitive pumps, each of two oil drain ports of the first load-sensitive pump 101 and two oil drain ports of the second load-sensitive pump 201 is communicated with the hydraulic oil tank 3.

[0046] Based on the foregoing embodiment, further, the hydraulic oil tank 3 is further connected to an oil drain pipeline 9, and the oil drain pipeline 9 is configured to be connected to an oil drain port; and/or the hydraulic oil tank 3 is further connected to an oil return pipeline 10, the oil return pipeline 10 is configured to be connected to an oil return port, and the oil return pipeline 10 is provided with an oil return filter 11.

[0047] The hydraulic power system is used for a work machine, and the oil drain port is an oil drain port of an execution mechanism of the work machine, and is used for oil drainage; and the oil return port is an oil return port of the execution mechanism of the work machine, and is used for oil return. Specifically, when the work machine is a machine provided with a superstructure hydraulic system and an undercarriage leg system, for example, a crane, or the like, the oil drain pipeline 9 may be configured to be connected to a superstructure oil drain port D.

[0048] Further, the oil return pipeline 10 is connected to a superstructure oil return port E and an undercarriage multi-way valve oil return port G. Specifically, when the work machine is a machine provided with a superstructure hydraulic system and an undercarriage leg system, for example, a crane, or the like, the oil return pipeline 10 may be configured to be connected to the superstructure oil return port E and the undercarriage multi-way valve oil return port G. The oil return filter 11 is disposed on the oil return pipeline 10, and is configured to filter out impurities in oil that flows back to the hydraulic oil tank 3.

[0049] Further, the first reversing valve 4 and the second reversing valve 5 may be solenoid reversing valves.

[0050] Based on the foregoing embodiment, further, this embodiment provides a work machine. The work machine includes the hydraulic power system in any foregoing embodiment. Specifically, the work machine may be a crane, a dynamic compactor, an excavator, or another machine that requires the hydraulic power system. This is not specifically limited in this application.

[0051] Based on the foregoing embodiment, further, this embodiment provides a control method of a hydraulic power system based on the hydraulic power system in any foregoing embodiment. As shown in FIG. 2, the control method includes the following steps:

Step S110: Detect a rotational speed of a motor 2 when the hydraulic power system is switched to a mode of an engine 1.

Step S120: When the rotational speed of the motor 2 is zero, adjust a reversing valve to enable a first load-sensitive pump 101 to be connected to a feedback port, and connect the engine 1 to a first pump set.

Step S130: Run the mode of the engine 1.

[0052] In another embodiment of this application, the foregoing method further includes:

Step S140: When the hydraulic power system is switched to a mode of the motor 2, disconnect the engine 1 from the first pump set.

Step S150: Adjust the reversing valve to enable a second load-sensitive pump 201 to be connected to the feedback port.

Step S160: Run the mode of the motor 2.

[0053] According to the control method of a hydraulic power system provided in this application, the mode of the motor 2 may be run when a condition of power supply required by the motor 2 is met. When the condition of power supply required by the motor 2 is not met, the mode of the engine 1 is run.

[0054] Based on the foregoing embodiment, further, this embodiment provides a hydraulic power system. A gearbox power take-off (PTO) connected to the engine 1 in the hydraulic power system is connected to a pump set, specifically, a duplex piston load-sensitive pump and a duplex gear pump. The motor 2 is separately connected to another same pump set. The motor 2 and the pump set connected to the motor may be flexibly arranged according to a specific case of a space. The two pump sets are connected in parallel in a one-to-one correspondence through pipelines, and share the hydraulic oil tank 3. The hydraulic power system may be used for a work machine with a superstructure hydraulic system and an undercarriage leg system, for example, a crane, or the like, the two pump set share one set of the superstructure hydraulic system and the undercarriage leg system. The superstructure hydraulic system specifically includes the main valve and the execution mechanism, for example, a hoisting motor, or the like.

[0055] The one-way valve 6 is added to an oil outlet of an oil pump, to avoid pressure release from the pump set when the other power source is stopped. Load feedback ports of two load-sensitive pump sets are switched through two solenoid reversing valves. For a hydraulic principle, refer to FIG. 1, during the switching to the mode of the engine 1 (that is, a PTO outputs power), two conditions need to be met: 1. It is detected that the rotational speed of the motor 2 is 0, the motor 2 is in a stopped state, and the undercarriage engine 1 is allowed to be hooked up to the power take-off, that is, the engine 1 is connected to a gearbox, or otherwise, is forcibly kept from being hooked up to the power take-off. 2. The first reversing valve 4 and the second reversing valve 5 are simultaneously powered up, that is, are connected to a load the feedback pipeline Ls1 and a load the feedback pipeline Ls2 of the superstructure hydraulic system. During switching to the mode of the motor 2, two conditions need to be met: 1. The power take-off of the engine 1 has been disengaged, that is, the engine 1 is disengaged from the gearbox. 2. The first reversing valve 4 and the second reversing valve 5 are simultaneously powered down, that is, a load the feedback pipeline Ls1' and a load the feedback pipeline Ls2' are connected to the superstructure hydraulic system.

[0056] Based on the foregoing embodiment, further, this embodiment provides a hydraulic power system. A gearbox power take-off (PTO) connected to the engine 1 in the hydraulic po

A dual power system formed by the motor 2 and a pump set in this embodiment is a parallel structure, and is a load sensitive system with a parallel mode of a dual power+a dual pump set. Each of the motor 2 and the gearbox PTO is connected to one pump set, the two pump sets are arranged in parallel, and a hydraulic principle and a control logic are provided, referring to FIG. 1. The motor 2 may be flexibly arranged without being restricted by a PTO through-shaft connection. Two sets of power sources share one set of an uppercarriage hydraulic system and an undercarriage leg system, thereby implementing normal execution of working actions in switching of two power source modes.

[0057] Finally, it should be noted that the foregoing embodiments are merely intended for describing the technical solutions of this application, but not for limiting this application. Although this application is described in detail with reference to the foregoing embodiments, persons of ordinary skill in the art should understand that they may still make modifications to the technical solutions described in the foregoing embodiments or make equivalent replacements to some technical features thereof, without departing from the spirit and scope of the technical solutions of embodiments of this application.

Claims

1. A hydraulic power system, comprising a hydraulic oil tank, an engine, a motor, a first pump set, and a second pump set, wherein the engine is connected to the first pump set, the motor is connected to the second pump set, the first pump set and the second pump set are respectively connected to the hydraulic

oil tank, the first pump set comprises a first load-sensitive pump, the second pump set comprises a second load-sensitive pump, an oil outlet pipeline of the first load-sensitive pump and an oil outlet pipeline of the second load-sensitive pump are connected in parallel, and a feedback pipeline of the first load-sensitive pump and a feedback pipeline of the second load-sensitive pump are connected in parallel by a reversing valve.

2. The hydraulic power system according to claim 1, wherein the first load-sensitive pump and the second load-sensitive pump are both duplex load-sensitive pumps, a first oil outlet pipeline of the first load-sensitive pump and a first oil outlet pipeline of the second load-sensitive pump are connected in parallel, and a second oil outlet pipeline of the first load-sensitive pump and a second oil outlet pipeline of the second load-sensitive pump are connected in parallel; and
a first feedback pipeline of the first load-sensitive pump and a first feedback pipeline of the second load-sensitive pump are connected in parallel by a first reversing valve, and a second feedback pipeline of the first load-sensitive pump and a second feedback pipeline of the second load-sensitive pump are connected in parallel by a second reversing valve.

3. The hydraulic power system according to claim 2, wherein the first feedback pipeline of the first load-sensitive pump and the first feedback pipeline of the second load-sensitive pump are connected to two oil ports at one end of the first reversing valve in a one-to-one correspondence, one oil port of two oil ports at the other end of the first reversing valve is connected to a first feedback port, and the other oil port of the two oil ports at the other end of the first reversing valve is connected to the hydraulic oil tank; and
the second feedback pipeline of the first load-sensitive pump and the second feedback pipeline of the second load-sensitive pump are connected to two oil ports at one end of the second reversing valve in a one-to-one correspondence, one oil port of two oil ports at the other end of the second reversing valve is connected to a second feedback port, and the other oil port of the two oil ports at the other end of the second reversing valve is connected to the hydraulic oil tank.

4. The hydraulic power system according to claim 2, wherein the first oil outlet pipeline of the first load-sensitive pump and the first oil outlet pipeline of the second load-sensitive pump are connected in parallel to a first inlet of a main valve, the second oil outlet pipeline of the first load-sensitive pump and the second oil outlet pipeline of the second load-sensitive pump are connected in parallel to a second inlet of the main valve, and the main valve is configured to be connected to an execution mechanism.

5. The hydraulic power system according to any one of claims 1 to 4, wherein the first pump set further comprises a first gear pump, the second pump set further comprises a second gear pump, and an oil outlet pipeline of the first gear pump and an oil outlet pipeline of the second gear pump are connected in parallel.

6. The hydraulic power system according to claim 5, wherein the first gear pump and the second gear pump are both duplex gear pumps, and a first oil outlet pipeline of the first gear pump and a first oil outlet pipeline of the second gear pump are connected in parallel to an undercarriage multi-way valve inlet; and a second oil outlet pipeline of the first gear pump and a second oil outlet pipeline of the second gear pump are connected in parallel to an air-conditioning heat-dissipation motor.

7. The hydraulic power system according to any one of claims 1 to 6, wherein each oil outlet pipeline of the first pump set and each oil outlet pipeline of the second pump set are respectively provided with a one-way valve.

8. The hydraulic power system according to any one of claims 1 to 7, wherein the hydraulic oil tank is connected to an oil inlet pipeline, and an oil inlet of the first pump set and an oil inlet of the second pump set are respectively connected to the oil inlet pipeline; and the oil inlet pipeline is provided with a cutoff valve.

9. The hydraulic power system according to any one of claims 1 to 8, wherein the hydraulic oil tank is further connected to an oil drain pipeline, and the oil drain pipeline is configured to be connected to an oil drain port.

10. The hydraulic power system according to any one of claims 1 to 9, wherein the hydraulic oil tank is further connected to an oil return pipeline, the oil return pipeline is configured to be connected to an oil return port, and the oil return pipeline is provided with an oil return filter.

11. A work machine, comprising the hydraulic power system according to any one of claims 1 to 10.

12. A control method of a hydraulic power system, being based on the hydraulic power system according to any one of claims 1 to 10, wherein the control method comprises:
detecting a rotational speed of a motor when the hydraulic power system is switched to a mode of an engine;

when the rotational speed of the motor is zero, adjusting a reversing valve to enable a first load-sensitive pump to be connected to a feedback port, and connecting the engine to a first pump set; and
running the mode of the engine.

13. The control method according to claim 12, further comprising:

when the hydraulic power system is switched to a mode of the motor, disconnecting the engine from the first pump set;
adjusting the reversing valve to enable a second load-sensitive pump to be connected to the feedback port; and
running the mode of the motor.

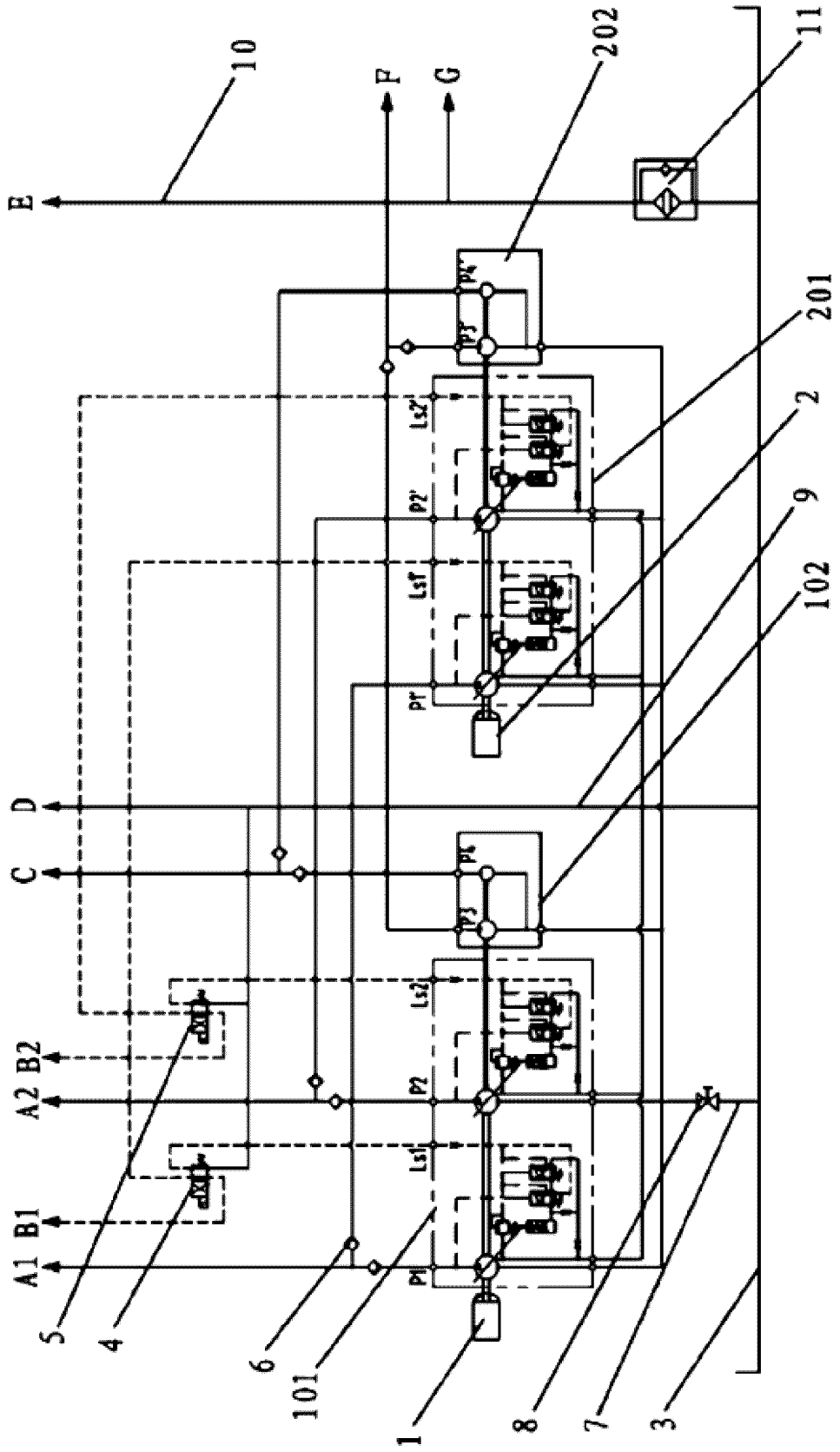

FIG. 1

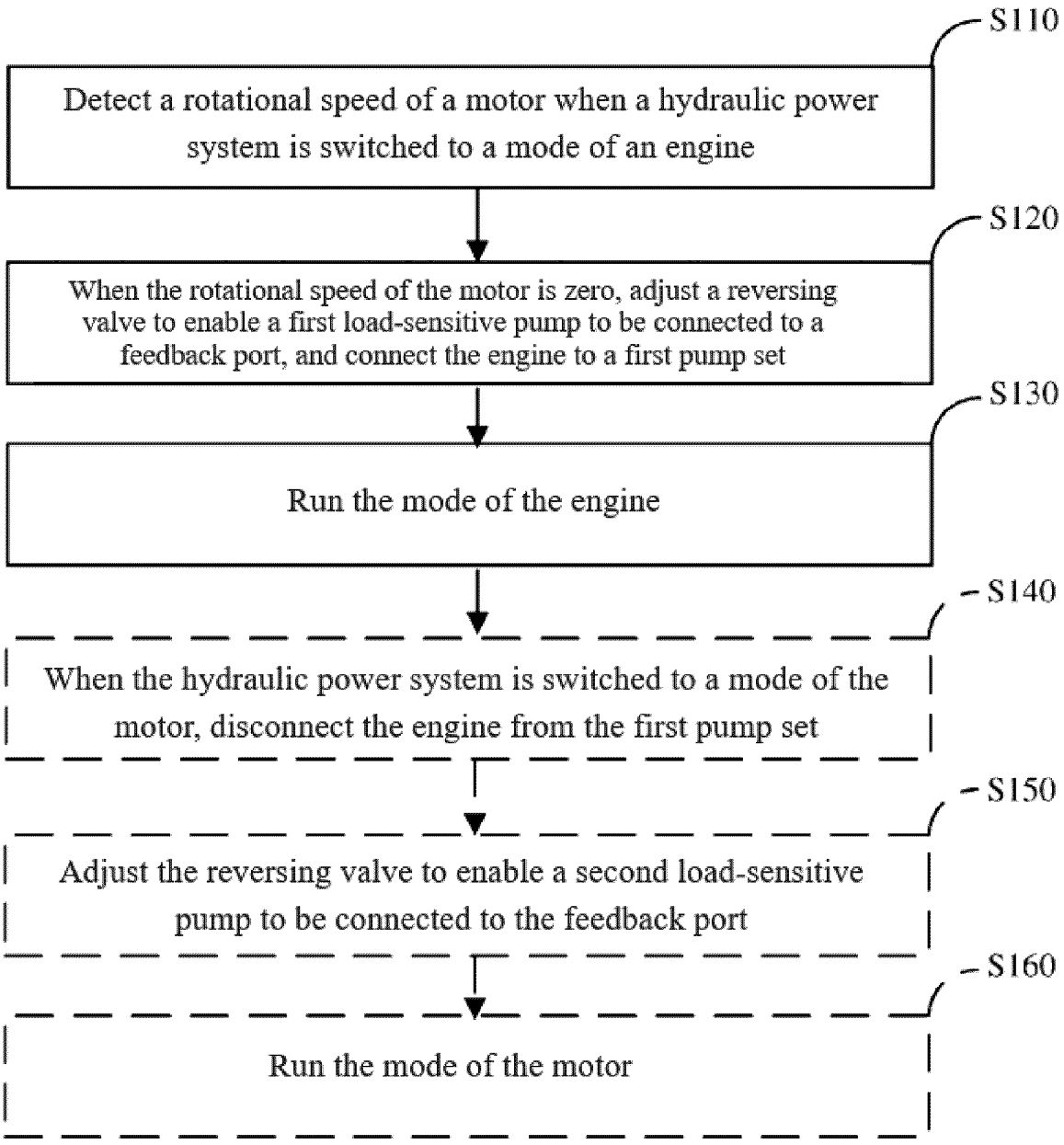
S110
Detect a rotational speed of a motor when a hydraulic power system is switched to a mode of an engine
S120
When the rotational speed of the motor is zero, adjust a reversing valve to enable a first load-sensitive pump to be connected to a feedback port, and connect the engine to a first pump set
S130
Run the mode of the engine
S140
When the hydraulic power system is switched to a mode of the motor, disconnect the engine from the first pump set
S150
Adjust the reversing valve to enable a second load-sensitive pump to be connected to the feedback port
S160
Run the mode of the motor

FIG. 2

INTERNATIONAL SEARCH REPORT

International application No.
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A. CLASSIFICATION OF SUBJECT MATTER

B66C13/20(2006.01)i; F15B13/02(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)

IPC: B66C; F15B

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

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

CNTXT; VEN; CNKI: 液压, 电动机, 电机, 发动机, 泵, 齿轮, 负载敏感, 双动力源, 双重动力源, 换向, 阀, hydraulic, double, dual, two, engine, motor, gear, load, power, pump, sensitive, switch

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
PX	CN 217708618 U (SANY AUTOMOBILE HOISTING MACHINERY CO., LTD.) 01 November 2022 (2022-11-01) see claims 1-10, and description, paragraph 50	1-13
Y	CN 106678099 A (XUZHOU XCMG SCHWING MACHINERY CO., LTD.) 17 May 2017 (2017-05-17) see description, paragraphs 9-13, and figure 1	1-13
Y	CN 214404147 U (HENAN E-WORK INDUSTRIAL EQUIPMENT CO., LTD.) 15 October 2021 (2021-10-15) see description, paragraphs 17-18, and figure 1	1-13
A	CN 212225638 U (XUZHOU XUGONG ROAD CONSTRUCTION MACHINERY CO., LTD.) 25 December 2020 (2020-12-25) see entire document	1-13
A	CN 214465195 U (HUNAN SANY ROAD MACHINERY CO., LTD.) 22 October 2021 (2021-10-22) see entire document	1-13

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

* Special categories of cited documents:
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"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
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"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
22 May 2023	**02 June 2023**
Name and mailing address of the ISA/CN **China National Intellectual Property Administration (ISA/CN)** **China No. 6, Xitucheng Road, Jimenqiao, Haidian District, Beijing 100088**	Authorized officer Telephone No.

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INTERNATIONAL SEARCH REPORT

International application No.
PCT/CN2022/144124

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Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	JP 2003329005 A (KAYABA INDUSTRY CO., LTD.) 19 November 2003 (2003-11-19) see entire document	1-13
A	JP H06200905 A (KAYABA INDUSTRY CO., LTD.) 19 July 1994 (1994-07-19) see entire document	1-13

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INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/CN2022/144124

Patent document cited in search report	Publication date (day/month/year)	Patent family member(s)	Publication date (day/month/year)
CN 217708618 U	01 November 2022	None	
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CN 214404147 U	15 October 2021	None	
CN 212225638 U	25 December 2020	None	
CN 214465195 U	22 October 2021	None	
JP 2003329005 A	19 November 2003	None	
JP H06200905 A	19 July 1994	JP 3195095 B2	06 August 2001

Form PCT/ISA/210 (patent family annex) (July 2022)