A multiple pump unit is used for operating a plurality of actuators, and includes a plurality of pump shafts and a plurality of hydraulic pumps. The plurality of pump shafts is driven by an electric motor. The plurality of hydraulic pumps is driven by the plurality of pump shafts. Pressurized oil for operating the plurality of actuators is fed out from the plurality of hydraulic pumps.
Fig. 24
MULTIPLE PUMP UNIT AND VEHICLE WITH MULTIPLE PUMP UNIT

PRIORITY INFORMATION


BACKGROUND

[0002] 1. Technical Field

[0003] The present invention generally relates to a multiple pump unit used for operating a plurality of actuators, and to a vehicle with such a multiple pump unit.

[0004] 2. Related Art

[0005] Hydraulic pumps have been conventionally used for various purposes. For example, work vehicles such as a lawn mower vehicles, tractors, or trucks drive a hydraulic pump with an engine, and the hydraulic pressure produced is used to rotate two wheel-driving hydraulic motors, which are a plurality of actuators, which in turn drive the two front or rear wheels.

[0006] Further, a work vehicle such as a lawn mower vehicle or a tractor is sometimes used to drive working machines such as a mower or a cultivator, and to raise and lower the machine. As a result, the concept of creating a dual pump unit by combining two hydraulic pumps and driving the machine via a PTO (power take off) shaft capable of taking out power from the drive source was proposed.

[0007] For example, Japanese Patent Laid-Open Publication No. 2004-306052 discloses a pump unit including a PTO shaft and two hydraulic pump bodies. In the disclosed configuration, a first pump shaft and a second pump shaft are operationally connected to an input shaft connected to a drive source, and power transmission between the input shaft and the PTO shaft, and shutting off the power transmission are made switchable by a hydraulic clutch mechanism provided between the input shaft and the PTO shaft. The first pump shaft drives a first hydraulic pump body, and pressurizes the oil supplied into the first hydraulic pump body from an oil supply port to discharge the oil from a discharge port. The second pump shaft drives a second hydraulic pump body, and pressurizes the oil supplied into the second hydraulic pump body from another oil supply port to discharge the oil from another discharge port.

[0008] A first hydraulic motor and a second hydraulic motor are respectively driven by the oil discharged from the first hydraulic pump body and the second hydraulic pump body, and wheels corresponding to them are rotated. Further, the PTO shaft and the working machine are connected by a transmission shaft.

[0009] In the case of the pump unit disclosed in Japanese Patent Laid-Open Publication No. 2003-306052, when the drive source is an engine, the engine must be driven whenever the wheels or an attachment are driven. Therefore, it still has room for improvement in the aspect of enhancement of quietness. For example, in the working vehicle including the pump unit disclosed in Japanese Patent Laid-Open Publication No. 2003-306052, when the drive source is an engine, the engine is always driven, and therefore use of the working vehicle in an environment where quietness is desired, such as an area near a residential district, is likely to be difficult due to the noise generated by the engine.

[0010] Further, although it has been conventionally conceived of driving one pump with one electric motor, with such a configuration the range of use is small, and usability is low. For example, when two wheels at both left and right sides are driven with one pump, independent control of the wheels is difficult, and it is likely to be difficult to make the turning radius small.

SUMMARY

[0011] It is an advantage of the present invention to provide a structure usable for many purposes and providing superior quietness, in a multiple pump unit and a vehicle with the multiple pump unit.

[0012] A multiple pump unit according to the present invention may be configured as a multiple pump unit used for operating a plurality of actuators, characterized by including a plurality of pump shafts driven by an electric motor, and a plurality of hydraulic pumps driven by the respective plurality of pump shafts, wherein pressurized oil for operating the plurality of actuators is fed out from the plurality of hydraulic pumps.

[0013] According to this constitution, a plurality of pump shafts which drive a plurality of hydraulic pumps are driven by the electric motor, and the pressurized oil for operating a plurality of actuators is fed out from the plurality of hydraulic pumps. Therefore, because electric power can be supplied to a secondary battery or the like from a generator or the like driven by an engine, and this electric power can then be supplied to the electric motor from the secondary battery or the like, the engine does not have to be always operated for operating the plurality of actuators. Therefore, the structure capable of providing very quiet operation is obtained. In addition, because the multiple pump unit can be used for a larger number of purposes, usability can be enhanced compared to configurations in which the electric motor drives only one pump shaft constituting a hydraulic pump.

[0014] Further, preferably, at least any one of the plurality of hydraulic pumps is a double port pump provided with a plurality of discharge ports in correspondence with one pump shaft, and the pressurized oil for operating the plurality of actuators is fed out from the plurality of discharge ports of the double port pump.

[0015] With this constitution, the pressurized oil for operating a larger number of actuators is fed out from the plurality of hydraulic pumps, and a larger number of actuators can be operated. Therefore, usability can be further enhanced.

[0016] Further, more preferably, a casing housing the plurality of hydraulic pumps and rotationally supporting a rotating shaft of the electric motor and the plurality of hydraulic pump shafts, and a PTO shaft rotatably supported by the casing are included, the rotating shaft of the electric motor and the plurality of hydraulic pump shafts are operationally connected, and power transmission is made selectively possible between the rotating shaft of the electric motor and the PTO shaft by a clutch mechanism.

[0017] According to this constitution, irrespective of the rotation of the electric motor, operation and non-operation of the working machine or the like operationally connected to the PTO shaft can be selected by the clutch mechanism, and usability can be further enhanced.

[0018] Further, more preferably, a PTO shaft side pulley fixed to the PTO shaft projecting from the casing is included.
Further, more preferably, a cooling fan is fixed to at least one of a rotary shaft of the electric motor or a hydraulic pump shaft among the plurality of hydraulic pumps.

With this constitution, the equipment including the electric motor and the plurality of hydraulic pumps can be easily cooled, making it easier to further enhance performance.

Further, more preferably, a casing housing the plurality of hydraulic pumps, and a cooling air guide part fixed to an outer side of the casing and guiding cooling air generated by the cooling fan along the outer side of the casing are included.

With this constitution, the casing can be easily cooled by the cooling air, making it still easier to further enhance performance.

Further, a vehicle with a multiple pump unit according to the present invention includes the described multiple pump unit, a secondary battery or a fuel cell supplying electric power to the electric motor, and electric power supply state selecting unit selecting whether to supply electric power to the electric motor from the secondary battery or the fuel cell, or to shut off the supply of the electric power to the electric motor from the secondary battery or the fuel cell.

Further, more preferably, a working machine supported by a vehicle body, and a working machine side pulley operationally connected to the working machine are included, the multiple pump unit includes a casing housing the plurality of hydraulic pumps, and rotatably supporting a rotary shaft of the electric motor and the plurality of hydraulic pump shafts, and a PTO shaft rotatably supported by the casing, the rotary shaft of the electric motor and the plurality of hydraulic pump shafts are operationally connected, power transmission is made selectively possible between the rotary shaft of the electric motor and the PTO shaft by a clutch mechanism, a PTO shaft side pulley fixed to the PTO shaft projected from the casing is included, and a belt is provided between the PTO shaft side pulley and the working machine side pulley.

Further, more preferably, the plurality of actuators driven by the pressurized oil from the multiple pump unit are two-wheel-driving hydraulic motors.

Further, more preferably, a generator driven by an engine is included, and electric power generated by the generator is supplied to the electric motor via the secondary battery or directly.

Further, more preferably, an engine side pulley capable of being selectively connected to an output shaft of an engine by a clutch, and a working machine supported by a vehicle body, and a working machine side pulley operationally connected to the working machine are included, and a belt is provided between the engine side pulley and the working machine side pulley.

Further, more preferably, a plurality of actuators driven by the pressurized oil from the multiple pump unit are each any of a working machine raising and lowering cylinder device raising and lowering a working machine, a working machine driving device driving the working machine, and a working machine tilting cylinder device tilting to displace the working machine, and electric power is supplied to a wheel-driving electric motor from any of the secondary battery, the fuel cell, and a generator to drive the wheel-driving electric motor.

Further, more preferably, a charge pump provided to replenish at least any one of the plurality of hydraulic pumps with pressurized oil is included.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1a is a diagram showing a basic constitution of a vehicle with a multiple pump unit of a first embodiment according to the present invention;

FIG. 1b is a diagram showing a basic constitution of a vehicle with a multiple pump unit of a second embodiment according to the present invention;

FIG. 1c is a diagram showing a basic constitution of a vehicle with a multiple pump unit of a seventh embodiment according to the present invention;

FIG. 2 is a schematic illustration showing a constitution of a working vehicle that is the vehicle with the multiple pump unit of the first embodiment;

FIG. 3 is a schematic sectional view taken along the line A-A in FIG. 2;

FIG. 4 is a diagram showing a hydraulic circuit used in the first embodiment;

FIG. 5 is a sectional view showing a hydraulic circuit used in the second embodiment;

FIG. 6 is a schematic illustration showing a constitution of a working vehicle that is the vehicle with the multiple pump unit of the second embodiment according to the present invention;

FIG. 7 is a schematic sectional view taken along the line B-B in FIG. 6;

FIG. 8 is a diagram showing a hydraulic circuit used in the second embodiment;

FIG. 9 is a sectional view showing a hydraulic circuit used in the second embodiment;

FIG. 10 is a sectional view showing a hydraulic circuit used in the second embodiment;

FIG. 11 is a sectional view showing a hydraulic circuit used in the second embodiment;

FIG. 12 is a sectional view showing a hydraulic circuit used in the second embodiment;

FIG. 13 is a sectional view showing a hydraulic circuit used in the second embodiment;

FIG. 14 is a schematic illustration showing a constitution of a working vehicle that is the vehicle with the multiple pump unit of the seventh embodiment of the present invention;

FIG. 15a is a diagram showing a basic constitution of a vehicle with a multiple pump unit of an eighth embodiment of the present invention;

FIG. 15b is a diagram showing a basic constitution of a vehicle with a multiple pump unit of an eighth embodiment of the present invention;

FIG. 16 is a sectional view showing a drive device portion of a wheel on one side in a working vehicle that is a vehicle with a multiple pump unit of a tenth embodiment of the present invention;

FIG. 17 is a sectional view similar to FIG. 16, in a working vehicle that is a vehicle with a multiple pump unit of an eleventh embodiment of the present invention;
[0050] FIG. 18 is a view corresponding to an enlarged section of a part C in FIG. 16, in a working vehicle that is a vehicle with a multiple pump unit of a twelfth embodiment of the present invention;

[0051] FIG. 19 is a view corresponding to an enlarged section of a part D in FIG. 16, in a working vehicle that is a vehicle with a multiple pump unit of a thirteenth embodiment of the present invention;

[0052] FIG. 20 is a diagram showing a basic constitution and a hydraulic circuit of a working vehicle that is a vehicle with a multiple pump unit of a fourteenth embodiment of the present invention;

[0053] FIG. 21 is a diagram showing a basic constitution and a hydraulic circuit of a working vehicle that is a vehicle with a multiple pump unit of a fifteenth embodiment of the present invention;

[0054] FIG. 22 is a diagram showing a basic constitution and a hydraulic circuit of a working vehicle that is a vehicle with a multiple pump unit of a first reference example relating to the present invention;

[0055] FIG. 23 is a diagram showing a basic constitution and a hydraulic circuit of a working vehicle that is a vehicle with a multiple pump unit of a second reference example of the present invention;

[0056] FIG. 24 is a diagram showing a basic constitution and a hydraulic circuit of a working vehicle that is a vehicle with a multiple pump unit of a sixteenth embodiment of the present invention; and

[0057] FIG. 25 is a diagram showing a basic constitution and a hydraulic circuit of a working vehicle that is a vehicle with a multiple pump unit of a third reference example relating to the present invention.

DESCRIPTION OF EXEMPLARY EMBODIMENTS

First Embodiment of the Invention

[0058] Hereinafter, embodiments of the present invention will be described in detail while referring to the drawings. FIG. 1a is a block diagram showing a basic constitution of this embodiment, FIG. 1b is a block diagram showing a basic constitution of a second embodiment which will be described later, and FIG. 1c is a block diagram showing a basic constitution of a seventh embodiment which will be described later. FIG. 2 is a schematic side view of a vehicle with a multiple pump unit of this embodiment configured as a lawn mower vehicle, and FIG. 3 is a schematic sectional view taken along the line A-A in FIG. 2. FIG. 4 is a diagram of a hydraulic circuit used in this embodiment, and FIG. 5 is a sectional view showing the multiple pump unit of this embodiment.

[0059] First, based on FIG. 1a, the basic constitution of the vehicle with the multiple pump unit of this embodiment will be described. The basic constitution of the vehicle with the multiple pump unit of this embodiment includes an engine 10, a generator 12 connected to the engine 10 in such a manner that it is capable of transmitting power and being driven by the engine 10, a battery 14 that is a secondary battery supplied with electric power from the generator 12, a dual pump unit 16 that is the multiple pump unit, two wheel-driving hydraulic motors 18 and 20 that are wheel-driving hydraulic motors, a controller 22 that is a control unit and a working machine 24.

The controller 22 is, for example, a computer such as an ECU (Electronic Control Unit) including a CPU.

[0060] The dual pump unit 16 is used for operating the two wheel-driving hydraulic motors 18 and 20 via a hydraulic circuit, and includes an electric motor 26, and a dual pump (DUP) 28 having two hydraulic pumps. The electric motor 26 is supplied with electric power from the battery 14 and drives two pump shafts constituting the dual pump 28. Because the two hydraulic pumps are driven by the two pump shafts, pressurized oil is discharged from the two hydraulic pumps and the discharged pressurized oil operates the two wheel-driving hydraulic motors 18 and 20 provided at the left and right of the vehicle via the hydraulic circuit. Specifically, the hydraulic motors 18 and 20 are driven.

[0061] Further, the power of the electric motor 26 is transmitted to the PTO shaft from the dual pump unit 16, then transmitted to a pulley fixed to a driven shaft for driving the working machine 24 via a pulley fixed to the PTO shaft and a belt, and the working machine 24 is thus driven.

[0062] Further, the controller 22 sends a control signal to a DC/DC converter, not shown, connected to the battery 14, and controls the electric power taken out from the battery 14. Further, the controller 22 sends a control signal to an inverter not shown connected to the electric motor 26, and controls the output of the electric motor 26. FIGS. 1, 1a, 1b and 1c show representation such that control signals are transferred to and from the battery 14 and the controller 22, and to and from the electric motor 26 and the controller 22 (further to and from the battery 14 and the wheel driving electric motors 142 and 144 in FIG. 1c), but actually, control signals are transferred to and from the DC/DC converter connected to the battery 14 or the inverter connected to the electric motor 26 (further, the wheel driving electric motors 142 and 144 in FIG. 1c) and the controller 22. The controller 22 has electric power supply state selecting unit which selects whether to supply electric power to the electric motor 26 from the battery 14 or to shut off the supply of the electric power to the electric motor 26 from the battery 14.

[0063] Next, based on FIGS. 2 and 3, a working vehicle 30 that is a vehicle with a multiple pump unit will be described in detail. Hereinafter, an example wherein the present invention is applied to a lawn mower vehicle will be described as an example of a vehicle with the multiple pump unit. In addition to a working vehicle which conducts, for example, work to a ground, that is, ground work, the vehicle with the multiple pump unit may be any vehicle, as long as the vehicle generally drives wheels and the like using a hydraulic motor that is an actuator by using a hydraulic pump. A vehicle having a cultivator, a truck having a deck tilting device, a vehicle having a seedling transplanting machine, a vehicle having a bulldozer attachment, a vehicle having an attached digger and the like may all also be adopted in addition to a lawn mower vehicle having a mower as shown in FIGS. 2 and 3, for example. For example, in the case of a truck, the deck tilting device or the like corresponds to an actuator. Further, the actuator may be a hydraulic cylinder device constituting a power steering apparatus.

[0064] FIGS. 2 and 3 show the constitution of the working vehicle 30. In the working vehicle 30, two wheels (rear wheels in the drawing) 32 are made drivable by a first hydraulic motor 34 and a second hydraulic motor 36 (FIG. 3) that are the two hydraulic motors. The working vehicle 30 is a mowing vehicle which includes a mower (lawn mower attachment) 38 corresponding to the working machine 24 (FIG. 1a), and also travels along the ground propelled by the two wheels 32.

Operation parts such as an operation lever 40 for operating the
mower 38, accelerates and brakes the working vehicle 30 are provided near a driver’s seat in which an operator sits.

The working vehicle 30 includes a frame 42 constituting a vehicle body, the engine 10 which is an on-vehicle internal combustion engine supported by the frame 42, the generator 12 which is operationally connected to an output shaft of the engine 10 (specifically, has its drive shaft operationally connected to the output shaft), the battery 14 (see FIGS. 1a, 1b and 1c, not shown in FIGS. 2 and 3) which is supplied with electric power from the generator 12 and stores the electric power, and the dual pump unit 16 which has the electric motor 26 driven by the electric power supplied from the battery 14. For example, the output shaft of the engine 10 may face downward and the drive shaft constituting the generator 12 may be connected to the lower end portion of the output shaft, or the output shaft of the engine 10 and the drive shaft of the generator 12 may be integrally constituted by a common shaft. A drive pulley is fixed to an end portion of the output shaft of the engine 10, and the generator 12 can be driven by the engine 10 via the drive pulley, a belt, and a driven pulley fixed to the drive shaft of the generator 12. The battery 14 and the dual pump unit 16 may be supported at the frame 42 directly or via other members.

The two wheels 32 which are rear wheels are supported at an intermediate portion in the longitudinal direction of the frame 42, and a pair of left and right casters 43 are supported at portions separated to the left and the right at a front end portion of the frame 42. The mower 38 is provided between the caster 43 and the wheels 32 with respect to the longitudinal direction of the frame 42. The mower 38 is supported at the frame 42 to be adjustable in the height direction. Further, the mower 38 is provided with a discharge duct 47 for discharging cut grass rearward. The discharge duct 47 extends rearward through a space between the first hydraulic motor 34 and the second hydraulic motor 36 provided to correspond to the two wheels 32.

The dual pump unit 16 includes a casing 44, the electric motor 26 (FIG. 1a), the dual pump 28 (FIG. 1a), and a PTO shaft 45, which are respectively provided in the casing 44. The dual pump 28 includes a first hydraulic pump and a second hydraulic pump which will be described later. An output shaft of the electric motor 26 is operationally connected to a first pump shaft constituting the first hydraulic pump and a second pump shaft constituting the second hydraulic pump. The pressurized oil discharged from the first hydraulic pump and the second hydraulic pump by driving of the first hydraulic pump and the second hydraulic pump is supplied to the first hydraulic motor 34 and the second hydraulic motor 36 via a hydraulic pipe line 46 (FIG. 3) constituting the hydraulic circuit, such that the wheels 32 are driven in conjunction with the respective hydraulic motors 34 and 36. The first hydraulic motor 34 and the second hydraulic motor 36 correspond to the wheel-driving hydraulic motors 18 and 20 (FIG. 1a), respectively.

Pair of operation levers 40 are provided to the left and right of the driver’s seat, and are used to adjust the hydraulic pressure which is supplied to each of the hydraulic motors 34 and 36 and adjust the drive force of the two left and right wheels 32 independently at the left and the right. In the example shown in the drawings, only the rear wheels of the working vehicle 30 are driven, but a hydraulic motor may be provided to correspond to each of four wheels in total, that is, two wheels for each of both left and right sides so that the two hydraulic motors of one of the left and right sides are driven by the pressurized oil discharged from one hydraulic pump, and the two hydraulic motors corresponding to the two wheels at the other one of the left and right sides are driven by the pressurized oil discharged from the other hydraulic pump.

Further, the dual pump unit 16 is capable of transmitting the power of the electric motor 26 to the PTO shaft 45 via a gear mechanism and a hydraulic clutch mechanism which will be described later. A lower end portion of the PTO shaft 45 is projected downward from a lower side of the casing 44, and a PTO shaft side pulley 48 is fixed to it. A belt 52 is provided between the PTO shaft side pulley 48 and a working machine side pulley 50 fixed to the driven shaft of the mower 38. Specifically, the working machine side pulley 50 is operationally connected to the mower 38. By such a constitution, the mower 38 is made drivable by the power of the electric motor 26.

FIG. 4 is a diagram showing the hydraulic circuit for explaining the flow of the pressurized oil between a first hydraulic pump 54 and a second hydraulic pump 56 which constitute the dual pump 28, and the first hydraulic motor 34 and the second hydraulic motor 36 which drive the wheels 32. The engine 10 drives the output shaft, and thereby, the generator 12 is driven via the output shaft. The electric power generated by the generator 12 is supplied to the battery 14, and the electric motor 26 is driven by the electric power from the battery 14. The DC/DC converter (not shown) connected to the battery 14 and an inverter (not shown) connected to the electric motor 26 are controlled by the controller 22. 22.

In the dual pump unit 16, the first pump shaft and the second pump shaft, which will be described later, are operationally connected to the output shaft of the electric motor 26. Specifically, the output shaft of the electric motor 26 and the first pump shaft are constituted of a common drive shaft 58, and the output shaft of the electric motor 26 and a second pump shaft 60 are connected to be capable of transmitting power by a gear mechanism 62. As shown in FIG. 5 which will be described later, an output shaft 64 of the electric motor 26 and a first pump shaft 66 can be connected to be capable of transmitting power by the gear mechanism 62.

Returning again to FIG. 4, the first hydraulic pump 54 is driven by the drive shaft 58 which is the first pump shaft, and the second hydraulic pump 56 is driven by the second pump shaft 60. Further, a charge pump 68 is made drivable by the drive shaft 58. Thereby, the electric motor 26, the first hydraulic pump 54, the charge pump 68 and the second hydraulic pump 56 are driven at the same time.

The charge pump 68 has the function of replenishing an oil deficit caused as a result of oil leakage which is caused by the oil circulating in the hydraulic circuit and the like. More specifically, the charge pump 68 sucks oil from an external tank 72 through a filter 70, pressurizes the oil, supplies the oil to a hydraulic path at a low pressure side through a check valve 74, and supplies part of the oil to a hydraulic path at a high pressure side through another check valve 74 as necessary. Specifically, a discharge side of the charge pump 68 branches into a charge line 220 and a working oil line 222 from a main pressurized oil line 216 via a pressure reducing valve 218 for setting charge pressure. A relief valve 76 has a function of maintaining the hydraulic pressure of the main pressurized oil line 216. The external tank 72 is connected to the casing 44 which is a pump case, so that oil is supplied to the tank 72 from an oil reservoir in the casing 44. The first hydraulic pump 54 and the second hydraulic pump 56 are housed in the casing 44.
The pressurized oil discharged from the first hydraulic pump 54 is supplied to the first hydraulic motor 34 corresponding to the wheel 32 at one side (upper side in FIG. 4) of the left and right wheels 32, and drives the wheel 32 at the one side via a planetary gear mechanism 78. The first hydraulic pump 54 has a function of causing the pressurized oil to flow by reversing the pressure increasing side and the pressure decreasing side.

Further, the pressurized oil discharged from the second hydraulic pump 56 is supplied to the second hydraulic motor 36 corresponding to the wheel 32 at the other side (lower side of FIG. 4) of the left and right wheels, and drives the wheel 32 at the other side via the planetary gear mechanism 78. The second hydraulic pump 56 also has a function of causing the pressurized oil to flow by reversing the pressure increasing side and the pressure decreasing side as the first hydraulic pump 54.

The charge line 220 and the hydraulic circuit including the second hydraulic pump 56 are connected by a connecting line 80. The oil supplied from the connecting line 80 is supplied to a low pressure side of the hydraulic path including the second hydraulic pump 56 through a check valve 82, and part of it is supplied to a high pressure side of the hydraulic path including the second hydraulic pump 56 through another check valve 82. Oil reservoirs in the casing respectively constituting the first hydraulic motor 34 and the second hydraulic motor 36 are connected to the tank 72.

Further, bypass valves 84 are provided at bypass paths disposed in parallel with respect to the flow of the pressurized oil for the respective hydraulic pumps 54 and 56, and, by opening the bypass valves 84, the supply of the pressurized oil to the hydraulic motors 34 and 36 corresponding to the opened bypass valves 84 from the respective hydraulic pumps 54 and 56 is stopped. Thereby, the load on the hydraulic motors 34 and 36 can be removed when, for example, it is desired to push or otherwise forcibly move the working vehicle 30 when the electric motor is stopped. Such bypass valves 84 can be made manually operated valves.

Further, the second pump shaft 60 and a drive side member 86 are operationally connected by a gear mechanism 88, and a hydraulic clutch mechanism 90 is provided between the drive side member 86 and the PTO shaft 45. Thus, power transmission between the drive side member 86 and the PTO shaft 45 is selectively made possible by the hydraulic clutch mechanism 90. The pressurized oil from the main pressurized oil line 216 is allowed to be supplied to the hydraulic clutch mechanism 90 by the working oil line 222. Though not illustrated, a hydraulic path may be branched from the charge line 220 or the main pressurized oil line 216, and by the pressurized oil from the branched hydraulic path, the actuator, such as a cylinder for raising and lowering the mower 38 (see FIG. 2), can be operated.

Next, a specific example structure of the dual pump unit 16 which is the multiple pump unit of this embodiment will be described in more detail by referring to FIG. 5. The parts equivalent to the parts described in FIGS. 1a to 4 will be assigned the same reference numerals and characters, and their description will not be repeated. In the dual pump unit 16, the first pump shaft 66 constituting the first hydraulic pump 54, the second pump shaft 60 constituting the second hydraulic pump 56, the output shaft 64 of the electric motor 26, and the PTO shaft 45 are rotatably supported on the casing 44 so as to be parallel with each other, and the first hydraulic pump 54 and the second hydraulic pump 56 are housed in the casing 44.

As a gear part fixed to the output shaft 64 of the electric motor 26 is disposed between the first pump shaft 66 and the second pump shaft 60, the first pump shaft 66 and the second pump shaft 60 and the output shaft 64 of the electric motor 26 are operationally connected by the gear mechanism 62. The output shaft 64 of the electric motor 26 is extended to the side opposite from the first pump shaft 66 and the second pump shaft 60. A cooling fan 96 is fixed to a portion that is one end portion (upper end portion in FIG. 5) of the output shaft 64 and is projected outside the casing 44.

The first hydraulic pump 54 and the second hydraulic pump 56 are both variable displacement axial piston pumps, and each includes a plurality of piston cylinder mechanisms 98 disposed around the first pump shaft 66 (or the second pump shaft 60), and a movable swash plate mechanism 100 which restricts a stroke length of each of the pistons when a plurality of piston cylinder mechanisms 98 rotate around the first pump shaft 66 (or the second pump shaft 60). The movable swash plate mechanism 100 controls the degree and direction of the inclination with respect to the first pump shaft 66 (or the second pump shaft 60) by a swash plate control shaft, whereby the amount of oil sucked and discharged by the piston cylinder mechanism 98 is controlled. By reversing the direction of the swash plate, the pressure increasing side and the pressure decreasing side are switched with one another. The pressurized oil discharged from the first hydraulic pump 54 and the second hydraulic pump 56 as above is supplied to the first hydraulic motor 34 and the second hydraulic motor 36 (FIG. 4) respectively via the hydraulic circuit, and the respective hydraulic motors 34 and 36 are driven to rotate the corresponding wheels 32 (FIG. 4).

As shown in FIG. 5, a charge pump body 102 is fixed to a side of the casing 44 opposite from the portion supporting the electric motor 26. The charge pump 68 is provided inside the charge pump body 102, and the charge pump 68 is driven by an end portion of the first pump shaft 66 constituting the first hydraulic pump 54.

Meanwhile, the drive side member 86 is supported on an outside diameter side of an intermediate portion of the PTO shaft 45 in such a manner that the components are rotatable relative to each other, and the hydraulic clutch mechanism 90 is provided between the drive side member 86 and the PTO shaft 45. The hydraulic clutch mechanism 90 includes a plurality of drive side friction plates which are supported around a lower side portion of the drive side member 86 to be incapable of relative rotation and capable of displacement in an axial direction, and includes a plurality of driven side friction plates which are supported at a driven side member 104 fixed to a circumference of the PTO shaft 45 to be incapable of relative rotation and capable of displacement in the axial direction, and applies a resilient force to a member which brings the drive side friction plates and the driven side friction plates in pressure contact with each other in a direction to be away from each other by biasing means 106. Further, the hydraulic clutch mechanism 90 includes a clutch pressing moving member 108 which receives the action of hydraulic pressure and presses the either one of the friction plates so that the drive side friction plates and the driven side friction plates are engaged with each other. A gear constituting the gear mechanism 88 is integrally provided at an upper
portion of the drive side member 86. The power of the second pump shaft 60 is transmitted to the drive side member 86 by the gear mechanism 88.

[0084] In such a hydraulic clutch mechanism 90, in the state in which the drive side friction plates and the driven side friction plates are engaged by movement of the clutch pressing moving member 108, power transmission to the PTO shaft 45 from the output shaft 64 of the electric motor 26 is made possible, and, in a state in which engagement of the drive side friction plates and the driven side friction plates is released, power transmission to the PTO shaft 45 from the output shaft 64 of the electric motor 26 is shut off. When the PTO shaft 45 is driven, whereby the power of the PTO shaft 45 is transmitted to the driven shaft of the mower 38 via the PTO shaft side pulley 48, the belt 52, and the working machine side pulley 50 (FIG. 2), the mower 38 is driven. The connection state of the hydraulic clutch mechanism 90 is manually switchable by the operation part such as a switch not illustrated.

[0085] In the example multiple pump unit vehicle with the multiple pump unit of the present embodiment as above, the first pump shaft 66 (FIG. 5) or the drive shaft 58 (FIG. 4) which drives the first hydraulic pump 54, and the second pump shaft 60 which drives the second hydraulic pump 56 are driven by the electric motor 26, and the pressurized oil for operating the first hydraulic motor 34 and the second hydraulic motor 36, which are a plurality of actuators, is fed out from the first hydraulic pump 54 and the second hydraulic pump 56. Therefore, when electric power is supplied to the battery 14 from the generator 12 driven by the engine 10 (FIG. 4) and the electric power is supplied to the electric motor 26 from the battery 14 as in this embodiment, it is not always necessary to operate the engine 10 in order to operate the hydraulic motors 34 and 36 for driving the wheels 32, which contrasts with the structure of driving the first pump shaft 66 (FIG. 5) or the drive shaft 58 (FIG. 4) and the second pump shaft 60 by the power of the engine 10 without providing an electric motor. Therefore, with the present invention, a structure capable of operating very quietly can be obtained. Specifically, when sufficient electric power is charged in the battery 14, the respective hydraulic motors 34 and 36 corresponding to the wheels 32 can be driven by driving the electric motor 26 by the electric power from the battery 14 in the state in which the engine 10 is stopped and the driving noise is small.

[0086] In addition, the multiple pump unit can be used for a greater number of applications and usability can be enhanced compared to configurations in which the electric motor 26 drives only one pump shaft constituting the hydraulic pump. In the case of this embodiment, the different hydraulic motors 34 and 36 corresponding to the two wheels 32 can be driven by the pressurized oil from the different hydraulic pumps 54 and 56, and the two hydraulic motors 34 and 36 can be more effectively controlled independently. As a result, by making the output of one of the two hydraulic motors 34 and 36 larger than the output of the other hydraulic motor, the working vehicle 30 can be smoothly turned while skidding of the wheels 32 is suppressed. On the other hand, when the two hydraulic motors 34 and 36 corresponding to the two left and right wheels 32 are driven by the pressurized oil from one hydraulic pump, a flow dividing valve for directing the oil into the two hydraulic motors 34 and 36 must be provided in the hydraulic circuit, and it has room for improvement from the aspect of enhancement of usability.

[0087] Further, the casing 44 which houses the first hydraulic pump 54 and the second hydraulic pump 56, and rotatably supports the output shaft 64 of the electric motor 26, the first pump shaft 66 (FIG. 5) or the drive shaft 58 (FIG. 4) and the second pump shaft 60, and the PTO shaft 45 is supported by the casing 44 are included. Further, the output shaft 64 of the electric motor 26, and the first pump shaft 66 and the second pump shaft 60 are operationally connected, and the power transmission is selectively made possible between the output shaft 64 of the electric motor 26 and the PTO shaft 45 by the hydraulic clutch mechanism 90. Therefore, irrespective of the rotation of the electric motor 26, operation and non-operation of the mower 38 (FIG. 2) which is operationally connected to the PTO shaft 45 can be selected by the hydraulic clutch mechanism 90, and usability can be further enhanced.

[0088] Because the cooling fan 96 (FIGS. 2, 3 and 5) is fixed to the output shaft 64 of the electric motor 26, the electric motor 26 and the dual pump unit 16 including a plurality of hydraulic pumps 54 and 56 can be easily cooled, thereby making it possible to further enhance performance.

Second Embodiment of the Invention

[0089] FIGS. 6 to 9 show a second embodiment of the present invention. Unlike the above-described first embodiment, in this embodiment, the mower 38, which is the working machine, is not driven by the power of the electric motor, but by the power of the engine 10. First, the basic constitution of a vehicle with a multiple pump unit according to this embodiment will be described by referring to FIG. 1b. As shown in FIG. 1b, in the case of this embodiment, the power from the engine 10 is transmitted to the working machine 24, so that the working machine 24 is driven without a medium of the electric motor 26. Further, by the power of the electric motor 26, the two pump shafts provided respectively at the two hydraulic pumps constituting the dual pump 28 are driven. The pressurized oil discharged from the two hydraulic pumps is supplied to the two wheel-driving hydraulic motors 18 and 20, and the two wheel-driving hydraulic motors 18 and 20 are driven. In FIG. 1b, the basic constitution is otherwise the same as in the first embodiment described with reference to FIG. 1a.

[0090] Next, FIGS. 6 and 7 show a constitution of a working vehicle 30a, which is the example vehicle with the multiple pump unit of this embodiment. FIG. 7 is a sectional view taken along the line B-B in FIG. 6. As shown in FIGS. 6 and 7, neither the PTO shaft 45 nor the PTO shaft side pulley 48 (see FIGS. 2 and 3) is provided at a dual pump unit 16a. Instead, the drive shaft of the generator 12 is connected to the output shaft disposed in the vertical direction of the engine 10 to be capable of transmitting power, and an engine side pulley 112 is fixed to a lower end portion of a PTO shaft 45a which can be selectively connected to the drive shaft of the generator 12 by a clutch mechanism 110. Specifically, the engine side pulley 112 can be selectively connected to the output shaft of the engine 10 by the clutch mechanism 110. The clutch mechanism 110 enables manual selection of power transmission between the drive shaft of the generator 12 and the PTO shaft 45a and shutoff of the power transmission through operation of a component such as a switch.

[0091] Further, the belt 52 is provided between the engine side pulley 112 and the working machine side pulley 50 fixed to the driven shaft of the mower 38. Specifically, the working machine side pulley 50 is operationally connected to the
mower 38. Thereby, in the state in which the clutch mechanism 110 is connected, the mower 38 is drivable by the power of the engine 10. The constitution shown in FIGS. 6 and 7 is otherwise the same as that of the first embodiment described with reference to FIGS. 2 and 3.

[0092] Next, FIG. 8 is a diagram showing a hydraulic circuit used in this embodiment. Unlike the case of the first embodiment shown in FIG. 4 described above, in the case of this embodiment, the PTO shaft 45a is disposed to be selectively connectable to the drive shaft of the generator 12 by the clutch mechanism 110 (see FIG. 6, illustration is omitted in FIG. 8). The engine side pulley 112 is fixed to the PTO shaft 45a, and the mower 38 (FIG. 6) is made drivable via the engine side pulley 112, the belt 52 and the working machine side pulley 50 (see FIG. 6) fixed to the driven shaft of the mower 38.

[0093] Meanwhile, the dual pump unit 16a is not provided with the PTO shaft 45, the hydraulic clutch mechanism 90, the drive member 86, or the gear mechanism 88 (see FIG. 4). Specifically, as the concrete structure of the dual pump unit 16a shown in FIG. 9, the first pump shaft 66, the second pump shaft 60 and the output shaft 64 of the electric motor 26 are rotatably supported by the casing 44, but the PTO shaft 45 is not provided. According to the embodiment like this, the PTO shaft 45, the member for driving the PTO shaft 45, and the hydraulic clutch mechanism 90 can be omitted, and therefore, the dual pump unit 16a can be reduced in size correspondingly.

[0094] The constitution and operation are otherwise the same as in the first embodiment shown in FIGS. 1a and 2 to 5 described above, and therefore the same reference numerals and characters will be assigned to the equivalent parts and their description will not be repeated.

Third Embodiment of the Invention

[0095] FIG. 10 shows a third embodiment of the present invention. In the case of a dual pump unit 16b, which is the multiple pump unit of this embodiment, in the second embodiment described by using FIG. 9 described above, the output shaft of the electric motor 26 and the first pump shaft of the first hydraulic pump 54 are integrally constituted of a common drive shaft 114. A gear constituting a gear mechanism 62a is fixed to an intermediate portion of the drive shaft 114, and the power of the drive shaft 114 is allowed to be transmitted to the second pump shaft 60 by the gear mechanism 62a. The charge pump 68 is made drivable by an end portion of the drive shaft 114.

[0096] In the embodiments described above, with respect to the second embodiment shown in FIG. 9 described above, the output shaft 64 and the first pump shaft 66 (see FIG. 9) are constituted of the common drive shaft 114, and the gear for operationally connecting the output shaft 64 and the first pump shaft 66 is not required. Therefore, reduction in cost by reduction of the number of components can be achieved. Further, the width (lateral direction in FIG. 10) of the dual pump unit 16c can be reduced, and further reduction in size of the dual pump unit 16c can be achieved.

[0097] As the constitution and operation are otherwise the same as in the second embodiment shown in FIGS. 6 to 9 described above, redundant illustration and explanation are avoided by assigning the same reference numerals and characters to the equivalent parts, which are not described here.

Fourth Embodiment of the Invention

[0098] FIG. 11 shows a fourth embodiment of the present invention. Unlike in the third embodiment shown in FIG. 10 described above, in the dual pump unit 16c, which is a multiple pump unit of this embodiment, the cooling fan 96 is not fixed to the drive shaft 114 at the electric motor 26 side, but is fixed to an end portion of the drive shaft projecting outside the casing 44 at the charge pump 68 side.

[0099] The constitution and operation of the present embodiment are otherwise the same as in the second embodiment shown in FIGS. 6 to 9 described above or in the third embodiment shown in FIG. 10, and, therefore, redundant illustration and explanation is avoided by assigning the same reference numerals and characters to the equivalent parts, the description of which is not repeated.

Fifth Embodiment of the Invention

[0100] FIG. 12 shows a fifth embodiment of the present invention. Unlike the third embodiment shown in FIG. 10 described above, in the dual pump unit 16d which is a multiple pump unit of this embodiment, the cooling fan 96 is not fixed to the end portion of the drive shaft 114 but is fixed to the end portion of the second pump shaft projecting outside the casing at the charge pump 68 side (lower side in FIG. 12).

[0101] As the constitution and operation are otherwise the same as in the second embodiment shown in FIGS. 6 to 9 described above or in the third embodiment shown in FIG. 10, redundant illustration and explanation will be prevented by assigning the same reference numerals and characters to the equivalent parts, whose description is not repeated here.

Sixth Embodiment of the Invention

[0102] FIG. 13 shows a sixth embodiment of the present invention. In the dual pump unit 16e, which is a multiple pump unit according to this embodiment, an outer cover 116 which is a cooling air guiding part is fixed to an outer side of the casing 44 by a fastening member such as a bolt as in the third embodiment shown in FIG. 10 described above. The outer cover 116 has an inlet port 118 and an outlet port 120 for cooling air, and has a shape which covers the entire periphery of the dual pump unit 16e. Thereby, the cooling air generated by the cooling fan 96 flows inside the outer cover 116 and is guided along the outer side of the casing 44. Specifically, the cooling air, which is directed into the outer cover 116 from the inlet port 118 in the direction of the arrow a in FIG. 13 by the drive of the cooling fan 96, flows inside the outer cover 116 in the direction of the arrow b, and is then directed from the outlet port 120 in the direction of the arrow γ.

[0103] In order to fix the outer cover to the outer side of the casing by screw, in the case of the example shown in the drawing, projection portions 122 projecting toward an outer side with respect to the diameter direction of the drive shaft 114 are formed at a plurality of spots of the outer surface of the casing 44, and bolts penetrating through the outer cover 116 are connected to the projection portions 122. The dual pump unit 16c can be disposed so that the drive shaft 114 is parallel with the longitudinal direction with the cooling fan 96 side (upper side in FIG. 13) oriented to the front side in the longitudinal direction of the vehicle.
Further, a small hole 124, a first long hole 126, and a second long hole 128 are formed in the outer cover 116 in sequence from the end portion at the charge pump 68 side toward the end portion at the cooling fan 96 side. A supply pipe 130 for supplying oil to the charge pump 68 is connected to the charge pump body 102, and the supply pipe 130 is led outside the outer cover 116 through the small hole 124. Two supply and discharge pipes 132 for supplying and discharging oil to and from each of the first hydraulic pump 54 and the second hydraulic pump 56, four supply and discharge pipes 132 in total, are connected to the casing 44, and the four supply and discharge pipes 132 are led outside the outer cover 116 through the first long hole 128. Further, an end portion of a connecting pipe 134 for connecting the inside of the casing 44 and the external tank 72 (see FIG. 4) is connected to the casing 44, and the connecting pipe 134 is routed outside the outer cover 116 through the second long hole 128. A portion of a swash plate control shaft 136 for adjusting the discharge hydraulic pressure by the first hydraulic pump 54 and the second hydraulic pump 56, which is led outside the casing 44, is led outside the outer cover 116 through the second long hole 128 so as to be able to adjust the rotational angle of the swash plate control shaft 136 from outside the outer cover 116.

According to the embodiment as above, the casing 44 which houses the first hydraulic pump 54, the second hydraulic pump 56, and a portion of the electric motor 26, and the outer cover 116 which is fixed to the outer side of the casing 44 to guide the cooling air caused by the cooling fan 96 along the outer side of the casing 44 are included. Therefore, the casing 44 can be easily cooled by the cooling air, and performance of the first hydraulic pump 54, the second hydraulic pump 56, and the electric motor 26 inside the casing 44 can be further and simply enhanced.

As the constitution and operation are otherwise the same as those in the third embodiment shown in FIG. 10 described above, redundant explanation will be avoided by assigning the same reference numerals and characters to the equivalent parts and not repeating their description here.

In the first embodiment shown in FIG. 5 described above, and the second embodiment to the sixth embodiment shown in FIGS. 9 to 13, not only is one cooling fan 96 provided at one end portion of the output shaft 64, the drive shaft 114, or the second pump shaft 60, but another cooling fan is also fixed to an end portion of the first pump shaft 66, the second pump shaft 60, or the drive shaft 114, and the two cooling fans 96 can be provided at both sides with the casing 44 therebetween. For example, in the third embodiment shown in FIG. 10 described above, the cooling fans 96 can be fixed to both the end portion of the drive shaft 114 at the electric motor 26 side and the end portion of the drive shaft 114 at the charge pump body 102 side. With such a constitution, the casing 44 can be cooled more efficiently by driving the two cooling fans 96. The cooling air directed by the cooling fan 96 can be made to flow in one direction from one end portion of the casing 44 to the other end portion, or can be made to flow toward the center from both sides of the casing 44 and thereafter can be blown outside with respect to the diameter direction of the drive shaft 114 from the center.

Seventh Embodiment of the Invention

FIG. 14 shows a seventh embodiment of the present invention. Unlike the first embodiment shown in FIGS. 1a and 2 to 5 described above, in this embodiment, the mower 38 which is a working machine is made drivable by feeding the pressurized oil fed from the dual pump to a working machine driving hydraulic motor 137 which is an actuator and also a working machine driving device. First, a basic constitution of a vehicle with a multiple pump unit of this embodiment will be described with reference to FIG. 1c. As shown in FIG. 1c, in this embodiment, the power from the engine 10 is transmitted to the generator 12, and two pump shafts provided at two hydraulic pumps constituting the dual pump 28 are driven by the power of the electric motor 26 supplied with electric power from the battery 14. The pressurized oil discharged from the two hydraulic pumps is supplied to a working machine drive device 138 for driving a working machine, and a working machine raising and lowering device 140 for raising and lowering the working machine respectively to drive the working machine drive device 138 and the working machine raising and lowering device 140. The working machine raising and lowering device 140 may be, for example, a working machine raising and lowering cylinder device. The working machine drive device 138 may be, for example, the working machine driving hydraulic motor 137 (see FIG. 14).

Further, as shown in FIG. 1c, the electric power from the battery 14 is supplied to two wheel-driving electric motors 142 and 144 corresponding to two wheels to drive two wheel-driving electric motors 142 and 144. Further, the controller 22, which is a control unit, sends a control signal to a DC/DC converter not illustrated connected to the battery 14, and controls the electric power taken out from the battery 14. Further, the controller 22 sends a control signal to inverters not illustrated connected respectively to the electric motor 26 and the two wheel-driving electric motors 142 and 144 to control the respective output powers of the electric motor 26 and the two wheel-driving electric motors 142 and 144. The controller 22 has electric power supply state selecting unit which select whether to supply electric power to the electric motor 26 and the two wheel-driving electric motors 142 and 144 from the battery 14, or to shut off the supply of the electric power to the electric motor 26 and the two wheel-driving electric motors 142 and 144 from the battery 14. Except as described, the constitution shown in FIG. 1c is otherwise the same as that of the first embodiment described above with reference to FIG. 1c.

Next, FIG. 14 shows the constitution of a working vehicle 306 which is a vehicle with the multiple pump unit according to this embodiment. The dual pump unit 16a is provided with neither the PTO shaft 45 nor the PTO shaft side pulley 48 (see FIGS. 2 and 3) as in the second embodiment shown in FIG. 6 and described above. Additionally, neither the PTO shaft 45a (FIGS. 6 and 8) which is made selectively connectable by the clutch mechanism 110 nor the engine side pulley 112 (FIGS. 6 and 8) is provided at the output shaft of the engine 10. Instead, in the case of this embodiment, the dual pump unit 16a and the working machine driving hydraulic motor 137 corresponding to the working machine drive device 138 (FIG. 1c) are connected by a hydraulic pipe line 146, and the working machine driving hydraulic motor 137 is made drivable by the pressurized oil supplied from the dual pump unit 16a.

Further, the electric power from the battery 14 (see FIG. 1c) is supplied to a first electric motor 148 and a second electric motor (not shown) which correspond to the wheel-driving electric motors 142 and 144 (see FIG. 1c) and are for driving the wheels 32 to make the first electric motor 148 and
the second electric motor drivable. The mower 38 can be raised and lowered by the working machine raising and lowering device 140 (see FIG. 1c).

[0112] As the constitution and operation are otherwise the same as in the first embodiment shown in FIGS. 1a and 2 to 5 described above, redundant explanation will be avoided by assigning the same reference numerals and characters to the equivalent parts and not repeating the description of these parts.

Eighth Embodiment of the Invention

[0113] FIG. 15a shows an eighth embodiment of the present invention. In the case of this embodiment, a fuel cell system 152 having a fuel cell and a battery that is a secondary battery is included instead of the engine 10 and the generator 12 (see FIG. 1a) in the first embodiment shown in FIGS. 1a and 2 to 5 and described above. The fuel cell is constituted by stacking a plurality of sets of fuel cells each including, for example, an electrolyte film, an anode-side electrode and a cathode-side electrode, and is supplied with oxidized gas such as air and fuel gas such as hydrogen gas to generate electric power by electrochemical reaction. The generated electric power is supplied to the electric motor 26 directly or via the secondary battery. Further, the electric power drawn from either the battery or the fuel cell is controlled by the controller 22.

[0114] As the constitution and operation are otherwise the same as those in the first embodiment shown in FIGS. 1a and 2 to 5 described above, redundant illustration and explanation will be avoided by assigning the same reference numerals and characters to the equivalent parts and not repeating their description here.

Ninth Embodiment of the Invention

[0115] FIG. 15b shows a ninth embodiment of the present invention. In this embodiment, the fuel cell system 152 having a fuel cell and a battery that is a secondary battery is included instead of the engine 10 and the generator 12 (see FIG. 1a), in the seventh embodiment shown in FIGS. 1c and 14 described above. The constitution and operation of the fuel cell are the same as in the eighth embodiment shown in FIG. 15a described above. The electric power generated by the fuel cell is supplied to the electric motor 26 directly or via the battery.

[0116] The constitution and operation are otherwise the same as in the first embodiment shown in FIGS. 1a and 2 to 5 or in the eighth embodiment shown in FIG. 15a.

Tenth Embodiment of the Invention

[0117] FIG. 16 is a sectional view showing a drive device part of the wheel 32 at one side of the two wheels 32 which are the rear wheels in a working vehicle, being a vehicle with a multiple pump unit of a tenth embodiment of the present invention. In the present embodiment, in a device according to the first embodiment shown in FIGS. 1a and 2 to 5 and described above, a rotary shaft 154 constituting the first hydraulic motor 34 is made drivable by the pressurized oil being supplied to the first hydraulic motor 34. The rotational force of the rotary shaft 154 is decelerated by the planetary gear mechanism 78 and provided to the wheel 32. Specifically, the planetary gear mechanism 78 includes a sun gear 156 provided at one end portion (right end portion in FIG. 16) of the rotary shaft 154, a pinion gear 158 and a ring gear 160. A pinion shaft 162 is supported in the pinion gear 158, and by the pinion shaft 162, a wheel support member 164 fixed to the wheel 32 is rotated. The wheel support member 164 rotates with respect to the frame 42 (see FIGS. 2, 3 and the like) or a housing 166 fixed to a suspension system. A tip end portion of a bolt fixed by a screw to the housing 166 from outside in the diameter direction is engaged in a recessed portion 168 formed in an outer peripheral surface of the ring gear 160 to support the ring gear 160 to be incapable of rotating with respect to the housing 166. Theoretically, the rotation of the rotary shaft 154 is decelerated by the planetary gear mechanism 78 and is transmitted to the wheel 32.

[0118] Further, a braking device 170 is provided at the other end portion (left end portion in FIG. 16) side of the rotary shaft 154. The braking device 170 includes a brake lever 172, and the brake lever 172 swings by pushing and pulling a cable, not shown, connected to the brake lever 172. Through a swinging motion, a variable member 174 extends in a circumferential direction via a cam mechanism and the like to press an annular member 176 fixed to the rotary shaft 154 to brake the wheel 32. The constitution of a drive device part for a wheel on the other side not shown in FIG. 16 is the same except that the left and the right are reversed from the above described constitution.

[0119] As the constitution and operation are otherwise the same as in the first embodiment shown in FIGS. 1a and 2 to 5 described above, redundant illustration and explanation will be omitted.

[0120] The braking structure provided in the wheel support structure is not limited to the structure as in this embodiment, but, for example, a disc brake and an electromagnetic brake can be adopted.

[0121] In this embodiment, instead of the first hydraulic motor 34 and the second hydraulic motor 36 (see FIGS. 3, 4 and the like), the first electric motor 148 and the second electric motor constituting the eighth embodiment shown in FIG. 14 described above can be used. In such a case, a rotary shaft corresponding to the rotary shaft 154 in FIG. 16 is driven by the first electric motor 148 and the second electric motor.

Eleventh Embodiment of the Invention

[0122] FIG. 17 is a sectional view similar to FIG. 16 described above in a working vehicle, which is a vehicle with a multiple pump unit of an eleventh embodiment of the present invention. In this embodiment, planetary gear mechanisms 178a and 178b are adopted in two stages. Specifically, the pinion shaft 162 constituting the planetary gear mechanism 178a of the first stage is supported on a carrier 180, and the carrier 180 is engaged with a second sun gear 184 provided on an outer peripheral surface of a second rotary shaft 182 which is supported coaxially with the rotary shaft 154 and rotatable relatively to each other. A second pinion gear 186 constituting the planetary gear mechanism 178b of the second stage is meshed with the second sun gear 184 and a second ring gear 190 so that the wheel support member 164 is rotated by a second pinion shaft 188 supported at the second pinion gear 186.

[0123] Further, the ring gear 160 constituting the planetary gear mechanism 178a of the first stage and the second ring gear 190 constituting the planetary gear mechanism 178b of the second stage are fixed to the housing 166 inside the wheel support member 164. For this purpose, a plurality of pins 192 are inserted through the holes formed in part of the housing 166, and one end portions (lower end portions in FIG. 17) of
the pins 192 are locked to recessed portions provided on the outer peripheral surfaces of the ring gear 160 and the second ring gear 190. Inner rings of a pair of bearings are opposed to the other end portion (upper end portion in FIG. 17) of the pin 192 to prevent the pin 192 from removing from the housing 166. Thereby, the ring gear 160 and the second ring gear 190 are supported in a manner such that they are incapable of rotating with respect to the housing 166. With a configuration as described, the rotation of the rotary shaft 154 is decelerated in two stages by the planetary gear mechanisms 178a and 178b of the two stages. The constitution of a drive device part for a wheel on the other side not shown in FIG. 17 is the same as the above described constitution except that the left and right are reversed.

[0124] As the constitution and operation are otherwise the same as those in the tenth embodiment shown in FIG. 16 described above, redundant explanation will be avoided by assigning the same reference numerals and characters to the equivalent parts and not repeating their explanation.

Twelfth Embodiment of the Invention

[0125] FIG. 18 is a view corresponding to an enlarged section of a part C in FIG. 16 in a working vehicle, which is a vehicle with a multiple pump unit of a twelfth embodiment of the present invention. In this embodiment, in the tenth embodiment shown in FIG. 16 described above, in order to dispose the ring gear 160 such that it is incapable of rotating with respect to the housing 166, the pin 192 is inserted through a through-hole 194 formed in the housing 166, and one end portion of the pin 192 (lower end portion in FIG. 18) is locked to a recessed portion formed in the outer peripheral surface of the ring gear 160. Further, a C-shaped snap ring 196 is locked to an annular recessed portion 198 leading to an outside diameter side end portion of the through-hole 194. One surface of the snap ring 196 is opposed to an inner ring of one bearing, and thereby, positioning of the bearing is achieved.

[0126] The constitution and operation are otherwise the same as in the tenth embodiment shown in FIG. 16 described above.

Thirteenth Embodiment of the Invention

[0127] FIG. 19 is a view corresponding to an enlarged section of a part D in FIG. 16 in a working vehicle, which is a vehicle with a multiple pump unit of a thirteenth embodiment of the present invention. In this embodiment, in a configuration according to the tenth embodiment shown in FIG. 16 and described above, in order to dispose the ring gear 160 such that it is incapable of rotating with respect to the housing 166, the pin 192 is inserted through the through-hole 194 formed in the housing 166, and one end portion (lower end portion in FIG. 18) of the pin 192 is locked to the recessed portion formed in the outer peripheral surface of the ring gear 160. In this embodiment, the bearing for supporting the wheel support member 164 rotatably with respect to the housing 166 is a needle bearing, rather than a pair of ball bearings as in the tenth embodiment shown in FIG. 16, and prevention of the pin 192 from removing from the housing 166 is achieved by an inner ring (collar) constituting the needle bearing.

[0128] Further, a bearing 200 is provided between one end portion (right end portion in FIG. 19) of the rotary shaft 154 and the wheel support member 164. In order to prevent removal of the bearing 200 with respect to the rotary shaft 154, a nut 202 is connected by a screw to one end portion of the rotary shaft 154. Prevention of removal of the bearing 200 with respect to the rotary shaft 154 can also be achieved without the nut 202, by locking a snap ring to a locking groove formed in the outer peripheral surface of one end portion of the rotary shaft 154, and by opposing the snap ring to the bearing 200.

[0129] The constitution and operation are otherwise the same as in the tenth embodiment shown in FIG. 16 described above.

Fourteenth Embodiment of the Invention

[0130] FIG. 20 shows a hydraulic circuit of a dual pump unit 16f, which is a multiple pump unit of the fourteenth embodiment of the present invention, and a constitution of a working vehicle loaded with the dual pump unit 16f. In this example, the working vehicle is a tractor or the like having an attached cultivator, not illustrated that is a working machine. Such a working vehicle of this embodiment includes a pair of link mechanisms, not illustrated, for adjusting the tilt angle of the cultivator with respect to the ground, and a pair of extending and contracting hydraulic cylinder devices 206 which are actuators for extending and contracting arms constituting a pair of link mechanisms. Further, the working vehicle includes a raising and lowering hydraulic cylinder device 206 which is an actuator for raising and lowering the cultivator. In such a working vehicle, as in the case of the second embodiment shown in FIG. 8 described above, the generator 12 is driven by the engine 10 to generate electric power, and the generated electric power is supplied to the battery 14. Further, the electric motor 26 is made drivable by the electric power from the battery 14.

[0131] Further, the electric power from the battery 14 can be supplied to the first electric motor 148 and the second electric motor 150, which are wheel-driving electric motors for driving the two wheels 32. The electric power drawn from the battery 14 is controlled by the controller 22. The first electric motor 148 and the second electric motor 150 drive the wheels 32 via the planetary gear mechanisms 78. The electric motor 26 can drive a first pump shaft of a first hydraulic pump 54a and the second pump shaft constituting the second hydraulic pump 56, which constitute the dual pump unit 16f. The basic constitution for driving the first pump shaft and the second pump shaft is the same as that of the dual pump unit 16a of the second embodiment shown in FIG. 9 described above.

[0132] Especially in the dual pump unit 16f of this embodiment, as a discharge port of the first hydraulic pump 54a, two kidney-shaped (reniform) or arc-shaped discharge holes are formed at an outer side and an inner side with respect to the diameter direction in the portion existing around the first pump shaft. Thus, the first hydraulic pump 54a is formed as a double port pump provided with two discharge ports corresponding to the first pump shaft. The driving of the first pump shaft, the pressurized oil is simultaneously fed out from the two discharge ports of the first hydraulic pump.

[0133] Oil is fed to the first hydraulic pump 54a and the second hydraulic pump 56 from the external tank 72 via the filter 70 and then pressurized, so that the pressurized oil is supplied to a pair of the extending and contracting hydraulic cylinder devices 204a and 204b and the raising and lowering hydraulic cylinder device 206. Specifically, the pressurized oil discharged from one discharge port out of the two discharge ports of the first hydraulic pump 54a is capable of
being selectively supplied to two chambers of an extending and contracting hydraulic cylinder 210a by a switching valve 208a constituting the one extending and contracting hydraulic cylinder device 204a of the pair of extending and contracting hydraulic cylinder devices 204a and 204b. The pressurized oil discharged from the other discharge port out of the two discharge ports of the first hydraulic pump 54a is capable of being selectively supplied to two chambers of a raising and lowering hydraulic cylinder 214 by a switching valve 212 constituting the raising and lowering hydraulic cylinder device 206.

[0134] On the other hand, the pressurized oil discharged from the discharge port of the second hydraulic pump 56 is capable of being selectively supplied to two chambers of an extending and contracting hydraulic cylinder 210b by a switching valve 208b constituting the other extending and contracting hydraulic cylinder device 204b of the pair of extending and contracting hydraulic cylinder devices 204a and 204b. Further, in the neutral positions of the switching valves 208a, 212 and 208b, the pressurized oil from the first hydraulic pump 54a or the second hydraulic pump 56 is returned to the casing 44. The oil reservoir in the casing 44 is caused to communicate with the tank 72.

[0135] "According to such a working vehicle, as in each of the above described embodiments, quieter performance can be achieved because it is not necessary that the engine be continually operated in order to raise and lower the cultivator or displace the tilt of the cultivator. Further, with the constitution in which the first hydraulic pump 54a is made a double port pump provided with the two discharge ports corresponding to the first pump shaft, and the pressurized oil for operating the extending and contracting hydraulic cylinder device 204a and the raising and lowering hydraulic cylinder device 206 which are the two actuators is fed out from the two discharge ports of the first hydraulic pump 54a, the pressurized oil for actuating a larger number of actuators is fed out from the first hydraulic pump 54a and the second hydraulic pump 56, and can operate a larger number of actuators. Therefore, operability can be further enhanced.

[0136] "Although in this example the cultivator is driven by a working machine driving electric motor (not illustrated) supplied with electric power from the engine 10 or the battery 14, the cultivator can also be driven by a hydraulic motor supplied with the pressurized oil from the first hydraulic pump 54a or the second hydraulic pump 56. Specifically, in FIG. 20, instead of any of the pair of extending and contracting hydraulic cylinder devices 204a and 204b, a working machine drive device which is an actuator, that is, a working machine driving hydraulic motor, can be provided. The constitution of the dual pump unit 16f shown in FIG. 20 is otherwise the same as that of the second embodiment shown in FIGS. 8 to 9 and described above. Instead of the engine 10, the fuel cell system 152 can be used as in the eighth embodiment and the ninth embodiment shown in FIGS. 15a and 15b described above.

[0137] "The dual pump unit 16f of this embodiment shown in FIG. 20 is installed on the working vehicle 30b of the seventh embodiment shown in FIG. 14 described above, and the working machine driving hydraulic motor 137 and the wheel-driving hydraulic motors corresponding to the two wheels can be driven by the dual pump unit 16f. In this case, the pressurized oil from the two discharge ports of the first hydraulic pump 54a (FIG. 20), for example, is supplied to the one wheel-driving hydraulic motor and the working machine driving hydraulic motor 137, and the pressurized oil from the discharge port of the second hydraulic pump 56 (FIG. 20) is supplied to the other wheel-driving hydraulic motor.

Fifteenth Embodiment of the Invention

[0138] "FIG. 21 is a diagram showing a basic constitution and a hydraulic circuit of a working vehicle which is a vehicle with a multiple pump unit of a fifteenth embodiment of the present invention. In this embodiment, as in the first embodiment shown in FIG. 4 and described above, the first hydraulic pump 54 and the second hydraulic pump 56 constituting the dual pump 28 are driven by the electric motor 26. The electric motor 26 is driven by the electric power supplied from the battery 14.

[0139] "The pressurized oil discharged from the first hydraulic pump 54 is supplied to a first hydraulic motor 34a corresponding to the wheel 32 on one side of the wheels 32 on the left and right (upper side in FIG. 21), and drives the wheel 32 on the one side via the planetary gear mechanism 78. The pressurized oil discharged from the second hydraulic pump 56 is supplied to a second hydraulic motor 36a corresponding to the wheel 32 on the other side (lower side in FIG. 21) of the wheels on the left and right, and drives the wheel 32 on the other side via the planetary gear mechanism 78.

[0140] "Especially in this embodiment, the first hydraulic motor 34a and the second hydraulic motor 36a are both variable displacement hydraulic motors. For example, each of the hydraulic motors 34a and 36a may be a swash plate type variable displacement piston motor. For example, a plurality of piston cylinder mechanisms disposed around the motor rotary shaft of each of the hydraulic motors 34a and 36a, and a movable swash plate mechanism which restricts a stroke length of each piston when a plurality of piston cylinder mechanisms rotate around the motor rotary shaft are included. The movable swash plate mechanism controls the degree of inclination with respect to the motor rotary shaft by a swash plate control shaft. Specifically, a tilt angle of the swash plate is made adjustable. The tilt angle of the swash plate of each of the hydraulic motors 34a and 36a changes in two stages of predetermined large displacement and small displacement or continuously within a range from a predetermined large displacement to a predetermined small displacement, in correspondence with a control signal from the controller 22 (see FIG. 1a), based on an operation of a driver, for example.

[0141] "In the case of a working vehicle using such variable displacement hydraulic motors 34a and 36a, the wide range of the deceleration ratio makes it possible to more easily respond to increases in speed of the working vehicle than possible with the working vehicle using a fixed displacement hydraulic motor.

[0142] "As the constitution and operation are otherwise the same as those in the first embodiment shown in FIGS. 1a and 2 to 5 described above, redundant illustration and explanation will be omitted.

FIRST REFERENCE EXAMPLE RELATING TO THE PRESENT INVENTION

[0143] "FIG. 22 is a diagram showing a basic constitution and a hydraulic circuit of a working vehicle, which is a vehicle with a multiple pump unit of a first reference example relating to the present invention. This reference example is out of “What is claimed is.” of the present invention. In the
In case of this reference example, in the same constitution as the first embodiment shown in FIGS. 1a and 2 to 5 described above, the cooling fan 96 is fixed to the end portion of the drive shaft 114 constituting the electric motor 26 as in the case of the dual pump unit 166 of the third embodiment shown in FIG. 10 described above. The drive shaft 114 constitutes the first pump shaft constituting the first hydraulic pump 54. The charge pump 68 is made drivable by the end portion of the drive shaft 114. The electric motor 26 is driven by the electric power from the battery 14 which is supplied with the electric power from the generator 12 driven by the engine 10 as in the first embodiment shown in FIG. 4 described above.

In contrast to each of the above-described embodiments of the present invention, in this reference example, no second hydraulic pump 56 (see FIG. 4 and the like) is provided. Therefore, no gear mechanism for driving the pump shaft constituting the second hydraulic pump 56 by the drive shaft 114 is provided. Specifically, the electric motor 26 drives only the first hydraulic pump 54 of the hydraulic pumps. The charge pump 68 has the function of replenishing oil lost due to leakage, such as through gaps in the respective parts when oil circulates in the hydraulic circuit and the like. More specifically, the charge pump 68 sucks oil from the external tank 72 via the filter 70, pressurizes the oil, and supplies the oil to the hydraulic path at the low pressure side via the check valve 74. Specifically, the discharge side of the charge pump 68 is connected to the charge line 220, and the relief valve 76 has the function of keeping the hydraulic pressure of the charge line 220 at a predetermined value. The first hydraulic pump 54 is housed in a casing 44. The external tank 72 draws oil from the inside of the casing 44 and supplies the oil to the charge pump 68 via the filter 70.

The pressurized oil discharged from the first hydraulic pump 54 is supplied to an axle rotating hydraulic motor 224. A pinion shaft 228 constituting an input part of a differential gear device 226 is rotationally driven by a rotary shaft (not shown) constituting the axle rotating hydraulic motor 224. Further, side gears (not shown) at both left and right sides constituting the differential gear device 226 are rotated by the rotation of the pinion shaft 228. The side gears are fixed to an axle 230 connected to the left and right wheels 32. Therefore, by the rotational drive of the axle rotating hydraulic motor 224, the left and right wheels 32 are rotated. By reversing the tilting direction of the swash plate of the first hydraulic pump 54, that is, in the direction in which the swash plate inclines with rotation, the hydraulic motor 224 is made rotatable in any normal or reverse direction.

Further, the axle rotating hydraulic motor 224 is provided with a bypass valve 84 in a bypass route disposed in parallel with respect to the flow of the pressurized oil, so that, when the bypass valve 84 is opened, shortcut is taken between the discharge side and the suction side of the axle rotating hydraulic motor 224. Thereby, when it is desired that the working vehicle be forcibly moved, for example, in a state in which the electric motor is stopped and the like, the load on the axle rotating hydraulic motor 224 can be removed.

Free wheel preventing lines 234 for drawing pressurized oil from the reservoir inside the casing 44 are respectively connected at a discharge side and a suction side at the time of normal rotation of the first hydraulic pump 54 of a main pressurized oil line 232 connecting the first hydraulic pump 54 and the axle rotating hydraulic motor 224. Second check valves 236 are provided at the respective free wheel preventing lines 234. The second check valve 236 has the function of replenishing pressurized oil to the main pressurized oil line 232 from the reservoir to prevent the working vehicle from slipping down due to shortage of the pressurized oil of part of the main pressurized oil line 232 when the working vehicle stops on an uphill or a downhill.

The main pressurized oil line 232, the charge line 220, the axle rotating hydraulic motor 224, the bypass valve 84, the differential gear device 226 and a portion including part of the axle 230 are housed in the casing 44, housing the electric motor 26 and the first hydraulic pump 54, and the casing 44 and the elements housed in the casing 44 are set as a single unit.

In the reference example as above, as in each of the above-described embodiments, when electric power is supplied to the battery 14 (see FIG. 4) from the generator 12 (see FIG. 4) driven by the engine 10 (see FIG. 4) and the electric power is supplied to the electric motor 26 from the battery 14, the axle rotating hydraulic motor 224 for driving the wheels 32 can be operated without always operating the engine 10, unlike in the structure which drives the drive shaft 114 by the power of the engine 10 without the electric motor 26. Therefore, a structure capable of quieter operation is obtained. Specifically, when sufficient electric power is stored in the battery 14, the axle rotating hydraulic motor 224 corresponding to the wheels 32 can be driven by driving the electric motor 26 by the electric power from the battery 14 in the state in which the engine 10 is stopped and driving noise is small.

As the constitution and operation are otherwise the same as those in the above-described first embodiment, redundant explanation will be omitted by assigning the same reference numerals and characters to the equivalent parts and not repeating their explanation here.

SECOND REFERENCE EXAMPLE RELATING TO THE PRESENT INVENTION

FIG. 23 is a diagram showing a basic constitution and a hydraulic circuit of a working vehicle, which is a vehicle with a multiple pump unit of a second reference example relating to the present invention. This reference example is also out of “What is claimed is:” of the present invention. This reference example differs from the first reference example shown in FIG. 22 described above in that a second casing 240 which houses the axle rotating hydraulic motor 224, the differential gear device 226, and a portion including part of the axle 230, is provided apart from a first casing 238 which houses the electric motor 26, the first hydraulic pump 54, and the bypass valve 84. The first casing 238 and the second casing 240 are provided at different locations as separate components. Specifically, a hydraulic circuit part including the first hydraulic pump 54 and a hydraulic circuit part including the axle rotating hydraulic motor 224 are set as separate units different from each other. A hydraulic pipe line 242 is connected to the first casing 238 and the second casing 240. The hydraulic pipe line 242 constitutes part of the main pressurized oil line 232. Oil reservoirs of the first casing 238 and the second casing 240 are connected to the external tank 72.

Further, the charge pump 68 is disposed between the first hydraulic pump 54 and the electric motor 26, so that the first hydraulic pump 54, the electric motor 26 and the charge pump 68 may be rotationally driven at the same time by the drive shaft 114. Unlike this reference example, the first hydraulic pump 54, the electric motor 26 and the charge pump 68 are disposed to be in the same positional relationship as in
the first reference example shown in FIG. 22 described above so that the charge pump 68 may be made drivable by the end portion of the drive shaft 114.

[0153] In the case of this reference example as above, in the working vehicle, the degree of freedom of disposition of the parts can be enhanced to a greater degree than in the first reference example shown in FIG. 22 described above. For example, the degree of freedom of disposition of the first hydraulic pump 54 is enhanced.

[0154] As the constitution and operation are otherwise the same as in the first reference example shown in FIG. 22 described above, redundant explanation will be avoided by assigning the same reference numerals and characters to the equivalent parts and not repeating their description here.

Sixteenth Embodiment of the Present Invention

[0155] FIG. 24 is a diagram showing a basic constitution and a hydraulic circuit of a working vehicle, which is a vehicle with a multiple pump unit of a sixteenth embodiment of the present invention. In this embodiment, in the constitution of the first embodiment shown in FIG. 4 described above, a gear mechanism for transmitting power to the second pump shaft 60 from the drive shaft 114 is not provided between the drive shaft 114 constituting the first pump shaft of the first hydraulic pump 54 and the second pump shaft 60 of the second hydraulic pump 56.

[0156] In this embodiment, the electric motor 26, the first hydraulic pump 54, the first hydraulic motor 34 and the planetary gear mechanism 78 corresponding to the first hydraulic motor 34 are housed in a first casing 244, and the second hydraulic pump 56, the second hydraulic motor 36 and the planetary gear mechanism 78 corresponding to the second hydraulic motor 36 are housed in a second casing 246. Further, a charge pump 68a is driven by the second pump shaft 60. The charge pump 68a is housed in the second casing 246, pressurizes the oil sucked from the oil reservoir in the second casing 246, and supplies the oil to a hydraulic path at a low pressure side via the check valve 82.

[0157] The cooling fan 96 and a drive side pulley 248 are fixed to the drive shaft 114 projected outside the first casing 244. The cooling fan 96 and a driven side pulley 250 are fixed to the second pump shaft 60 projected outside the second casing 246. A belt 252 is looped over the drive side pulley 248 and the driven side pulley 250. Therefore, when the drive shaft 114 rotates, the second pump shaft 60 also rotates via the belt 252. Specifically, the drive shaft 114 and the second pump shaft 60 are operationally connected.

[0158] Suction sides of the charge pump 68 which is driven by the drive shaft 114 and the charge pump 68a which is driven by the second pump shaft 60 are respectively connected to the oil reservoirs inside the first casing 244 and the second casing 246. Further, a manual switching valve 254 is provided in a bypass path disposed in parallel with respect to the flow of the pressurized oil for each of the hydraulic pumps 54 and 56. By switching the manual switching valve 254, it is possible to select whether to continue the bypass path at a region of the manual switching valve 254, or to cause the suction side and the discharge side of the hydraulic pump 54 (or 56) to communicate with the oil reservoir inside the first casing 244 or the second casing 246. In the present example, as in the first embodiment shown in FIGS. 1a and 2 to 5 and described above, the drive shaft 114 and the second pump shaft 60 are driven by the electric motor 26, and the first hydraulic pump 54 and the second hydraulic pump 56 which are driven by the respective shafts 114 and 60 are included, and the pressurized oil for operating the first hydraulic motor 34 and the second hydraulic motor 36 corresponding to the left and right wheels 32 is fed out from the respective hydraulic pumps 54 and 56. In this embodiment, the casings 244 and 246 are set as separate units from each other, but by connecting them with a member not illustrated, they can constitute a single unit.

[0159] As the constitution and operation are otherwise the same as in the first embodiment described above, redundant explanation will be avoided by assigning the same reference numerals and characters to the equivalent parts and not repeating their description here.

THIRD REFERENCE EXAMPLE RELATING TO THE PRESENT INVENTION

[0160] FIG. 25 is a diagram showing a basic constitution and a hydraulic circuit of a working vehicle which is a vehicle with a multiple pump unit of a third reference example relating to the present invention. This reference example is out of “What is claimed is;” of the present invention. The configuration of this reference example corresponds to that of the sixteenth embodiment shown in FIG. 24 described above, with the exception that the drive shaft 114 constituting the first pump shaft of the first hydraulic pump 54 and the second pump shaft of the second hydraulic pump 56 are not operationally connected. In the present example, the second pump shaft is constituted of a second drive shaft 256, and the second drive shaft 256 constitutes a rotary shaft of a second electric motor 258 as in the case of the drive shaft 114 constituting the first pump shaft. Specifically, the first hydraulic pump 54 and the second hydraulic pump 56 are driven by the electric motor 26 and second electric motor 258, respectively, which are separate components. Further, the cooling fan 96 is fixed to a portion of the second drive shaft 256 constituting the second electric motor 258 projecting outside the second casing 246. The second electric motor 258 is controlled by the controller 22 (see FIG. 1a) similarly to the electric motor 26 for driving the first hydraulic pump 54, is supplied with electric power from the battery 14 (see FIG. 4), and is driven at a rotational speed equal to the electric motor 26. With such a constitution, the first hydraulic pump 54 and the second hydraulic pump 56 are driven independently from each other, but their rotation at the input sides are the same as each other, and, if the tilting amount of each swash plate, that is, the inclined amount at the time of rotation is the same, the working vehicle travels in a straight line, whereas, if the tilting amount is changed, the traveling direction can be changed.

[0161] As the constitution and operation are otherwise the same as in the sixteenth embodiment shown in FIG. 24 described above, the redundant explanation will be avoided by assigning the same reference numerals and characters to the equivalent parts.

[0162] Further, in each of the above described embodiments, electric power can be directly supplied to the electric motor 26 from the generator 12 or the fuel cell instead of supplying the electric power generated in the generator 12 or the fuel cell to the secondary battery such as the battery 14 and supplying the electric power to the electric motor 26 from the secondary battery. In such a case, power supply switching unit may be provided at either the generator 12 or the fuel cell, or between the secondary battery and the electric motor 26, and by the power supply switching unit, supply of the electric power to the electric motor 26 directly from the generator 12.
or the fuel cell, or supply of the electric power to the electric motor 26 from the secondary battery can be made switchable automatically or manually by an operation part such as a switch. For example, when the charge amount of the secondary battery is at a predetermined value or less, electric power can be automatically supplied to the electric motor 26 directly from the generator 12 or the fuel cell.

[0163] Of the above-described respective embodiments, in the case of driving the working machine except for the wheels 32 which are the drive wheels by hydraulic pressure from the hydraulic pump in the fourteenth embodiment shown in FIG. 20 and the like, at least one hydraulic pump which drives the working machine out of a plurality of hydraulic pumps constituting the dual pump unit can be made a fixed displacement type instead of a variable displacement type. Although in the above-described embodiments, examples of providing the two hydraulic pumps constituting the dual pump unit are described, three or more hydraulic pumps may be provided, and each of the three or more hydraulic pumps can be driven by one electric motor. Further, in the above-described respective embodiments and reference examples, the wheels 32 driven by the hydraulic motor or the electric motor are not limited to the rear wheels as shown in the illustrated examples, but may also be the front wheels. Further, in the case of the constitution having the electric device which drives the wheels via the hydraulic transmission as in each of the above described embodiments, the electric motor rotates at a constant speed, as compared with the case of directly driving the wheels with the electric motor. Therefore, the additional advantage is obtained that the control device of the electric motor and the electric motor itself can be manufactured at a relatively low cost.

What is claimed is:

1. A multiple pump unit used for operating a plurality of actuators, comprising:
   a plurality of pump shafts driven by an electric motor; and
   a plurality of hydraulic pumps driven by the respective plurality of pump shafts,
   wherein pressurized oil for operating the plurality of actuators is fed out from the plurality of hydraulic pumps.

2. The multiple pump unit according to claim 1, wherein at least any one of the plurality of hydraulic pumps is a double port pump provided with a plurality of discharge ports in correspondence with one pump shaft, and
   the pressurized oil for operating the plurality of actuators is fed out from the plurality of discharge ports of the double port pump.

3. The multiple pump unit according to claim 1, further comprising:
   a casing housing the plurality of hydraulic pumps, and
   rotatably supporting a rotary shaft of the electric motor and the plurality of hydraulic pump shafts; and
   a PTO shaft rotatably supported by the casing,
   wherein the rotary shaft of the electric motor and the plurality of hydraulic pump shafts are operationally connected, and
   power transmission is made selectively possible between the rotary shaft of the electric motor and the PTO shaft by a clutch mechanism.

4. The multiple pump unit according to claim 3, further comprising:
   a PTO shaft side pulley fixed to the PTO shaft projecting from the casing.

5. The multiple pump unit according to claim 1, wherein a cooling fan is fixed to at least one of a rotary shaft of the electric motor or a hydraulic pump shaft among the plurality of hydraulic pumps.

6. The multiple pump unit according to claim 5, further comprising:
   a casing housing the plurality of hydraulic pumps; and
   a cooling air guide part fixed to an outer side of the casing and guiding cooling air generated by the cooling fan along the outer side of the casing.

7. A vehicle with a multiple pump unit, comprising:
   the multiple pump unit according to claim 1;
   a secondary battery or a fuel cell supplying electric power to the electric motor; and
   electric power supply state selecting unit selecting whether to supply electric power to the electric motor from the secondary battery or the fuel cell, or to shut off the supply of the electric power to the electric motor from the secondary battery or the fuel cell.

8. The vehicle with the multiple pump unit according to claim 7, comprising:
   a working machine supported by a vehicle body; and
   a working machine side pulley operationally connected to the working machine,
   wherein the multiple pump unit is the multiple pump unit according to claim 4, and a belt is provided between the PTO shaft side pulley and the working machine side pulley.

9. The vehicle with the multiple pump unit according to claim 7,
   wherein the plurality of actuators driven by the pressurized oil from the multiple pump unit are two wheel-driving hydraulic motors.

10. The vehicle with the multiple pump unit according to claim 7, further comprising:
    a generator driven by an engine,
    wherein electric power generated by the generator is supplied to the electric motor via the secondary battery or directly.

11. The vehicle with the multiple pump unit according to claim 7, further comprising:
    an engine side pulley capable of being selectively connected to an output shaft of an engine by a clutch;
    a working machine supported by a vehicle body; and
    a working machine side pulley operationally connected to the working machine,
    wherein a belt is provided between the engine side pulley and the working machine side pulley.

12. The vehicle with the multiple pump unit according to claim 7,
    wherein a plurality of actuators driven by the pressurized oil from the multiple pump unit are each any of a working machine raising and lowering cylinder device raising and lowering a working machine, a working machine drive device driving the working machine, and a working machine tilting cylinder device tilting to displace the working machine, and
    electric power is supplied to a wheel-driving electric motor from any of the secondary battery, the fuel cell and a generator to drive the wheel-driving electric motor.

13. The vehicle with the multiple pump unit according to claim 7, further comprising:
    a charge pump provided to replenish at least any one of the plurality of hydraulic pumps with pressurized oil.