United States Patent Application Publication	20250263908
Kind Code	A1
Publication Date	August 21, 2025
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WORKING MACHINE

Abstract

A working machine includes a machine body, an engine provided on the machine body, a motor generator to be operated as a motor to assist driving of the engine in an assisting operation, and to be operated as a generator by power of the engine to generate electricity in a generating operation, a battery to store the electricity generated by the motor generator, a cooling device to cool the battery with power transmitted from the engine, a hydraulic driving device to which powers of the engine and the motor generator are transmitted, a working device to be operated by power of the hydraulic driving device, and a traveling device to be operated by the power of the hydraulic driving device. The cooling device stops based on an operating state of either one of the hydraulic diving device, the working device, and the traveling device.

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Appl. No.: **19/200211**

Filed: **May 06, 2025**

Foreign Application Priority Data

JP	2019-122511	Jun. 28, 2019
JP	2019-122515	Jun. 28, 2019
JP	2019-122516	Jun. 28, 2019

Related U.S. Application Data

parent WO continuation PCT/JP2020/024730 20200624 PENDING child US 17347693

parent US division 17347693 20210615 parent-grant-document US 12331486 child US 19200211

Publication Classification

Int. Cl.: **E02F9/20** (20060101); **E02F3/84** (20060101)

U.S. Cl.:

CPC **E02F9/2075** (20130101); **E02F3/84** (20130101);

Background/Summary

CROSS REFERENCE TO RELATED APPLICATIONS [0001] This application is a divisional application of U.S. application Ser. No. 17/347,693, filed on Jun. 15, 2021, which is a continuation application of International Application No. PCT/JP2020/024730, filed on Jun. 24, 2020, which claims the benefit of priority to Japanese Patent Application No. 2019-122511, filed on Jun. 28, 2019, to Japanese Patent Application No. 2019-122515, filed on Jun. 28, 2019, and to Japanese Patent Application No. 2019-122516, filed on Jun. 28, 2019. The entire contents of each of these applications are hereby incorporated herein by reference.

BACKGROUND OF THE INVENTION
Field of the Invention
[0002] The present invention relates to a working machine such as a compact track loader or a skid steer loader.
Description of the Related Art
[0003] Japanese Patent Publication No. 3941951 is known, which discloses a hybrid type working machine including an engine and a motor generator among working machines such as a compact track loader. In the working machine of Japanese Patent Publication No. 3941951, when an operation-mode judgment means determines that a hydraulic-operating portion is in the working mode, an electric motor generator controller means obtains a powering torque value to be output to the electric motor generator with reference to an actual engine revolving speed detected by an engine revolving speed detector means based on a powering torque output information obtained by relating, to the engine revolving speed, the powering torque output characteristics of the electric motor generator, which is set according to the current working mode.
[0004] In Japanese Patent Publication No. 3941951, when a remaining amount of power storage detected by a remaining power-storage detector means is less than a predetermined value, the powering torque value obtained above is limited according to a remaining amount of power storage, and a driving signal is output to an inverter so that the electric motor generator outputs a limited powering torque value.
[0005] In addition, a working machine of Japanese Unexamined Patent Application Publication No. 2009-174446 includes an assist torque adding means to add an assist torque on an output torque, and an overloading state judgment means to judge whether an overloading state in which an input torque exceeds an output torque occurs, and further the assist torque adding means adds the assist torque on the output torque when it is judged the overloading state is occurring presently.
SUMMARY OF THE INVENTION
[0006] A working machine of the present invention includes a machine body, an engine provided on the machine body, a motor generator to be operated as a motor to assist driving of the engine in an assisting operation and to be operated as a generator by power of the engine to generate electricity in a generating operation, a battery to store the electricity generated by the motor

generator, an acceleration sensor to measure acceleration of the machine body, and a controller to selectively set either one of the assisting operation and the generating operation based on the acceleration of the machine body measured by the acceleration sensor.

[0007] The controller estimates, based on the acceleration of the machine body measured by the acceleration sensor, what kind of traveling state the machine body is in, and performs the selective setting based on the estimated traveling state.

[0008] When a fore-and-aft directional acceleration of the machine body is not less than a threshold, the controller estimates that the machine body is in a straight traveling state where the machine body is traveling straight. When the fore-and-aft directional acceleration of the machine body is less than the threshold, the controller estimates that the machine body is in a non-straight traveling state defined as any traveling state other than the straight traveling state. The controller selectively sets either one of the assisting operation and the generating operation based on whether the traveling state is estimated as the straight traveling state or the non-straight traveling state.

[0009] The controller estimates, based on a width directional acceleration of the machine body and on a yaw rate of the machine body, whether the machine body is in a turning state where the machine body is turning or not. The controller selectively sets either one of the assisting operation and the generating operation based on whether or not the traveling state is estimated as the turning state.

[0010] The controller includes a powering torque setting unit to set a powering torque of the motor generator in the assisting operation, a regenerating torque setting unit to set a regenerating torque of the motor generator in the generating operation, and an operation control unit to perform the assisting operation at the powering torque set by the powering torque setting unit when a revolving speed of the engine is not higher than a first revolving speed, and to perform the generating operation at the regenerating torque set by the regenerating torque setting unit when the revolving speed of the engine is not lower than a second revolving speed that is higher than the first revolving speed.

[0011] Either one of the powering torque setting unit and the regenerating torque setting unit changes the setting of corresponding one of the powering torque and the regenerating torque based on the acceleration of the machine body.

[0012] The controller changes either the first revolving speed or the second revolving speed based on the acceleration of the machine body.

[0013] A working machine includes a machine body, an engine provided on the machine body, a motor generator to be operated as a motor to assist driving of the engine in an assisting operation, and to be operated as a generator by power of the engine to generate electricity in a generating operation, a battery to store the electricity generated by the motor generator, a cooling device to cool the battery with the power transmitted from the engine, a hydraulic driving device to which the powers of the engine and the motor generator are transmitted, a working device to be operated by power of the hydraulic driving device, and a traveling device to be operated by the power of the hydraulic driving device. The cooling device stops based on an operating state of either one of the hydraulic diving device, the working device, and the traveling device.

[0014] The working machine includes a load detector to detect a load of either one of the hydraulic diving device, the working device, and the traveling device. The cooling device stops when the load detected by the load detector is a predetermined load or more.

[0015] The working machine includes an operation member to operate either one of the working device and the traveling device. The cooling device stops when an operation extent of the operation member is a predetermined extent or more.

[0016] The working machine includes a temperature detector to detect temperature of the battery. The cooling device does not stop when the temperature detected by the temperature detector is a predetermined temperature or more.

[0017] The cooling device includes an evaporator through which coolant to cool the battery flows,

and a compressor to compress the coolant that has flown through the evaporator. The compressor stops based on the operating state.
[0018] The hydraulic driving device includes a hydraulic pump, and the working device includes a boom swingably provided on the machine body, and a boom cylinder to be operated by hydraulic fluid delivered from the hydraulic pump to swing the boom.
[0019] A working machine includes a machine body, an engine provided on the machine body, a motor generator to be operated as a motor to assist driving of the engine in an assisting operation and to be operated as a generator by power of the engine to generate electricity in a generating operation, a battery to store the electricity generated by the motor generator, a traveling device to be operated by powers of at least the engine and the motor generator, and a controller configured so that, in a state where the motor generator is in the assisting operation, the controller stops or limits the assisting operation when an outputting condition relating to outputting from the traveling device deviates from that corresponding to an inputting condition relating to inputting to the traveling device.
[0020] The working machine includes a traveling operation member to operate the traveling device, and a rotation detector to detect a rotation speed of the traveling device. When the inputting condition is an operation extent of the traveling operation member and the outputting condition is the rotation speed detected by the rotation detector, the controller stops or limits the assisting operation when the rotation speed of the traveling device is lower than that corresponding to the operation extent.
[0021] The working machine includes a traveling operation member to operate the traveling device, and a rotation detector to detect a rotation speed of the traveling device. When the inputting condition is an operation extent of the traveling operation member and the outputting condition is the rotation speed detected by the rotation detector, the controller stops or limits the assisting operation when the rotation speed of the traveling device is higher than that corresponding to the operation extent.
[0022] The working machine includes a traveling operation member to operate the traveling device, and a vehicle-speed detector to detect a vehicle speed of the machine body. When the inputting condition is an operation extent of the traveling operation member and the outputting condition is the vehicle speed detected by the vehicle-speed detector, the controller stops or limits the assisting operation when the vehicle speed is lower than that corresponding to the operation extent.
[0023] The working machine includes a traveling operation member to operate the traveling device, and a vehicle-speed detector to detect a vehicle speed of the machine body. When the inputting condition is an operation extent of the traveling operation member and the outputting condition is the vehicle speed detected by the vehicle-speed detector, the controller stops or limits the assisting operation when the vehicle speed is higher than that corresponding to the operation extent.
[0024] The controller includes a powering torque setting unit to set a powering torque of the motor generator in the assisting operation, a regenerating torque setting unit to set a regenerating torque of the motor generator in the generating operation, and an operation control unit to perform the assisting operation at the powering torque set by the powering torque setting unit when a revolving speed of the engine is not higher than a first revolving speed, and to perform the generating operation at the regenerating torque set by the regenerating torque setting unit when the revolving speed of the engine is not lower than a second revolving speed that is higher than the first revolving speed.
[0025] The powering torque setting unit reduces the powering torque when the deviation occurs.
[0026] The powering torque setting unit increases the powering torque when a load on the engine increases. The power torque setting unit reduces the powering torque when the load on the engine reduces.
[0027] The working machine includes a detection sensor to detect the revolving speed of the engine. The powering torque setting unit increases the powering torque when the revolving speed

of the engine detected by the detection sensor increases. The powering torque setting unit reduces the powering torque when the revolving speed of the engine reduces.
[0028] The above and other elements, features, steps, characteristics and advantages of the present invention will become more apparent from the following detailed description of the preferred embodiments with reference to the attached drawings.

Description

BRIEF DESCRIPTION OF THE DRAWINGS
[0029] A more complete appreciation of preferred embodiments of the present invention and many of the attendant advantages thereof will be readily obtained as the same becomes better understood by reference to the following detailed description when considered in connection with the accompanying drawings described below.
[0030] FIG. **1** is an overall side view of a working machine.
[0031] FIG. **2** is a perspective view of the machine body.
[0032] FIG. **3** is a perspective view illustrating arrangement of equipment (devices).
[0033] FIG. **4** is a cross-sectional view illustrating inside of a rotating electric machine.
[0034] FIG. **5** is a view illustrating a hydraulic system for traveling.
[0035] FIG. **6** is a view illustrating the hydraulic system for working.
[0036] FIG. **7** is a view illustrating setting lines of relationship between an engine revolving speed and a primary traveling pressure.
[0037] FIG. **8** is a view illustrating a control block diagram of the working machine.
[0038] FIG. **9** is a view illustrating an example of a control map.
[0039] FIG. **10** is a view illustrating a cooling device.
[0040] FIG. **11**A is a view illustrating an example of a process in the cooling device.
[0041] FIG. **11**B is a view illustrating a different process in the cooling device from FIG. **11**A.
[0042] FIG. **11**C is a view illustrating another different process in the cooling device from FIG. **11**A and FIG. **11**B.
[0043] FIG. **12** is a schematic view of a machine body on which an inertial measurement unit is mounted.
[0044] FIG. **13** is a view illustrating a relationship between a traveling state and an inertial force detected by the inertial measurement unit.
[0045] FIG. **14** is a view illustrating an example of changing a first revolving speed N**1** and a second revolving speed N**2** according to magnitude of an inertial force of the machine body.
[0046] FIG. **15** is a view illustrating a relationship between an operation extent of a traveling operation member and a rotating speed of a traveling device.
[0047] FIG. **16**A is a view illustrating control under a state where traveling rotating speeds M**1** and M**2** is lower than that corresponding to an operation extent of the traveling operation member.
[0048] FIG. **16**B is a view illustrating control under a state where traveling rotating speeds M**1** and M**2** is higher than that corresponding to an operation extent of the traveling operation member.
[0049] FIG. **17** is a view illustrating a relationship between an operation extent of the traveling operation member and a traveling vehicle speed.
[0050] FIG. **18**A is a view illustrating control under a state where traveling vehicle speeds V**1** and V**2** is lower than that corresponding to an operation extent of the traveling operation member.
[0051] FIG. **18**B is a view illustrating control under a state where traveling vehicle speeds V**1** and V**2** is higher than that corresponding to an operation extent of the traveling operation member.
[0052] FIG. **19** is a view illustrating control under a state where a load is applied to an engine.
[0053] FIG. **20** is a view illustrating a relationship between a moving average value Dave of a reducing amount ΔE**1** and a judgement value W**1**.

[0054] FIG. **21** is a view illustrating a relationship between an engine revolving speed and a powering torque in an assisting operation.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0055] The preferred embodiments will now be described with reference to the accompanying drawings, wherein like reference numerals designate corresponding or identical elements throughout the various drawings. The drawings are to be viewed in an orientation in which the reference numerals are viewed correctly.

[0056] With reference to drawings, a working machine according to an embodiment of the present invention will be described below.

[0057] FIG. **1** shows a side view of a working machine **1** of the present invention. In FIG. **1**, a compact track loader is illustrated as an example of a working machine. However, the working machine is not limited to a compact track loader, but may be another typed loader, such as a skid steer loader, for example. In addition, it may also be a working machine other than the loader. In description of the present invention, a forward direction of an operator seating on a driver seat of the working machine (the left side in FIG. **1**) is referred to as the front, a rearward direction of the operator (the right side in FIG. **1**) is referred to as the rear, a left direction of the operator (the front surface side of FIG. **1**) is referred to as the left, and a right direction of the operator (the back surface side of FIG. **1**) is referred to as the right. A direction orthogonal to the forward and rearward directions of a machine body may be referred to as a machine width direction (also referred to as a width direction).

[0058] The working machine **1** includes a machine body **2**, a working device **3**, and a pair of traveling devices **4**L and **4**R.

[0059] A cabin **5** is mounted on an upper front portion of the machine body **2**. A rear portion of the cabin **5** is supported by a bracket of the machine body **2** pivotally around a support shaft. A front portion of the cabin **5** is configured to be mounted on a front portion of the machine body **2**. A driver seat **7** is provided in the cabin **5**.

[0060] The pair of traveling devices **4**L and **4**R are constituted of crawler-type traveling devices. The traveling device **4**L is installed on one side (left side) of the machine body **2**, and the traveling device **4**R is installed on the other side (right side) of the machine body **2**.

[0061] The working device **3** includes booms **10**, boom cylinders **14**, working tool cylinders **15**, and a working tool **11**. The booms **10** are supported by lift links **12** and control links **13**. Each of the boom cylinders **14**, which consists of a double-acting hydraulic cylinder, is interposed between a base portion of the corresponding boom **10** and a rear lower portion of the machine body **2**. By simultaneously extending and contracting the boom cylinders **14**, the booms **10** are pivoted up and down.

[0062] At a tip end of the boom **10**, each of attachment brackets **18** is supported pivotally around a horizontal axis, and the back surface of the working tool **11** is attached to the left and right attachment brackets **18**. That is, the working tool **11** is attached to the tip ends of the booms **10**.

[0063] Each of the working tool cylinders **15**, which is a double-acting hydraulic cylinder, is interposed between the corresponding attachment bracket **18** and a middle portion of the tip end of the corresponding boom **10**. The extending and contracting of the working tool cylinders **15** swing the working tool **11** (the scooping and dumping operations).

[0064] The working tool **11** is configured to be attached to and detached from the attachment brackets **18**. The working tool **11** is, for example, an attachment (auxiliary attachment) such as a bucket, a hydraulic crusher, a hydraulic breakers, an angle broom, an earth auger, a pallet fork, a sweeper, a mower, or a snow blower.

[0065] Next, the machine body will be described.

[0066] As shown in FIG. **2**, the machine body **2** has a right frame portion **20**, a left frame portion **21**, a front frame portion **22**, a bottom frame portion **23**, and an upper frame portion **24**.

[0067] The right frame portion **20** constitutes a right portion of the machine body **2**. The left frame portion **21** constitutes a left portion of the machine body **2**. The front frame portion **22** constitutes a front portion of the machine body **2**, and connects front portions of the right frame portion **20** and the left frame portion **21** with each other. The bottom frame portion **23** constitutes a bottom portion of the machine body **2**, and connects lower portions of the right frame portion **20** and the left frame portion **21** with each other. An upper frame portion **24** constitutes a rearward upper portion of the machine body **2**, and connects upper rearward portions of the right frame portion **20** and the left frame portion **21** with each other.

[0068] Rear portions of the right frame portion **20** and the left frame portion **21** swingably support the booms **10** and the like. Each of the right frame portion **20** and the left frame portion **21** is provided with a track frame **25** and a motor attachment portion **26**.

[0069] As shown in FIG. **3**, an engine **60**, a cooling fan **61**, a radiator, a motor generator **63**, and a hydraulic driving device **64** is installed on the machine body **2**. The engine **60** is an internal combustion engine such as a diesel engine or a gasoline engine. The cooling fan **61** is driven by the power of the engine **60**, and the radiator cools cooling water for cooling the engine **60**. The motor generator **63** is a device configured to be operated as a motor to assist driving of the engine **60** in an assisting operation and to be operated as a generator by power of the engine to generate electricity in a generating operation. The motor generator **63** is constituted of a permanent magnet embedded three-phase AC synchronous motor.

[0070] The hydraulic driving device **64** is a device configured to be driven by powers/power of the engine **60** and/or the motor generator **63**, and mainly outputs power for working. The hydraulic driving device **64** is located in front of the motor generator **63**. The hydraulic driving device **64** includes a plurality of hydraulic pumps, and, as shown in FIGS. **5** and **6**, the plurality of hydraulic pumps include a traveling pump **52**L, a traveling pump **52**R, a sub pump P**1**, and a main pump P**2**, for example.

[0071] In addition, a battery **66** and an electric power controller **67** are provided on the machine body **2**.

[0072] The battery **66** stores an electric power generated by the motor generator **63**, and supplies the stored electric power to the motor generator **63** and other devices.

[0073] The working machine **1** is configured to drive the hydraulic driving device **64** by power of the engine **60**, to drive the hydraulic driving device **64** with both the engine **60** and the motor generator **63**, and to operate the motor generator **63** by power of the engine **60** so as to generate electricity. That is, transmission of power to the working device is performed in a parallel hybrid system. A power transmission structure of the engine **60** and the motor generator **63** will be described below.

[0074] As shown in FIGS. **3** and **4**, a housing **65** is located on a front portion of the engine **60**, the housing **65** houses a flywheel having a substantially-discoidal shape and the motor generator **63**. The motor generator **63** includes a coupler portion **63***a* connecting to the flywheel, a rotor **63***b* fixed to the coupler portion **63***a*, a stator **63***c* provided on the rotor **63***b*, and a water jacket **63***d* provided on an outside of the stator **63***c*.

[0075] The coupler portion **63***a* is formed to have a cylindrical shape, and has a rear end attached to the flywheel. An intermediate shaft **68***a* is provided inside the coupler portion **63***a*. A coupler **68***b* is located at the rear end of the intermediate shaft **68***a*, and an outer side of the coupler **68***b* is connected to the flywheel. In addition, a front end of the intermediate shaft **68***a* is connected to a drive shaft of the hydraulic driving device **64**.

[0076] Thus, when the engine **60** is driven, a rotational power of the crankshaft (output shaft) **60***a* of the engine **60** is transmitted to the flywheel to rotate the flywheel. As shown by an arrowed line F**1** in FIG. **4**, a rotational power of the flywheel is transmitted from the coupler **68***b* to the intermediate shaft **68***a*, and then transmitted from the intermediate shaft **68***a* to the drive shaft of the hydraulic driving device **64** to drive the hydraulic driving device **64**.

[0077] In addition, as shown by an arrowed line F**2** in FIG. **4**, a rotational power of the flywheel is

transmitted to the rotor **63***b* through the coupler portion **63***a*. Thus, when a rotational power of the engine **60** is transmitted to the rotor **63***b* (and the coupler portion **63***a*), the motor generator **63** can be operated as a generator. On the other hand, when an electric power stored in the battery **66** is supplied to the stator **63***c*, the rotor **63***b* can be rotated. As shown by an arrowed line F**3**, a rotational power of the rotor **63***b* can be transmitted to the flywheel through the coupler portion **63***a*. Thus, the motor generator **63** can be operated as an electric motor to assist the engine **60**.
[0078] FIGS. **5** and **6** show respective hydraulic circuits (hydraulic systems) of the working device. FIG. **5** shows a hydraulic system for traveling, and FIG. **6** shows a hydraulic system for working.
[0079] As shown in FIG. **5**, the hydraulic system for traveling is a system configured to operate the traveling devices **4**L and **4**R with a hydraulic pressure generated when the hydraulic driving device **64** is driven. The hydraulic system for traveling includes a sub pump P**1**, which is a hydraulic pump to deliver hydraulic fluid, a first traveling motor mechanism **31**L, a second traveling motor mechanism **31**R, and a traveling driving mechanism **34**.
[0080] The sub pump P**1** is constituted of a constant-displacement gear pump. The sub pump P**1** is configured to deliver hydraulic fluid stored in a tank (hydraulic fluid tank). A delivery fluid line **40** through which hydraulic fluid flows is extended from a delivery port of the sub pump P**1**. A first charging fluid line **41** is connected to a delivery side of the delivery fluid line **40**. The first charging fluid line **41** extends to the traveling driving mechanism **34**. Of hydraulic fluid delivered from the sub pump P**1**, the hydraulic fluid to be used for control may be referred to as a pilot fluid, and a pressure of the pilot fluid may be referred to as a pilot pressure.
[0081] The traveling driving mechanism **34** is a mechanism configured to drive the first traveling motor mechanism **31**L and the second traveling motor mechanism **31**R, and includes a drive circuit **34**L for driving the first traveling motor mechanism **31**L (referred to as a left drive circuit) and a drive circuit **34**R for driving the second traveling motor mechanism **31**R (referred to as a right drive circuit).
[0082] The drive circuits **34**L and **34**R respectively include traveling pumps **52**L and **52**R, shift fluid lines **57***h* and **57***i*, and respective second charging fluid lines **42**. The shift fluid lines **57***h* and **57***i* are fluid lines respectively connecting the traveling pumps **52**L and **52**R to the traveling motors **36**L and **36**R. The second charging fluid lines **42** are fluid lines connected to the respective shift fluid lines **57***h* and **57***i* and configured to supply hydraulic fluid, which is supplied from the sub pump P**1**, to the shift fluid lines **57***h* and **57***i*. Each of the traveling pumps **52**L and **52**R is constituted of a variable displacement axial pump of swash plate type to be driven by the power of the engine **60**. Each of the traveling pumps **52**L and **52**R includes a pressure receiver portion **52***a* and a pressure receiver portion **52***b* on which a pilot pressure is applied, and changes an angle of a swash plate with the pilot pressure applied on the pressure receiver portions **52***a* and **52***b*. When an angle of the swash plate is changed, outputs (output rates of the hydraulic fluid) of the traveling pumps **52**L and **52**R and an output direction of hydraulic fluid can be changed. In other words, the traveling pumps **52**L and **52**R changes an angles of the swash plates to change a driving forces to be output to the traveling devices **4**L and **4**R.
[0083] The first traveling motor mechanism **31**L is a mechanism configured to transmit power to the drive shaft of the traveling device **4**L that is installed leftward on the machine body **2**. The second traveling motor mechanism **31**R is a mechanism configured to transmit power to the drive shaft of the traveling device **4**R that is installed rightward on the machine body **2**. The traveling motor mechanisms **31**L and **31**R include the traveling motors **36**L and **36**R and a speed shifter mechanism.
[0084] Each of the traveling motors **36**L and **36**R is a variable displacement axial pump of swash plate type, for example. The traveling motor **36**L is attached to the motor attachment portion **26** located on the left frame portion **21**, and provides a traveling power to the traveling device **4**L. The traveling motor **36**R is attached to the motor attachment portion **26** located on the right frame portion **20**, and provides a traveling power to the traveling device **4**R. The traveling motors **36**L

and **36**R are motors configured to change a vehicle speed (that is, a rotating speed) between a first speed and a second speed. In other words, the traveling motors **36**L and **36**R are motors capable of changing a force of propelling the working machine **1**, that is, the traveling devices **4**L and **4**R.
[0085] Each speed shifter mechanism includes a swash plate switching cylinder **38***a* and a traveling switching valve **38***b*. The swash plate switching cylinder **38***a* is telescopically movable to change an angle of the corresponding swash plate of each of the traveling motors **36**L and **36**R. The traveling switching valve **38***b* is a valve to extend and contract the swash plate switching cylinder **38***a* in one and the other directions, that is, a two-position switching valve configured to be switched between a first position **39***a* and a second position **39***b*. The traveling switching valves **38***b* are switched by a speed-shifting switching valve **44**. The speed-shifting switching valve **44** is connected to the delivery fluid line **40**, and is connected to the traveling switching valve **38***b* of the first traveling motor mechanism **31**L and to the traveling switching valve **38***b* of the second traveling motor mechanism **31**R. The speed-shifting switching valve **44** is a two-position switching valve configured to be switched between a first position **44***a* and a second position **44***b*. When the speed-shifting switching valve **44** is set to the first position **44***a*, a pressure of the hydraulic fluid to be applied to the traveling switching valve **38***b* of the speed shifter mechanism is set as a pressure corresponding to a predetermined speed (for example, a first speed). When the speed-shifting switching valve **44** is set to the first position **44***a*, a pressure of the hydraulic fluid to be applied to the traveling switching valve **38***b* is set as another pressure corresponding to another speed (a second peed) faster than the predetermined speed (the first speed). Thus, when the speed-shifting switching valve **44** is in the first position **44***a*, the traveling switching valves **38***b* are in the respective first positions **39***a*, and accordingly the swash plate switching cylinders **38***a* are contracted to set the traveling motors **36**L and **36**R in the first speed state. When the speed-shifting switching valve **44** is in the second position **44***b*, the traveling switching valve **38***b* is in the second position **39***b*, and accordingly the swash plate switching cylinder **38***a* is extended to set the traveling motors **36**L and **36**R in the second speed state. The shifting of the traveling motors **36**L and **36**R between the first speed state and the second speed state is controlled by a working controller **70**. For example, the working controller **70** is provided with an operation member **58** such as a switch (a speed shifter switch) (see FIG. **8**). When the operation member **58** is switched to set the first speed, the working controller **70** outputs a control signal to demagnetize a solenoid of the speed-shifting switching valve **44** to set the speed-shifting switching valve **44** to the first position **44***a*. When the operation member **58** is switched to set the second speed, the working controller **70** outputs a control signal to magnetize a solenoid of the speed-shifting switching valve **44** to set the speed-shifting switching valve **44** to the second position **44***b*.
[0086] As shown in FIG. **5**, the working machine **1** is provided with an operation device **53**. The operation device **53** is a device configured to operate the traveling devices **4**L and **4**R, that is, the first traveling motor mechanism **31**L, the second traveling motor mechanism **31**R, and the traveling driving mechanism **34**. The operation device **53** includes a traveling operation member **54** and a plurality of operation valves **55** (**55***a*, **55***b*, **55***c*, and **55***d*). The plurality of operation valves **55** (**55***a*, **55***b*, **55***c*, and **55***d*) are traveling operation valves.
[0087] The traveling operation member **54** is an operation member supported by the operation valves **55**, and is configured to swing in a left-and-right direction (a machine width direction) or a fore-and-aft direction. The plurality of operation valves **55** are operated by the common traveling operation member **54**, i.e., by the single traveling operation member **54**. The plurality of operation valves **55** are actuated according to the swinging of the traveling operation member **54**. To the plurality of operation valves **55**, hydraulic fluid (the pilot fluid) delivered from the sub pump P**1** can be supplied through the delivery fluid line **40**. The plurality of operation valves **55** include the operation valve **55***a*, the operation valve **55***b*, the operation valve **55***c*, and the operation valve **55***d*.
[0088] The plurality of operation valves **55** are connected to the traveling driving mechanism **34** (traveling pumps **52**L and **52**R) via traveling fluid lines **45**. The traveling fluid lines **45** include a

first traveling fluid line **45***a*, a second traveling fluid line **45***b*, a third traveling fluid line **45***c*, a fourth traveling fluid line **45***d*, and a fifth traveling fluid line **45***e*. The first traveling fluid line **45***a* is a fluid line connected to the pressure receiver portion **52***a* of the traveling pump **52**L. The second traveling fluid line **45***b* is a fluid line connected to the pressure receiver portion **52***b* of the traveling pump **52**L. The third traveling fluid line **45***c* is a fluid line connected to the pressure receiver portion **52***a* of the traveling pump **52**R.

[0089] The fourth traveling fluid line **45***d* is a fluid line connected to the pressure receiver portion **52***b* of the traveling pump **52**R. The fifth traveling fluid line **45***e* is a fluid line that connects the operation valve **55**, the first traveling fluid line **45***a*, the second traveling fluid line **45***b*, the third traveling fluid line **45***c*, and the fourth traveling fluid line **45***d* to each other. The fifth traveling fluid line **45***e* connects shuttle valves **46** to the operation valves **55** (**55***a*, **55***b*, **55***c*, and **55***d*), respectively.

[0090] When the traveling operation member **54** is pivoted forward (in a direction indicated by an arrowed line A**1** in FIG. **5**), the operation valve **55***a* is operated so as to apply pilot pressures to the pressure receiver portions **52***a* of the traveling pumps **52**L and **52**R to tilt the swash plates of the traveling pumps **52**L and **52**R in respective normal rotation directions from respective neutral positions, and in this state, the traveling pumps **52**L and **52**R deliver hydraulic fluid. As the result, the output shafts **35**L and **35**R of the traveling motors **36**L and **36**R normally rotate (rotate forward) at a speed proportional to a pivoting extent of the traveling operation member **54**, and thus the working machine **1** moves straight forward.

[0091] When the traveling operation member **54** is pivoted backward (in a direction indicated by an arrowed line A**2** in FIG. **5**), the operation valve **55***b* is operated so as to apply pilot pressures to the pressure receiver portions **52***b* of the traveling pumps **52**L and **52**R to tilt the swash plates of the traveling pumps **52**L and **52**R in respective reverse rotation directions from the respective neutral positions, and in this state, the traveling pumps **52**L and **52**R deliver hydraulic fluid. As the result, the output shafts **35**L and **35**R of the traveling motors **36**L and **36**R reversely rotate (rotate backward) at a speed proportional to a pivoting extent of the traveling operation member **54**, and thus the working machine **1** moves straight backward.

[0092] When the traveling operation member **54** is pivoted rightward (in a direction indicated by an arrowed line A**3** in FIG. **5**), the operation valve **55***c* is operated so as to apply pilot pressures to the pressure receiver portion **52***a* of the traveling pump **52**L and the pressure receiver portion **52***b* of the traveling pump **52**R, respectively, to tilt the swash plate of the traveling pump **52**L in the normal rotation direction, and the swash plate of the traveling pump **52**R in the reverse rotation direction, respectively. As the result, the output shaft **35**L of the traveling motor **36**L located on the left side normally rotates and the output shaft **35**R of the traveling motor **36**R located on the right side reversely rotates, and thus the working machine **1** turns to the right (ultra-pivotal turn). When the traveling operation member **54** is pivoted leftward (in a direction indicated by an arrowed line A**4** in FIG. **5**), the operation valve **55***d* is operated so as to apply pilot pressures to the pressure receiver portion **52***b* of the traveling pump **52**L and the pressure receiver portion **52***a* of the traveling pump **52**R, respectively, to tilt the swash plate of the traveling pump **52**L in the reverse rotation direction, and the swash plate of the traveling pump **52**R in the normal rotation direction, respectively. As the result, the output shaft **35**L of the traveling motor **36**L located on the left side reversely rotates and the output shaft **35**R of the traveling motor **36**R located on the right side normally rotates, and thus the working machine **1** turns to the left (ultra-pivotal turn).

[0093] When the traveling operation member **54** is pivoted in an oblique direction, the rotational directions and the rotation speeds of the output shafts **35**L and **35**R of the left traveling motor **36**L and the right traveling motor **36**R are determined based on a differential pressure between the pilot pressures applied to the pressure receiver portion **52***a* and the pressure receiver portion **52***b*, and then the working machine **1** turns right (the right pivotal turn) or left (the left pivotal turn) in forward traveling or reverse traveling.

[0094] The working machine **1** may be provided with an anti-stall control valve **48**. The anti-stall control valve **48** is located in the fluid line (delivery fluid line **40**) between the plurality of operation valves **55** (**55***a*, **55***b*, **55***c*, and **55***d*) and the sub pump P**1**.
[0095] The anti-stall control valve **48** is a proportional solenoid valve having a variable aperture. The anti-stall control valve **48** is capable of setting a pilot pressure (referred to as a primary pilot pressure) applied to the plurality of operation valves **55** (**55***a*, **55***b*, **55***c*, and **55***d*) based on a reduction amount (dropping) ΔE**1** of a revolving speed of the engine **60** (referred to as an engine revolving speed). The revolving speed of the engine can be detected by a sensor **91** for detecting an engine revolving speed. The engine revolving speed detected by the sensor **91** is input to the working controller **70**.
[0096] FIG. **7** shows a relationship between the engine revolving speed, the primary traveling pressure (that is, the primary pilot pressure), and setting lines L**51** and L**52**. The setting line L**51** shows a relationship between the engine revolving speed and the primary traveling pressure when a reduction amount ΔE**1** is less than a predetermined value (i.e., less than an anti-stall judgment value). The setting line L**52** shows a relationship between an engine revolving speed and the primary traveling pressure when the reduction amount ΔE**1** is equal to or more than the anti-stall judgment value.
[0097] The working controller **70** adjusts an opening aperture of the anti-stall control valve **48** so that the relationship between the engine revolving speed and the primary traveling pressure matches with the reference pilot pressure indicated by the setting line L**51** when the reduction amount ΔE**1** is less than the anti-stall judgment value. When the reduction amount ΔE**1** is equal to or more than the anti-stall judgment value, the working controller **70** adjusts the opening aperture of the anti-stall control valve **48** so that the relationship between the engine revolving speed and the primary traveling pressure matches with the setting line L**52**, which indicates a pressure lower than the reference pilot pressure. On the setting line L**52**, the primary traveling pressure for a predetermined engine speed is lower than the primary traveling pressure of the setting line L**51**. That is, when focusing on the same engine speed, the primary traveling pressure of the setting line L**52** is set lower than the primary traveling pressure of the setting line L**51**. Thus, a pressure of the hydraulic fluid (that is, the pilot pressure) to enter the operation valve **55** is kept low under the control based on the setting line L**52**. As the result, the swash plate angles of the traveling pumps **52**L and **52**R are adjusted, and the load applied to the engine is reduced, thereby preventing the engine from stalling. Although FIG. **7** shows the setting line L**52** as a single line, the setting line L**52** may be considered as a plurality of lines. For example, the setting line L**52** may be set for each engine revolving speed. It is preferable that the working controller **70** has data indicating the setting lines L**51** and L**52** or control parameters such as functions.
[0098] Next, the hydraulic system for working will be described.
[0099] As shown in FIG. **6**, the hydraulic system for working is a system configured to operate the working device **3** and the like. The hydraulic system for working is a system configured to operate the working device **3** with the hydraulic pressure generated when the hydraulic driving device **64** is driven. The hydraulic system for working is provided with a plurality of control valves **51** and the main pump P**2** that is a hydraulic pump configured to deliver hydraulic fluid. The main pump P**2** is a pump located at a position different from a position of the sub pump P**1**, and is constituted of a small-displacement gear pump. The main pump P**2** is configured to deliver the hydraulic fluid stored in a hydraulic fluid tank. In particular, the main pump P**2** delivers hydraulic fluid that mainly operates the hydraulic actuators.
[0100] A fluid line **51***f* is extended from a delivery port of the main pump P**2**. The plurality of control valves **51** are connected to this fluid line **51***f*. The plurality of control valves **51** include a boom control valve **51***a*, a bucket control valve **51***b*, and an auxiliary control valve **51***c*. The boom control valve **51***a* is configured to control the boom cylinder **14**, the bucket control valve **51***b* is configured to control the working tool cylinder **15**, and the auxiliary control valve **51***c* is

configured to control the hydraulic actuator of the auxiliary attachment.

[0101] Operations of the boom **10** and the working tool **11** can be performed by a working operation member **37** included in the operation device **43**. The working operation member **37** is an operation member supported by a plurality of operation valves **59** and configured to swing in a left-and-right direction (that is, the machine width direction) or the fore-and-aft direction. By operating to tilt the working operation member **37**, the operation valves **59** located on the lower portion of the working operation member **37** can be operated.

[0102] The plurality of operation valves **59** are fluidly connected to the plurality of control valves **51** via a plurality of working fluid lines **47** (**47***a*, **47***b*, **47***c*, and **47***d*), respectively. In particular, the operation valve **59***a* is connected to the boom control valve **51***a* through the working fluid line **47***a*. The operation valve **59***b* is connected to the boom control valve **51***a* through the working fluid line **47***b*. The operation valve **59***c* is connected to the bucket control valve **51***b* through the working fluid line **47***c*. The operation valve **59***d* is connected to the bucket control valve **51***b* through the working fluid line **47***d*. The plurality of operation valves **59***a* to **59***d* are each capable of setting a pressure of the hydraulic fluid to be delivered according to an operation of the working operation member **37**.

[0103] When the working operation member **37** is tilted forward, the operation valve **59***a* is operated, and the pilot pressure is output from the operation valve **59***a*. This pilot pressure is applied to a pressure receiver portion of the boom control valve **51***a*, and the hydraulic fluid entering the boom control valve **51***a* is supplied to a rod side chamber of the boom cylinder **14**, thus the boom **10** is lowered.

[0104] When the working operation member **37** is tilted backward, the operation valve **59***b* is operated, and a pilot pressure is output from the operation valve **59***b*. This pilot pressure is applied to another pressure receiver portion of the boom control valve **51***a*, and the hydraulic fluid entering the valve **51***a* is supplied to a bottom side chamber of the boom cylinder **14**, thus the boom **10** is raised.

[0105] That is, the boom control valve **51***a* is capable of controlling a flow rate of the hydraulic fluid flowing to the boom cylinder **14** according to a pressure of the hydraulic fluid set through an operation of the working operation member **37** (a pilot pressure set by the operation valve **59***a* and a pilot pressure set by the operation valve **59***b*).

[0106] When the working operation member **37** is tilted rightward, the operation valve **59***c* is operated, and the pilot pressure is applied to a pressure receiver portion of the bucket control valve **51***b*. As the result, the bucket control valve **51***b* is operated in a direction to extend the working tool cylinder **15**, and the working tool **11** performs the dumping movement at a speed proportional to a tilting amount of the working operation member **37**.

[0107] When the working operation member **37** is tilted leftward, the operation valve **59***d* is operated, and the pilot fluid is applied to a pressure receiver portion of the bucket control valve **51***b*. As the result, the bucket control valve **51***b* is operated in a direction to contract the working tool cylinder **15**, and the working tool **11** performs the scooping movement at a speed proportional to a tilting amount of the working operation member **37**.

[0108] That is, the bucket control valve **51***b* is capable of controlling a flow rate of the hydraulic fluid flowing in the working tool cylinder **15** according to a pressure of the hydraulic fluid set through an operation of the working operation member **37** (a pilot pressure set by the operation valve **59***c* and a pilot pressure set by the operation valve **59***d*). That is, the operation valves **59***a*, **59***b*, **59***c*, and **59***d* change a pressure of hydraulic fluid according to an operation of the working operation member **37**, and supply the changed hydraulic fluid to the control valves such as the boom control valve **51***a*, the bucket control valve **51***b*, and the auxiliary control valve **51***c*.

[0109] The auxiliary attachments can be operated by a switch **56** provided in the vicinity of the driver seat **7** (see FIG. **8**). The switch **56** is constituted of a tiltable seesaw switch, a slidable slide switch, or a depressable push switch. An operation of the switch **56** is input to the working controller **70**. The first solenoid valve **56***a* and the second solenoid valve **56***b*, which are constituted of solenoid valves or the like, have variable openings according to an operation extent of the switch **56**. As the result, the pilot fluid is supplied to the auxiliary control valve **51***c* connected to the first solenoid valve **56***a* and the second solenoid valve **56***b*, and an auxiliary actuator of the auxiliary attachment is actuated by hydraulic fluid supplied from the auxiliary control valve **51***c*.

[0110] As shown in FIG. **8**, operation extents of the operation members (the working operation member **37**, the traveling operation member **54**) can be detected by operation detectors **77**. The operation detectors **77** are operably connected to the working controller **70** to be described later. The operation detectors **77** include a first operation detector **77**A and a second operation detector **77**B. The first operation detector **77**A detects an operation extent of the working operation member **37** (referred to as a working operation extent). The second operation detector **77**B detects an operation extent of the traveling operation member **54** (referred to as a traveling operation extent). The first operation detector **77**A and the second operation detector **77**B are position sensors or the like that are configured to detect positions of the operation members.

[0111] FIG. **8** shows a control block diagram in the working machine **1**. As shown in FIG. **8**, the power controller **67** is electrically connected to the working controller **70**. The power controller **67** includes an inverter **67**A and an inverter control unit **67**B.

[0112] The inverter **67**A, for example, includes a plurality of switching elements, and converts a direct current into an alternating current by switching the switching elements or the like. The inverter **67**A is electrically connected to the motor generator **63** and the battery **66**. The inverter control unit **67**B is constituted of a CPU, electrical and electronic circuits, or the like. When a predetermined signal is output to the inverter control unit **67**B, the inverter control unit **67**B operates the motor generator **63** as either the motor or as the generator. An amount (remaining amount) of energy stored in the battery **66** can be detected by a charging detection sensor **97** provided in the battery **66**.

[0113] The working controller **70** is a device configured to perform various controls of the working device, and is constituted of a CPU, an electrical and/or electronic circuit, or the like. The working controller **70** performs a control (that is, the hydraulic control) relating to a hydraulic pressure (that is, the hydraulic fluid). In the hydraulic control, the working controller **70** magnetizes and demagnetizes solenoids of the speed-shifting switching valve **44**, the first solenoid valve **56***a*, and the second solenoid valve **56***b*, as described above. The working controller **70** also operates as a controller configured to control the power controller **67**. The working controller **70** outputs an assist command to the inverter control unit **67**B, and the inverter control unit **67**B operates the motor generator **63** as the motor. The working controller **70** outputs a power generation command to the inverter control unit **67**B, and the inverter control unit **67**B operates the motor generator **63** as the generator. That is, under the control by the working controller **70**, the motor generator **63** can perform either one of the assisting operation to assist the driving of the engine **60** and the generating operation to operate as a generator with the power of the engine **60** to generate electric power. The working controller **70** sets either one of a powering torque of the motor generator **63** in the assisting operation and the regenerating torque of the motor generator **63** in the generating operation, and issues a command about the set torque to the power controller **67**.

[0114] When the motor generator **63** performs the assisting operation, powers of the engine **60** and the motor generator **63** are transmitted to the hydraulic driving device **64**. When the motor generator **63** performs the generating operation, a power of the engine **60** is transmitted to the hydraulic driving device **64**, and an electric power generated by the motor generator **63** is charged to the battery **66**. The motor generator **63** is driven by the electric power charged in the battery **66**.

[0115] In the above-mentioned embodiment, the working controller **70** and the electric power controller **67** are separately configured, but may be integrally configured and are not limited to the configuration of the above-mentioned embodiment.

[0116] The working controller **70** includes a memory unit **70***a*, a powering torque setting unit **70***b*, a regenerating torque setting unit **70***c*, and an operation control unit **70***d*. The memory unit **70***a* is constituted of non-volatile memory or the like. The powering torque setting unit **70***b*, the regenerating torque setting unit **70***c*, and the operation control unit **70***d* are constituted of electrical and/or electronic circuits provided in the working controller **70**, computer programs or the like stored in a CPU, or the like. The memory unit **70***a*, the powering torque setting unit **70***b*, the regenerating torque setting unit **70***c*, and the operation control unit **70***d* may be provided in the power controller **67**.

[0117] The memory unit **70***a* stores control information used when the motor generator **63** performs either the assisting operation or the charging operation, for example, stores a control map shown in FIG. **9**. The control map shows a relationship between a revolving speed of the engine **60** (that is, the engine revolving speed) and the selection between the assisting operation and the charging operation (that is, the operation selection), a relationship between the engine revolving speed and a powering torque in the assisting operation, and the relationship between the engine revolving speed and the regenerating torque in the charging operation. In the above-mentioned embodiment, a relationship between the engine revolving speed and the switching of operation, a relationship between the engine revolving speed and the powering torque in assisting operation, and a relationship between the engine revolving speed and the regenerating torque in the charging operation may be shown by control tables, parameters, functions, or the like, which are not limited thereto.

[0118] The powering torque setting unit **70***b* sets the powering torque used when the assisting operation is performed. As shown in FIG. **9**, the powering torque setting unit **70***b* refers to the control information such as the control map stored in the memory portion **70***a*, and sets the powering torque relative to the engine revolving speed with use of a standard line L**1**, for example.

[0119] The regenerating torque setting unit **70***c* sets the regenerating torque used when the generating operation is performed. As shown in FIG. **9**, the regenerating torque setting unit **70***c* refers to control information in the same way as the powering torque setting unit **70***b*, and sets the regenerating torque relative to the engine revolving speed with use of the standard line L**1**, for example. The standard line L**1** includes a sloping line L**1***a*, in which the torque varies with the engine revolving speed, and a constant line L**1***b*, in which the torque is constant regardless of the engine revolving speed.

[0120] The operation control unit **70***d* executes the assisting operation by outputting the powering torque to the power controller **67** when the engine revolving speed is a first revolving speed N**1** or lower, the powering torque being set by the powering torque setting unit **70***b*, and executes the generating operation by outputting the regenerating torque to the power controller **67** when the engine revolving speed is a second revolving speed N**2** higher than the first revolving speed or higher, the regenerating torque being set by the regenerating torque setting unit **70***c*.

[0121] As shown in FIG. **10**, the working machine **1** is provided with a cooling device **71** configured to cool the battery **66**. The cooling device **71** is a device configured to be operated by power of the engine **60** to apply, to the battery **66**, a cooling air whose temperature is lowered by a refrigerant, thereby cooling the battery **66**, for example.

[0122] The cooling device **71** is stopped based on an operating state of either one of the hydraulic driving device **64**, the working device **3**, and the traveling devices **4**L and **4**R. For example, the cooling device **71** stops when an output of the hydraulic driving device **64** is a predetermined output or more, when a load generated during operation of the working device **3** is a predetermined load or more, or when a load generated during operation of the traveling devices **4**L and **4**R is a predetermined load or more. In this regard, the cooling device **71** is activated when the output of the hydraulic driving device **64** is less than the predetermined output, when the load generated during of the working device **3** is less than the predetermined load, or when the load generated during operation of the traveling devices **4**L and **4**R is less than the predetermined load.

[0123] A structure and operation of the cooling device **71** will be described in detail below.

[0124] The cooling device **71** includes a compressor **71***a*, a condenser **71***b*, a receiver **71***c*, an evaporator **71***d*, and a cooling fan **71***e*. The compressor **71***a* and the condenser **71***b* are connected to each other by a cooling line **72** such as a pipe, and the receiver **71***c* and the evaporator **71***d* are also connected to each other by another cooling line **72**. The evaporator **71***d* and the cooling fan **71***e* are housed in a case **69** that houses the battery **66**.
[0125] The compressor **71***a* includes a main body **71***a***1**, a drive shaft **71***a***2**, and a pulley **71***a***3** that rotates with the drive shaft **71***a***2**. A belt **60***c* wound on a pulley **60***b* that rotates according to rotation of the output shaft **60***a* of the engine **60** is wound on the pulley **71***a***3**. Thus, a rotational power from the output shaft **60***a* of the engine **60** is transmitted to the main body **71***a***1** through the pulley **60***b*, the belt **60***c*, the pulley **71***a***3**, and the drive shaft **71***a***2**. The compressor **71***a* is provided with a switch **71***a***4** configured to be switched between an ON state and an OFF state. The compressor **71***a* is activated with the electric power supplied when the switch **71***a***4** is turned ON under a condition where the power is transmitted to the main body **71***a***1**. The compressor **71***a* is stopped with the supply of electric power stopped when the switch **71***a***4** is turned off under a condition the power is transmitted to the main body **71***a***1**. That is, the switch **71***a***4** is an electric power switch.
[0126] When the compressor **71***a* is activated, refrigerant in the cooling line **72** is compressed and output to the condenser **71***b*. The compressor **71***a*, when activated, compresses the refrigerant and delivers the compressed refrigerant to the condenser **71***b* through the cooling line **72**.
[0127] The condenser **71***b* is provided with a cooling fan to lower a temperature of the refrigerant.
[0128] The refrigerant that has passed through the condenser **71***b* flows to the evaporator **71***d* through the receiver **71***c*, and refrigerant that has passed through inside of the evaporator **71***d* returns to the compressor **71***a*.
[0129] As shown in FIG. **10**, a cooling line **73** may be branched from a section **72***a* of the cooling line **72** between the receiver **71***c* and the evaporator **71***d*, and may be connected to an air conditioner **74** provided in the cabin **5**. On-off valves **75***a* and **75***b* constituted of solenoid valves or the like are connected to the section **72***a* of the cooling line **72** and the cooling line **73**. The on-off valves **75***a* and **75***b* can be switched by the working controller **70**. The on-off valve **75***b* is closed when the on-off valve **75***a* is opened. The on-off valve **75***b* is opened when the on-off valve **75***a* is closed. In this manner, the refrigerant in the cooling lines **72** and **73** is allowed to selectively flow either to the side for cooling the battery **66** (to the evaporator **71***d*) or to the air conditioner **74**.
[0130] As shown in FIG. **8**, the working machine **1** is provided with a load detection unit (load detector) **76**. The load detector **76** detects an operating state of at least one of the hydraulic driving device **64**, the working device **3**, and the traveling devices **4**L and **4**R, that is, detects the load. For example, the load detector **76** is a pressure detector sensor configured to detect a pressure of hydraulic fluid. The load detector **76** is operably connected to the working controller **70**.
[0131] The load detector (that is, the pressure detection sensor) **76** is provided on each of the speed-shifting fluid lines **57***h* and **57***i*, for example. The load detectors **76** provided on the respective speed-shifting fluid lines **57***h* and **57***i* can detect respective pressures after operations of the traveling pumps **52**L and **52**R (referred to as pump-output pressures), and the pump-output pressures can be considered as loads on the traveling pumps **52**L and **52**R (that is, output loads) or as loads on the traveling devices **4**L and **4**R (that is, output loads).
[0132] The load detector (that is, the pressure detection sensor) **76** may be provided on a fluid line connecting the hydraulic cylinder of the working device **3** to the control valve **51** (that is, the boom control valve **51***a*, the bucket control valve **51***b*). In this case, due to the load detector (that is, the pressure detection sensor) **76**, the pressures of the hydraulic cylinders (that is, the boom cylinder **14**, the working tool cylinder **15**) of the working device **3** during the working (referred to as the working pressure) can be considered as a load on the working device **3** (referred to as the output load).
[0133] As shown in FIG. **11**A, the working controller **70** judges whether the cooling device **71** (that

is, the compressor **71***a*) is operated or not (S**1**). When the cooling device **71** is operated (S**1**, Yes), the working controller **70** monitors the output load on any of the traveling pumps **52**L and **52**R, the traveling devices **4**L and **4**R, and the hydraulic cylinders of the working device **3** (S**2**).
[0134] When the output load is equal to or larger than a predetermined judgment load (S**3**, Yes), the working controller **70** stops the cooling device **71** (that is, the compressor **71***a*) by switching the switch **71***a***4** from ON to OFF (S**4**). On the other hand, when the output load is less than the judgment load (S**3**, No), the working controller **70** keeps (maintains) the switch **71***a***4** in the ON state. The judgment load is a value to be used to judge whether or not an excessive load is applied to the working machine **1** in either the working or the traveling.
[0135] In the above-mentioned embodiment, it is judged whether or not the output load on any of the traveling pumps **52**L and **52**R, the traveling devices **4**L and **4**R, and the hydraulic cylinders of the working device **3** is the judgment load or more. Additionally, the cooling system **71** may be stopped when a combined total load on at least two output loads is the judgment load or more.
[0136] In addition, the cooling device **71** may be stopped when an operation extent of the operation member (that is, the working operation member **37** or the traveling operation member **54**) is a predetermined extent or more.
[0137] As shown in FIG. **11**B, when the cooling device **71** (that is, the compressor **71***a*) is operated (S**1**, Yes), the working controller **70** monitors either the working operation extent of the working operation member **37** detected by the first operation detector **77**A or the traveling operation extent of the traveling operation member **54** detected by the second operation detector **77**B (S**10**). When either the working operation extent or the traveling operation extent is the predetermined judgment operation extent or more (S**11**, Yes), the working controller **70** switches the switch **71***a***4** from the ON state to the OFF state (S**12**). On the other hand, when each of the working operation extent and the traveling operation extent is less than the judgment operation extent (S**11**, No), the working controller **70** keeps (maintains) the switch **71***a***4** in the ON state. The judgment operation extent is a value to be used to judge whether or not the working device **3** or the traveling devices **4**L and **4**R should be operated quickly.
[0138] In the above-described embodiment, it is judged whether or not either the working operation extent or the traveling operation extent is the judgment operation extent or more. Additionally, the cooling device **71** may be stopped when the total operation extent which is the sum of at least two extents, the working operation extent and the traveling operation extent, is the judgment load or more.
[0139] It may also be judged, based on a temperature of the battery **66**, whether or not to stop the cooling device **71**. The temperature of the battery **66** is detected by the temperature detector **78**. The temperature detector **78** is provided inside the case **69**, and detects the temperature of the battery **66**. The temperature detector **78** is connected to the working controller **70**.
[0140] As shown in FIG. **11**C, when the cooling device **71** is operated (S**1**, Yes), the working controller **70** judges whether or not a temperature (referred to as a battery temperature) detected by the temperature detector **78** is the cooling judgment value or higher (S**20**). The cooling judgment value is a value used to determine whether or not the battery **66** needs to be cooled. The cooling judgment value is set as 50° C. or higher, for example. The cooling judgment value is not limited thereto.
[0141] When the battery temperature is the cooling judgment value or higher (S**20**, No), the working controller **70** keeps (maintains) the switch **71***a***4** in the ON state. On the other hand, when the battery temperature is less than the cooling judgment value (S**20**, Yes), the working controller **70** monitors the output load (S**2**) similar to the process in FIG. **11**A, and when the output load is the judgment load or more (S**3**, Yes), the cooling device **71** is stopped (S**4**). On the other hand, when the output load is less than the judgment load (S**3**, No), the working controller **70** keeps (maintains) the switch **71***a***4** in the ON state.
[0142] In the present embodiment, the cooling device **71** (that is, the compressor **71***a*) is stopped by

switching the switch **71***a***4** between the ON state and the OFF state. Alternatively, the working controller **70** may engage or disengage an electromagnetic clutch interposed between the driving shaft **71***a***2** of the compressor **71***a* and the output shaft **60***a* to stop the cooling device **71** (that is, the compressor **71***a*).

[0143] The working machine **1** includes the machine body **2**, the engine **60**, the motor generator **63**, the battery **66**, the cooling device **71**, the hydraulic driving device **64**, the working device **3**, and the traveling devices **4**L and **4**R, and the cooling device **71** is stopped based on the operating state of any one of the hydraulic driving device **64**, the working device **3**, and the traveling devices **4**L and **4**R. According to this configuration, a driving power of the engine **60** can be secured by stopping the cooling device **71**, and a storing capacity of the battery **66** can be secured without lowering the powering torque or the like on the motor generator **63**.

[0144] The working machine **1** includes the load detection unit (load detector) **76** configured to detect a load on any of the hydraulic driving device **64**, the working device **3**, and the traveling devices **4**L and **4**R-The cooling device **71** is stopped when the load detected by the load detection unit (that is, the load detector) **76** is the predetermined load or more. Accordingly, when an output load is applied on any of the hydraulic driving device **64**, the working device **3**, and the traveling devices **4**L and **4**R, the cooling device **71** is stopped to secure a driving force of the engine **60**.

[0145] The working device **3** includes the operation member (the working operation member **37** or the traveling operation member **54**) for operating either the working device **3** or the traveling devices **4**L and **4**R. The cooling device **71** is stopped when the operation extent of the operation member (the working operation member **37** or the traveling operation member **54**) is the predetermined extent or more. According to this configuration, the cooling device **71** can be efficiently stopped when the operation extent of the operation member is the predetermined extent or more and the power outputting is required. That is, an operation of the cooling device **71** can be maintained or stopped in synchronization with the operation extent of the operation member.

[0146] The working machine **1** includes the temperature detector **78** configured to detect the temperature of the battery **66**. The cooling device **71** is not stopped when the temperature detected by the temperature detector **78** is a predetermined temperature or more. According to this configuration, when the temperature of the battery **66** is high, the cooling by the cooling device **71** can be given priority.

[0147] The cooling device **71** includes the evaporator **71***d* through which the refrigerant for cooling the battery **66** flows, and the compressor **71***a* configured to compress the refrigerant that has flown through the evaporator **71***d*. The compressor **71***a* is selectively stopped based on its operating state. According to this configuration, the cooling device **71** can be entirely and easily stopped by stopping compression of the refrigerant by the compressor **71***a*.

[0148] As shown in FIGS. **8** and **12**, the working machine **1** includes an inertial measurement unit (IMU) **90** configured to measure an inertial force of the machine body **2**.

[0149] The inertial measurement unit **90** is attached, for example, below the driver seat **7**, inside the cabin **5**, on the top plate (that is, an outer roof) of the cabin **5**, or on the bottom frame portion **23**. The position of the inertial measurement unit **90** is not limited to of the above-mentioned positions in the embodiment. The inertial measurement unit **90** includes a gyro sensor that detects an angular velocity in three axes (that is, the X, Y, and Z axes) and an angular accelerometer that detects an angular acceleration. In other words, the inertial measurement unit **90** is a device that includes two acceleration sensors, i.e., the gyro sensor and the angular accelerometer. The inertial measurement unit **90** to be provided in the working machine **1** is not limited to that having the two acceleration sensors, and may be provided with only a single gyro sensor.

[0150] The inertial measurement unit **90** is capable of detecting a roll angle, a pitch angle, a yaw angle, and the like of the machine body **2**. The inertial measurement unit **90** is electrically connected to the working controller **70**.

[0151] The working controller **70** estimates, based on the inertial force of the machine body **2** measured by the inertial measurement unit **90**, what kind of traveling state the machine body **2** is in, and selectively sets either the assisting operation or the generating operation based on the estimated traveling state.

[0152] The setting of the assisting operation and the power generation command based on the inertial force detected by the inertial measurement unit **90** will be described below.

[0153] As shown in FIG. **12**, the working controller **70** refers to a fore-and-aft directional acceleration (referred to as a first acceleration) A**1** of the machine body **2**, a left-and-right (or width) directional acceleration (referred to as a second acceleration) A**2** of the machine body **2**, and a yaw rate A**3** of the working machine **1** (that is, the machine body **2**), which are measured by the inertial measurement unit **90**.

[0154] As shown in FIG. **13**, when the first acceleration A**1** is not less than a threshold thereof, the working controller **70** estimates that the machine body **2** is in a straight traveling state where the machine body **2** is traveling straight. When the first acceleration A**1** is less than the threshold, the working controller **70** estimates that the machine body **2** is in a non-straight traveling state defined as any traveling state other than the straight traveling state.

[0155] The working controller **70** estimates, based on the second acceleration A**2** and the yaw rate A**3**, whether the machine body **2** is in a turning state where the machine body **2** is turning or not. For example, the working controller **70** estimates that the machine body **2** is turning in a way referred to as first turning when the second acceleration A**2** is the threshold thereof or larger and the yaw rate A**3** is a threshold thereof or larger. The working controller **70** also estimates that the machine body **2** is turning in a way referred to as second turning when the second acceleration A**2** is less than the threshold thereof and the yaw rate A**3** is the threshold thereof or larger. On the other hand, when the second acceleration A**2** is less than the threshold thereof and the yaw rate A**3** is also less than the threshold thereof, the working controller **70** estimates that the machine body **2** is in a state other than the turning state. That is, the working controller **70** distinguishingly estimates, based on the second acceleration A**2** and the yaw rate A**3**, either one of the two kinds of turnings, e.g., the ultra-pivotal turn and the pivotal turn, as well as whether the machine body **2** is in a state other than the turning.

[0156] As described above, the working controller **70** is configured to estimate, based on an inertial force, what kind of traveling state (such as the straight traveling, the first turning, the second turning, or a state other than the turning) the machine body **2** is in. The working controller **70** makes various settings in the assisting operation or the power generation command in correspondence to the traveling state (the straight traveling, the first turning, the second turning, or the state other than the turning) in which the machine body **2** is.

[0157] Either the powering torque setting unit **70***b* or the regenerating torque setting unit **70***c* changes the setting of either the powering torque or the regenerating torque based on the inertial force of the machine body **2**. For example, as shown in FIG. **9**, when, in consideration of the traveling state of the machine body **2** estimated based on the inertial force of the machine body **2**, the powering torque setting unit **70***b* or the regenerating torque setting unit **70***c* needs to increase the torque at a given engine speed in the assisting operation or charging operation to a torque larger than that on the standard line L**1** at the same engine speed, the torque on the slope line L**1***a* of the standard line L**1** is changed to a torque on a correction line L**2** indicating variation of given by shifting the slope line L**1***a* of the standard line L**1** to the higher side of an engine revolving speed when In addition, when, in consideration of the traveling state of the machine body **2** estimated based on an inertial force of the machine body **2**, the torque per unit engine revolution needs to be larger than that on the standard line L**1**, the powering torque setting unit **70***b* changes the torque to a torque on a correction line L**3**. When instantaneously increasing a torque is needed, the powering torque setting unit **70***b* changes the torque to a torque on a correction line L**4**.

[0158] For example, when the traveling state is estimated as the straight traveling, each of the powering torque setting unit **70***b* and the regenerating torque setting unit **70***c* sets a torque based on the standard line L**1**. When the traveling state is estimated as the turning (the ultra-pivotal turn, the pivotal turn), the powering torque setting unit **70***b* sets a torque based on the correction line L**3**. In particular, when an instantaneous torque is required, the powering torque setting unit **70***b* sets a torque based on the correction line L**4**. When the traveling state is estimated as a state other than the turning, each of the powering torque setting unit **70***b* and the regenerating torque setting unit **70***c* sets a torque based on the correction line L**2**. The above-mentioned examples are just examples, and are not limited.

[0159] The correction lines L**2** to L**4** may be prepared in advance as control information in the memory unit **70***a*, may be calculated by the reduction amount ΔE**1** of the engine revolving speed, or may be obtained by a formula (function) so that their slopes become larger than that of the standard line L**1** in correspondence to a difference between the first revolving speed N**1** and the second revolving speed N**2**. In the correction lines L**2** to L**4**, the rate (slope) of increasing of the torque may be set according to a magnitude of the inertial force.

[0160] Alternatively, as shown in FIG. **14**, the working controller **70** may change the first revolving speed N**1** and the second revolving speed N**2** indicated by the standard line L**1** based on a magnitude of the inertial force of the machine body **2**. As shown in FIG. **14**, while an inclination of the slope line L**1***a* of the standard line L**1** is not changed, the larger the inertial force becomes, the more the first and second revolving speeds N**1** and N**2** are shifted in the direction lowering the revolving speed. The only requirement is that a torque or the like is set according to the inertial force detected by the inertial measurement unit **90**, and the setting is not limited to the above-mentioned embodiment.

[0161] The working machine **1** includes the acceleration sensor configured to measure the acceleration of the machine body **2**, and the controller (that is, the working controller **70**, the power controller **67**) configured to selectively set either the assisting operation or the generating operation based on the acceleration of the machine body **2** measured by the acceleration sensor. According to this configuration, even when the working machine **1** shows various behaviors in the working, the inertial measurement unit **90** is capable of detecting the behaviors in the working, so that the settings such as the torque can be easily made based on the operations of the working machine **1**.

[0162] The controller (that is, the working controller **70**, the power controller **67**) estimates what kind of traveling state the machine body **2** is in based on the acceleration of the machine body **2** measured by the acceleration sensor, and selectively sets either the assisting operation or the generating operation based on the traveling state. According to this configuration, the inertial measurement unit **90** is adaptable for estimating the various traveling states, and for quickly judging, based on the estimated traveling state, whether to perform the assisting operation or the generating operation.

[0163] The controller d (that is, the working controller **70**, the power controller **67**) estimates that the machine body **2** is in the straight traveling state where the machine body **2** is traveling straight when the fore-and-aft directional acceleration of the machine body **2** is not less than the threshold. The controller estimates that the machine body **2** is in the non-straight traveling state defined as any traveling state other than the straight traveling state when the fore-and-aft directional acceleration is less than the threshold. The controller selectively sets either one of the assisting operation and the generating operation based on whether the traveling state is estimated as the straight traveling state or the non-straight traveling state. According to this configuration, the selective setting of either the assisting operation or the generating operation can be performed immediately after the estimation of whether the machine body **2** is traveling straight or not.

[0164] The controller (that is, the working controller **70**, the power controller **67**) estimates, based on the width directional acceleration of the machine body **2** and on the yaw rate of the machine body **2**, whether the machine body **2** is in the turning state where the machine body **2** is turning or not. The controller selectively sets either one of the assisting operation and the generating operation based on whether or not the traveling state is estimated as the turning state. According to this configuration, the selective setting of either the assisting operation or the generating operation can be performed immediately after the estimation of whether the machine body **2** is turning or not.

[0165] Either the powering torque setting unit **70***b* or the regenerating torque setting unit **70***c* changes the setting of either the powering torque or the regenerating torque based on the acceleration of the machine body **2**. According to this configuration, the powering torque and the regenerating torques can be appropriately changed in correspondence to increase, reduction, or the like of the acceleration.

[0166] The controller (that is, the working controller **70**, the power controller **67**) changes either the first revolving speed NI or the second revolving speed N**2** based on the acceleration of the machine body **2**. According to this configuration, based on the acceleration of the working machine **1** in operation, whether to intensify the assisting operation or the generating operation is easily determined.

[0167] The working controller **70** may stop or limit the assisting operation when an outputting condition relating to outputting from the traveling devices **4**L and **4**R deviates from that corresponding to an inputting condition relating to inputting to the traveling devices **4**L and **4**R. For example, the assisting operation is stopped or limited when it is hard for an operator operating the traveling operation member **54** to expect a profit of the assisting operation, such as when the traveling devices **4**L and **4**R run idle, the rotations of the traveling devices **4**L and **4**R stop, or the speed (vehicle speed) of the machine body **2** is too slow or too fast.

[0168] The following explains an operation when the outputting condition of the traveling devices **4**L and **4**R deviates from that corresponding to the inputting condition of the traveling devices **4**L and **4**R. In the following description, the explanation is made with the working controller **70** as an example, but the power controller **67** instead of the working controller **70** may perform the same operation of the working controller **70**.

[0169] As shown in FIG. **8**, the working machine **1** includes a rotation detector **85** configured to detect the rotation speeds of the traveling devices **4**L and **4**R. The rotation detector **85** includes sensors configured to detect respectively the rotation speeds M**1** and M**2** of the output shafts **35**L and **35**R of the traveling motors **36**L and **36**R.

[0170] When the operation extent of the traveling operation member **54** is defined as the inputting state and the rotation speeds M**1** and M**2** detected by the rotation detector **85** are defined as the outputting state, the working controller **70** stops or limits the assisting operation when the rotation speeds M**1** and M**2** are lower than that corresponding to the operation extent of the traveling operation member **54**.

[0171] For example, as shown in FIG. **15**, during operation of the traveling operation member **54** for forward traveling, when the rotation speeds (referred to as traveling rotation speeds) M**1** and M**2** detected by the rotation detector **85** gradually increase as shown in a line L**6**, the working controller **70** continues the assisting operation. On the other hand, the working controller **70** stops the assisting operation when the traveling rotation speeds M**1** and M**2** are almost zero as shown in a line L**7***a* or when the rotations of the traveling devices **4**L and **4**R are stopped.

[0172] FIG. **16**A shows a processing (that is, the control) to be executed when the traveling rotation speeds M**1** and M**2** are lower than that corresponding to the operation extent of the traveling operation member **54**. As shown in FIG. **16**A, when the assisting operation is being performed (S**30**, Yes), the working controller **70** refers to the traveling rotation speeds M**1** and M**2** detected by the rotation detector **85** (S**31**). In addition, the working controller **70** refers to either the operation extent of the traveling operation member **54** or the set rotation speed set based on the operation extent (S**32**). The working controller **70** judges whether both the traveling rotation speeds M**1** and M**2** are lower than that corresponding to the operation extent of the traveling operation member **54** by at least a predetermined value (S**33**). For example, as shown in FIG. **15**, when rotation differences ΔM**1** and ΔM**2**, which are differences between the set rotation speeds corresponding to the predetermined operation extent (the rotation speed set based on the line L**6**) and the actual traveling rotation speeds M**1** and M**2** detected by the rotation detector **85**, are the predetermined value or more, and both the rotations of the traveling devices **4**L and **4**R are lower than the set rotation speeds by the predetermined value or more (S**33**, Yes), for example, when the traveling devices **4**L and **4**R stop or the traveling devices **4**L and **4**R run idle under low rotation speeds of the traveling rotation speeds M**1** and M**2**, the assisting operation is stopped or limited (S**34**). When the assisting operation is limited, the torque set by the powering torque setting unit **70***b* based on the standard line L**1** is reduced. For example, an amount of torque reduction may be set based on the magnitude of the rotation differences ΔM**1** and ΔM**2** (for example, the amount of torque reduction=the rotation differences ΔM**1** and ΔM**2**×a constant).

[0173] In addition, the working controller **70** stops the assisting operation when both of the traveling rotation speeds M**1** and M**2** are higher than that corresponding to an operation extent of the traveling operation member **54**.

[0174] As shown in FIG. **15**, when both of the traveling rotation speeds M**1** and M**2** detected by the rotation detector **85** are higher than those on the line L**7***b*, the working controller **70** stops or limits the assisting operation.

[0175] FIG. **16**B shows a processing (that is, the control) to be executed in a case where the traveling rotation speeds M**1** and M**2** are higher than those corresponding to the operation extent of the traveling operation member **54**. Steps S**31** to S**32** in FIG. **16**B are the same as those in FIG. **16**A. As shown in FIG. **16**B, the working controller **70** judges whether each of the traveling rotation speeds M**1** and M**2** is higher than that corresponding to an operation extent of the traveling operation member **54** by at least a predetermined value (S**35**). For example, as shown in FIG. **15**, when each of the rotation differences ΔM**1** and M**2** between the set rotation speeds corresponding to the predetermined operation extent and the traveling rotation speeds M**1** and M**2** detected by the rotation detector **85** is not lower than the predetermined value, and the traveling rotation speeds M**1** and M**2** are higher than those corresponding to the operation extent by at least the predetermined value (S**35**, Yes), for example, when the traveling rotation speeds M**1** and M**2** are high and the traveling devices **4**L and **4**R are accelerating during descending a slope, the assisting operation is stopped or limited (S**36**). The method for limiting the assisting operation is the same as that described above.

[0176] In the above-described embodiment, the assisting operation is stopped or limited when each of the traveling rotation speeds M**1** and M**2** of the traveling devices **4**L and **4**R is lower or higher than that corresponding to an operation extent of the traveling operation member **54**. Alternatively, the assisting operation may be stopped or limited based on a speed (that is, the vehicle speed) of the machine body.

[0177] As shown in FIG. **8**, the working machine **1** includes a vehicle-speed detector **86** configured to detect the vehicle speed of the machine body **2**. The vehicle-speed detector **86** is a device configured to respectively convert the traveling rotation speeds M**1** and M**2** of the output shafts **35**L and **35**R of the traveling motors **36**L and **36**R into the traveling vehicle speeds V**1** and V**2**. Although the vehicle-speed detector **86** is configured to convert the traveling rotation speeds M**1** and M**2** into the traveling vehicle speeds V**1** and V**2**, rotations of any portions driving the traveling devices **4**L and **4**R of the working machine **1**, such as rotations of axles, may be converted into the traveling vehicle speeds V**1** and V**2**. What is converted to the traveling vehicle speed is not limited thereto.

[0178] When the operation extent of the traveling operation member **54** is defined as the inputting state and the traveling vehicle speeds V**1** and V**2** detected by the vehicle-speed detector **86** are defined as the outputting state, the working controller **70** stops or limits the assisting operation when the traveling vehicle speeds V**1** and V**2** are lower than that corresponding to the operation extent of the traveling operation member **54**.

[0179] For example, as shown in FIG. **17**, when the traveling vehicle speeds V**1** and V**2** are gradually increased by operating the traveling operation member **54** is operated in the forward traveling operation direction, the working controller **70** continues the assisting operation. On the other hand, when the traveling vehicle speeds V**1** and V**2** scarcely rise (increase) as shown by a line L**8***a*, the working controller **70** stops the assisting operation.

[0180] As shown in FIG. **18**A, when the assisting operation is being performed (S**40**, Yes), the working controller **70** refers to the traveling vehicle speeds V**1** and V**2** detected by the vehicle-speed detector **86** (S**41**). In addition, the working controller **70** refers to either an operation extent of the traveling operation member **54** or the vehicle speed set based on the operation extent (S**42**). The working controller **70** judges whether both of the traveling vehicle speed V**1** and V**2** are each lower than that corresponding to the operation extent of the traveling operation member **54** by at least a predetermined value (S**43**). For example, as shown in FIG. **17**, when vehicle speed differences ΔV**1** and ΔV**2** between the set vehicle speed set based on the operation extent according to the line L**6** and the actual traveling vehicle speeds V**1** and V**2** detected by the vehicle-speed detector **86** is a predetermined value or more and both of the traveling vehicle speeds V**1** and V**2** are each lower than that corresponding to the operation extent by at least the predetermined value (S**43**, Yes), for example, when the traveling devices **4**L and **4**R are stopped or the traveling devices **4**L and **4**R run idle under the low traveling vehicle speeds V**1** and V**2**, the assisting operation is stopped or limited (S**44**). When the assisting operation is limited, the torque set by the powering torque setting unit **70***b* based on the standard line L**1** is reduced.

[0181] For example, an amount of torque reduction may be set based on a magnitude of the vehicle speed differences ΔV**1** and ΔV**2** (for example, the amount of torque reduction =the vehicle speed differences ΔV**1** and ΔV**2**×a constant).

[0182] In addition, the working controller **70** stops the assisting operation when both of the traveling vehicle speeds V**1** and V**2** are each higher than that corresponding to an operation extent of the traveling operation member **54**.

[0183] As shown in FIG. **17**, when the traveling vehicle speeds V**1** and V**2** given by operating the traveling operation member **54** in the forward-traveling operation direction are high as shown by the line L**8***b*, the working controller **70** stops or limits the assisting operation.

[0184] FIG. **18**B shows an operation performed when the traveling vehicle speeds V**1** and V**2** are each higher than that corresponding to an operation extent of the traveling operation member **54**. Steps S**41** to S**42** in FIG. **18**B are the same as those in FIG. **18**A. As shown in FIG. **18**B, the working controller **70** judges whether the traveling vehicle speeds V**1** and V**2** are each higher than that corresponding to the operation extent of the traveling operation member **54** by at least a predetermined value (S**45**). For example, as shown in FIG. **17**, when the rotation differences ΔM**1** and ΔM**2** between the set vehicle speeds corresponding to a predetermined operation extent and the actual traveling vehicle speeds V**1** and V**2** detected by the vehicle-speed detector **86** are each equal to or larger than the predetermined value and the traveling vehicle speeds V**1** and V**2** are each higher than that corresponding to the operation extent by at least the predetermined value (S**45**, Yes), for example, when the traveling vehicle speeds V**1** and V**2** are high and the traveling devices **4**L and **4**R are accelerating during descending a slope, the assisting operation is stopped or limited (S**46**). The method for limiting the assisting operation is the same as the method described above.

[0185] The powering torque setting unit **70***b* increases the powering torque when a load on the engine **60** is increasing, and reduces the powering torque when the load on the engine **60** is reducing. In other words, the powering torque setting unit **70***b* increases the powering torque when the engine revolving speed detected by the detection sensor **91** is reducing, and reduces the powering torque when the engine revolving speed is increasing.

[0186] In particular, as shown in FIG. **21**, when the engine revolving speed E**1** detected by the detection sensor **91** gradually reduces after a time point P**50** under the state where the working controller **70** (that is, the operation control unit **70***d*) is performing the assisting operation, the powering torque setting unit **70***b* gradually increases the powering torque from the time point P**50** as the engine revolving speed E**1** reduces. When the engine revolving speed E**1** begins to gradually

increase after a time point P**51**, the powering torque setting unit **70***b* gradually reduces the powering torque from the time point P**51** in accordance with the gradual reduction in the engine revolving speed E**1**. In other words, under the state where the assisting operation is being performed, the powering torque setting unit **70***b* increases the powering torque in a reducing section T**50** where the engine revolving speed E**1** is reducing, and the powering torque setting unit **70***b* reduces the powering torque in an increasing section T**51** where the engine revolving speed E**1** is increasing.
[0187] When the motor generator **63** is performing the assisting operation and the outputting condition relating to outputting from the traveling devices **4**L and **4**R deviates from that corresponding to the inputting condition relating to inputting to the traveling devices **4**L and **4**R, the controller (that is, the working controller **70** or the power controller **67**) stops or limits the assisting operation. According to this configuration, since the assisting operation by the motor generator **63** is not effective when the outputting condition of the traveling devices **4**L and **4**R deviates from that corresponding to the inputting condition of the traveling devices **4**L and **4**R, the unnecessary assisting operation is not performed, so that the assisting operation is performed only when the assistance is needed, thereby efficiently operating the motor generator.
[0188] The controller (that is, the working controller **70** or the power controller **67**) stops or limits the assisting operation when the rotation speeds of the traveling rotation speeds M**1** and M**2** are each lower than that corresponding to the operation extent of the traveling operation member **54**. According to this configuration, the assisting operation can be prevented from being wastefully performed. For example, an unnecessary assisting operation can be prevented when the machine body **2** or the like cannot travel forward or the traveling devices **4**L and **4**R slip wheels because the machine body **2** runs into earth or sand to fill its working tool with the earth or sand (in the scooping operation) to be conveyed.
[0189] The controller (that is, the working controller **70** or the power controller **67**) stops or limits the assisting operation when the rotation speeds of the traveling rotation speeds M**1** and M**2** are each higher than that corresponding to the operation extent of the traveling operation member **54**. According to this configuration, an unnecessary assist operation can be prevented when the vehicle is traveling downhill at the traveling rotation speeds M**1** and M**2** each of which is higher than that corresponding to the operation extent of the traveling operation member **54**.
[0190] The controller (that is, the working controller **70** or the power controller **67**) stops or limits the assisting operation when the traveling vehicle speeds V**1** and V**2** are each lower than that corresponding to an operation extent of the traveling operation member **54**. According to this configuration, an unnecessary assisting operation can be prevented in a case where the traveling devices **4**L and **4**R slip wheels, for example, in the scooping operation.
[0191] The controller (that is, the working controller **70**, the power controller **67**) stops or limits the assisting operation when the traveling vehicle speeds V**1** and V**2** are higher than that corresponding to an operation extent of the traveling operation member **54**. According to this configuration, the unnecessary assisting operation can be prevented in a case where the vehicle is traveling downhill.
[0192] The powering torque setting unit **70***b* reduces the powering torque when the outputting condition relating to outputting from the traveling devices **4**L and **4**R deviates from that corresponding to the inputting condition relating to inputting to the traveling devices **4**L and **4**R. Accordingly, consumption of electric power in the battery **66** can be suppressed in the assisting operation.
[0193] The working controller **70** may limit an output of the hydraulic driving device **64** and the assisting operation by, for example, setting an opening aperture of the anti-stall control valve **48** when the reduction amount (that is, a dropping amount) ΔE**1** of the engine revolving speed is a predetermined value or more. For example, the working controller **70** limits outputs of the traveling pumps **52**L and **52**R to limit the powering torque in the assisting operation.
[0194] The following description explains an operation in a case where the reduction amount ΔE**1**

of the engine revolving speed is a predetermined value or more. In the following explanation, the working controller **70** is used as an example, but the power controller **67** instead of the working controller **70** may perform the same operation of the working controller **70**.

[0195] As shown in FIG. **19**, when the assisting operation is being performed (S**50**, Yes), the working controller **70** monitors the reduction amount ΔE**1** of the engine revolving speed (S**51**). When the reduction amount ΔE**1** is the anti-stall judgment value or more (S**52**, Yes), an opening aperture of the anti-stall control valve **48** is set based on the setting line L**52** (S**53**). In addition, the working controller **70** judges whether or not a moving average value Dave of the reduction amount ΔE**1** is a judgment value W**1** or more (S**54**). As shown in FIG. **20**, when the moving average value Dave of the reduction amount ΔE**1** is the predetermined judgment value W**1** or more (S**54**, Yes), the working controller **70** reduces the torque to a new torque smaller than the powering torque set, based on the standard line L**1**, by the powering torque setting unit **70***b* (S**55**).

[0196] When the moving average value Dave of the reduction amount ΔE**1** is the judgment value W**1** or more for a predetermined period of time T**10** or more, the powering torque setting unit **70***b* may reduce the torque from the powering torque set, based on the standard line L**1**, by the powering torque setting unit **70***b*.

[0197] For example, it is assumed that the powering torque provided when the moving average value Dave of the reduction amount ΔE**1** is less than the judgment value W**1** is set to a torque "J**1**." On the assumption, the powering torque setting unit **70***b* of the working controller **70** may reduce the powering torque J**1** to a new powering torque J**2** less than the powering torque J**1** (J**2**<J**1**) when the moving average value Dave of the reduction amount ΔE**1** is the judgment value W**1** or more. In other words, the powering torque setting unit **70***b* reduces the powering torque to a new torque smaller than the powering torque corresponding to the standard line L**1** during a period T**1** where the moving average value Dave of the reduction amount ΔE**1** is the judgment value W**1** or more. For example, as shown in FIG. **9**, the powering torque setting unit **70***b* sets the powering torque as the powering torque J**2** based on a line L**15** rather than the powering torque J**1** based on the constant line L**1***b*.

[0198] The slope of the line L**15**, that is, the reduction amount of the powering torque may be set to a predetermined value, or the reduction amount may be set based on the dropping amount ΔE, that is, the moving average value Dave.

[0199] In addition, when the moving average value Dave is the judgment value W**1** or more, the working controller **70** may make the primary traveling pressure smaller than the pressure on a setting line L**52** at a predetermined engine revolving speed. That is, the difference (referred to as a reducing pressure) between the pressure set based on the setting line L**52** and the reference pilot pressure set based on the setting line L**51** may be increased. That is, as shown in FIG. **7**, when the moving average value Dave is the judgment value W**1** or more, the working controller **70** increases a difference between the setting line L**52** and the setting line L**51** by changing the setting line L**52** to a setting line L**52***a* having a slope different from that of the setting line L**52** or by moving the setting line L**52** to a setting line L**52***b* parallel to the setting line L**52**.

[0200] In the above-mentioned embodiment, the powering torque is reduced based on the moving average value Dave of the reduction amount ΔE**1**; however alternatively, the transition (an attenuating rate) of the reduction amount ΔE**1** of the engine revolving speed may be obtained through a low-pass filter, and thus the powering torque may be reduced when the attenuating rate is the judgment value W**1** or more. Also in this case, the method for reducing the powering torque is the same as the method described above.

[0201] In the above-mentioned embodiment, the opening aperture of the anti-stall control valve **48** is adjusted when the reduction amount ΔE**1** of the engine revolving speed becomes a predetermined value more; however, in the working machine **1** that is not provided with the anti-stall control valve **48**, the traveling motors **36**L and **36**R may be decelerated from the second speed to the first speed when the reduction amount ΔE**1** is the anti-stall judgment value or more (S**52**, Yes).

[0202] The controller (that is, the working controller **70** or the power controller **67**) limits the output of the hydraulic driving device **64** and limits the assisting operation when the reduction amount ΔE**1** of the engine revolving speed is a predetermined value or more. Accordingly, not only the output of the hydraulic driving device **64** is limited based on the state of the engine **60**, but also the assisting operation is limited. For example, in an overload state where the reduction amount ΔE**1** of the engine revolving speed is a predetermined value or more, the overload on the engine **60** can be reduced by limiting the output of the hydraulic driving device **64**, while the reduction in the storing capacity of the battery **66** can be suppressed by limiting the assisting operation.

[0203] The controller (that is, the working controller **70** or the power controller **67**) limits the outputs of the traveling pumps **52**L and **52**R and limits the powering torque in the assisting operation.

[0204] According to this configuration, the reduction of the storing capacity of the battery **66** can be suppressed by limiting the powering torque under a state where the outputs of the traveling pumps **52**L and **52**R is reduced.

[0205] The controller (that is, the working controller **70** or the power controller **67**) limits the primary traveling pressure output from the traveling operation valve **55** when the reduction amount ΔE**1** of the engine revolving speed is a predetermined value or more. The controller (that is, the working controller **70** or the electric power controller **67**) makes the primary traveling pressure (referred to as the primary pilot pressure) of the anti-stall control valve **48** smaller than the predetermined reference pilot pressure when the reduction amount ΔE**1** of the engine revolving speed is the predetermined value or more. According to this configuration, the stalling of the engine **60** can be efficiently prevented by limiting the primary traveling pressure output from the traveling operation valve **55**.

[0206] The controller (that is, the working controller **70** or the power controller **67**) sets the reducing pressure, which is the difference between the primary traveling pressure and the reference pilot pressure, based on the reduction amount ΔE**1** of the engine revolving speed. According to this configuration, the load on the engine **60** can be reduced.

[0207] The powering torque setting unit **70***b* reduces the powering torque based on the reduction amount ΔE**1** of the engine revolving speed. According to this configuration, the powering torque can be adjusted according to the load on the engine **60**.

[0208] In the above-described embodiment, the operation valves **55** and **59** are configured to change the pilot pressure when the working operation member **37** and the traveling operation member **57** are operated; however, the operation members may be electrically operable members. That is, the operating devices **43** and **53** may be devices configured to operate the hydraulic driving device **64**, and the control valves **51** and **48** with electric signals.

[0209] While preferred embodiments of the present invention have been described above, it is to be understood that variations and modifications will be apparent to those skilled in the art without departing from the scope and spirit of the present invention. The scope of the present invention, therefore, is to be determined solely by the following claims.

Claims

1. A working machine comprising: a machine body; an engine provided on the machine body; a motor generator to be operated as a motor to assist driving of the engine in an assisting operation, and to be operated as a generator by power of the engine to generate electricity in a generating operation; a battery to store the electricity generated by the motor generator; a cooling device to cool the battery with power transmitted from the engine; a hydraulic driving device to which powers of the engine and the motor generator are transmitted; a working device to be operated by power of the hydraulic driving device; and a traveling device to be operated by the power of the hydraulic driving device, wherein the cooling device stops based on an operating state of either one of the hydraulic diving device, the working device, and the traveling device.

2. The working machine according to claim 1, comprising: a load detector to detect a load of either one of the hydraulic diving device, the working device, and the traveling device, wherein the cooling device stops when the load detected by the load detector is a predetermined load or more.

3. The working machine according to claim 1, comprising: an operation member to operate either one of the working device and the traveling device, wherein the cooling device stops when an operation extent of the operation member is a predetermined extent or more.

4. The working machine according to claim 1, comprising a temperature detector to detect temperature of the battery, wherein the cooling device does not stop when the temperature detected by the temperature detector is a predetermined temperature or more.

5. The working machine according to claim 1 wherein the cooling device includes: an evaporator through which coolant to cool the battery flows; and a compressor to compress the coolant that has flown through the evaporator, and the compressor stops based on the operating state.

6. The working machine according to claim 1, wherein the hydraulic driving device includes a hydraulic pump, and the working device includes: a boom swingably provided on the machine body; and a boom cylinder to be operated by hydraulic fluid delivered from the hydraulic pump to swing the boom.