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Electric working machine

Abstract

An electric working machine may include: an electrical component; a first space in which the electrical component is disposed; a partition wall separating the first space from a second space different from the first space, the partition wall including a first communication opening communicating the first space and the second space; and a first one-way valve disposed at the first communication opening.

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Background/Summary

REFERENCE TO RELATED APPLICATIONS

(1) This application claims priority to Japanese Patent Application No. 2022-026616, filed on Feb. 24, 2022, the entire contents of which are hereby incorporated by reference into the present application.

TECHNICAL FIELD

(2) The disclosure herein relates to an electric working machine.

(3) US Patent Application Publication No. 2012/66916 describes an electric working machine. The electric working machine includes an electrical component, a first space in which the electrical component is disposed, and a partition wall separating the first space from a second space different from the first space and including a first communication opening communicating the first space and the second space.

Description

DESCRIPTION

- (1) In the electric working machine above, when liquid is in the first space, the liquid can be discharged from the first space to the second space through the first communication opening. However, when liquid is in the second space, the liquid may enter the first space from the second space through the first communication opening and contact the electrical component. The disclosure herein provides a technology that allows discharge of liquid from a first space to a second space and suppresses entry of liquid into the first space from the second space.
- (2) An electric working machine disclosed herein may comprise an electrical component; a first space in which the electrical component is disposed; a partition wall separating the first space from a second space different from the first space, the partition wall including a first communication opening communicating the first space and the second space; and a first one-way valve disposed at the first communication opening.
- (3) According to the configuration above, when liquid is in the first space, opening the first one-way valve allows the liquid to be discharged from the first space to the second space through the first one-way valve. Further, when liquid is in the second space, closing the first one-way valve suppresses entry of the liquid into the first space from the second space through the first one-way valve.
- (4) FIG. 1 is a perspective view of an electric working machine 2 according to an embodiment, as viewed from the right front side.
- (5) FIG. 2 is a perspective view of the electric working machine 2 according to the embodiment, as viewed from the left rear side.
- (6) FIG. 3 is a cross-sectional view of the electric working machine 2 according to the embodiment.
- (7) FIG. 4 is a cross-sectional view of the electric working machine 2 according to the embodiment in the vicinity of a sprocket 54.
- (8) FIG. 5 is an exploded perspective view of a lower portion of a right wall 22e of a body housing 22 near a rear end thereof in the electric working machine 2 according to the embodiment.
- (9) FIG. 6 is an exploded perspective view of a lower portion of a left wall 22d of the body housing 22 near a rear end thereof in the electric working machine 2 according to the embodiment.
- (10) FIG. 7 is a cross-sectional view of the electric working machine 2 according to the embodiment in the vicinity of a one-way valve 90, where a communication opening 78 is open.
- (11) FIG. 8 is a cross-sectional view of the electric working machine 2 according to the embodiment in the vicinity of the one-way valve 90, where the communication opening 78 is closed.
- (12) FIG. 9 is a cross-sectional view of the electric working machine 2 according to the embodiment in a first orientation.
- (13) FIG. 10 is a cross-sectional view of the electric working machine 2 according to the embodiment in a second orientation.
- (14) Representative, non-limiting examples of the present disclosure will now be described in further detail with reference to the attached drawings. This detailed description is merely intended to teach a person of skill in the art further details for practicing preferred aspects of the present

teachings and is not intended to limit the scope of the present disclosure. Furthermore, each of the additional features and teachings disclosed below may be utilized separately or in conjunction with other features and teachings to provide improved electric working machines, as well as methods for using and manufacturing the same.

(15) Moreover, combinations of features and steps disclosed in the following detailed description may not be necessary to practice the present disclosure in the broadest sense, and are instead taught merely to particularly describe representative examples of the present disclosure. Furthermore, various features of the above-described and below-described representative examples, as well as the various independent and dependent claims, may be combined in ways that are not specifically and explicitly enumerated in order to provide additional useful embodiments of the present teachings.

(16) All features disclosed in the description and/or the claims are intended to be disclosed separately and independently from each other for the purpose of original written disclosure, as well as for the purpose of restricting the claimed subject matter, independent of the compositions of the features in the embodiments and/or the claims. In addition, all value ranges or indications of groups of entities are intended to disclose every possible intermediate value or intermediate entity for the purpose of original written disclosure, as well as for the purpose of restricting the claimed subject matter.

(17) In one or more embodiments, the first one-way valve may be configured to open and close according to an orientation of the electric working machine.

(18) According to the configuration above, liquid can be discharged from the first space to the second space and entry of liquid into the first space from the second space can be suppressed simply by changing the orientation of the electric working machine.

(19) In one or more embodiments, the partition wall may separate the first space from a third space different from the first space. The partition wall may further include a second communication opening communicating the first space and the third space. The electric working machine may further comprise a second one-way valve disposed at the second communication opening and configured to open and close according to the orientation of the electric working machine. When the electric working machine is in a first orientation, the first one-way valve may be open and the second one-way valve may be closed. When the electric working machine is in a second orientation, the first one-way valve may be closed and the second one-way valve may be open.

(20) According to the configuration above, when the electric working machine is in the first orientation, liquid can be discharged from the first space to the second space through the first one-way valve and entry of liquid into the first space from the third space through the second one-way valve can be suppressed. Further, when the electric working machine is in the second orientation, liquid can be discharged from the first space to the third space through the second one-way valve and entry of liquid into the first space from the second space through the first one-way valve can be suppressed.

(21) In one or more embodiments, when the electric working machine is in the first orientation, the first one-way valve may be positioned below the second one-way valve in a direction of gravity. When the electric working machine is in the second orientation, the second one-way valve may be positioned below the first one-way valve in the direction of gravity.

(22) According to the configuration above, liquid within the first space can be concentrated to near the first one-way valve when the electric working machine is in the first orientation. The liquid can thus be discharged from the first space to the second space through the first one-way valve. Further, the liquid within the first space can be concentrated to near the second one-way valve when the electric working machine is in the second orientation. The liquid can thus be discharged from the first space to the third space through the second one-way valve.

(23) In one or more embodiments, the second space and the third space may be the same.

(24) According to the configuration above, liquid in the first space can be discharged to a single

space.

(25) In one or more embodiments, the electric working machine may further comprise a handle configured to be gripped by a user during use.

(26) According to the configuration above, the user can easily change the orientation of the electric working machine by gripping the handle.

(27) In one or more embodiments, the first one-way valve may be configured to open and close by gravity.

(28) According to the configuration above, a pressure required to open and close the first one-way valve can be reduced, as compared with one-way valves configured to open and close by means other than gravity, such as a duckbill one-way valve, an umbrella one-way valve, etc. Since opening and closing of the first one-way valve is facilitated, discharge of liquid from the first space to the second space is facilitated.

(29) In one or more embodiments, the electrical component may comprise an electrical connection member configured to electrically connect to a power supply source. When the electric working machine is in the first orientation, the first communication opening may be positioned below the electrical connection member in the direction of gravity.

(30) According to the configuration above, when the electric working machine is in the first orientation, the electrical connection member can be suppressed from submerging in liquid and the liquid can be discharged from the first space to the second space.

(31) In one or more embodiments, the electric working machine may further comprise a working unit. The electrical component may comprise a control unit configured to control operation of the working unit. When the electric working machine is in the first orientation, the first communication opening may be positioned below the control unit in the direction of gravity.

(32) According to the configuration above, when the electric working machine is in the first orientation, the control unit can be suppressed from submerging in liquid and the liquid can be discharged from the first space to the second space.

(33) In one or more embodiments, the partition wall may further include an air opening through which air flows into the first space. An opening area of the first communication opening may be smaller than an opening area of the air opening.

(34) According to the configuration above, liquid can be discharged from the first space to the second space and entry of liquid into the first space from the second space can be suppressed, as well as a sufficient amount of air can flow into the first space through the air opening.

(35) In one or more embodiments, the second space may be an outer space external to the electric working machine.

(36) According to the configuration above, liquid in the first space can be discharged to the outside of the electric working machine.

EMBODIMENTS

(37) As illustrated in FIG. 1, an electric working machine 2 is, for example, a handheld chainsaw. The electric working machine 2 includes a body 4, a guide bar 6, and a saw chain 8. The guide bar 6 has an elongated plate shape. The guide bar 6 is attached to the body 4 to project from the body 4. The saw chain 8 includes a plurality of cutters connected to each other. The saw chain 8 is attached to the guide bar 6 along its periphery. A battery pack B (see FIG. 2) is attached to the body 4. The electric working machine 2 rotates the saw chain 8 along the periphery of the guide bar 6 using electrical power supplied from the battery pack B to cut objects such as wood, etc. In the following description, when the electric working machine 2 is placed on a plane P such as the ground as illustrated in FIG. 3, a direction perpendicular to the plane P is termed an up-down direction, a direction defined by projecting a longitudinal direction of the guide bar 6 onto the plane P is termed a front-rear direction, and a direction perpendicular to the up-down direction and the front-rear direction is termed a right-left direction.

(38) As illustrated in FIGS. 1 and 2, the body 4 includes a left housing 10, a right housing 12, a

front handle **14**, a side cover **16**, and a battery cover **18**. The left housing **10** and the right housing **12** configure a body housing **22** and a rear handle **24**. The left housing **10** defines outer shapes of left halves of the body housing **22** and the rear handle **24**, while the right housing **12** defines outer shapes of right halves of the body housing **22** and the rear handle **24**. The body housing **22** includes a front wall **22a**, an upper wall **22b**, a lower wall **22c**, a left wall **22d**, a right wall **22e**, and a rear wall **22f**. In the following description, the front wall **22a**, the upper wall **22b**, the lower wall **22c**, the left wall **22d**, the right wall **22e**, and the rear wall **22f** of the body housing **22** may be termed a partition wall **23**.

(39) As illustrated in FIG. 2, the rear handle **24** is connected to the rear wall **22f** of the body housing **22**. A main power switch **25** is disposed near the connection of the rear wall **22f** of the body housing **22** to the rear handle **24**. The main power switch **25** is switchable between an on-state and an off-state in response to operation by a user. A trigger **26** that is manipulatable by the user is disposed at the rear handle **24**. When the trigger **26** is pushed in with the main power switch **25** being in the on-state, the saw chain **8** is rotated along the periphery of the guide bar **6**. To the contrary, the saw chain **8** is not rotated along the periphery of the guide bar **6** even when the trigger **26** is pushed in with the main power switch **25** being in the off-state.

(40) The front handle **14** extends upward from a lower front portion of the left wall **22d** of the body housing **22**, bends and extends rightward, further bends and extends downward, and then connects to the right wall **22e** (see FIG. 1) of the body housing **22**. The user can change the orientation of the electric working machine **2** by gripping the front handle **14** with one of his/her hands and gripping the rear handle **24** with the other hand.

(41) The side cover **16** is detachably attached to a front portion of the right wall **22e** of the body housing **22**. A cover space **28** (see FIG. 4) is defined between the side cover **16** and the front portion of the right wall **22e** of the body housing **22**.

(42) The battery cover **18** is pivotably attached to a rear portion of the upper wall **22b** of the body housing **22**. The battery cover **18** opens and closes a battery opening **30** defined in the upper wall **22b** of the body housing **22**. The battery opening **30** is defined in both an upper wall of the left housing **10** and an upper wall of the right housing **12**. As illustrated in FIG. 1, the battery cover **18** closes the battery opening **30** while the user is using the electric working machine **2**. As illustrated in FIG. 2, when an open knob **32** of the battery cover **18** is pushed by the user, the battery cover **18** pivots to open the battery opening **30**. While the battery opening **30** is open, the user can remove the battery pack **B** from the body **4** or attach the battery pack **B** to the body **4**.

(43) As illustrated in FIG. 3, the body **4** defines an internal space **36** therein. FIG. 3 omits the depiction of the guide bar **6** and the saw chain **8**. The internal space **36** includes a main internal space **38** and a secondary internal space **40**. The main internal space **38** is defined by the partition wall **23** of the body housing **22** and the rear handle **24**. The main internal space **38** communicates with an outer space **46** external to the body **4** through a front air opening **42** and a left air opening **44** (see FIG. 2). As illustrated in FIG. 1, the front air opening **42** is defined in the front wall **22a** of the body housing **22**. The front air opening **42** is an elongated opening having a longitudinal direction in the up-down direction. As illustrated in FIG. 2, the left air opening **44** is defined in the left wall **22d** of the body housing **22**. The left air opening **44** is disposed around the connection of the left wall **22d** of the body housing **22** to the front handle **14**. The left air opening **44** is an elongated opening. As illustrated in FIG. 4, the right wall **22e** of the body housing **22** separates the main internal space **38** from the cover space **28**.

(44) As illustrated in FIG. 3, the secondary internal space **40** is defined by the body housing **22** and the battery cover **18**. The body housing **22** includes an inner wall **48** and the inner wall **48** separates the main internal space **38** from the secondary internal space **40**. The secondary internal space **40** communicates with the main internal space **38** through an opening **48a** defined in the inner wall **48**.

(45) As illustrated in FIGS. 3 and 4, the electric working machine **2** includes a motor **52**, a sprocket **54**, a control unit **56**, a battery attachment unit **58**, and a trigger switch **60**. In the following

description, the motor **52**, the control unit **56**, the battery attachment unit **58**, and the trigger switch **60** may be termed electrical components **62**.

(46) As illustrated in FIG. 3, the motor **52** is disposed in the main internal space **38**. The motor **52** is, for example, a brushless motor. A cooling fan (not illustrated) is fixed to the motor **52**. The motor **52** operates with electrical power from the battery pack B (see FIG. 2). When the motor **52** operates, the cooling fan is thereby rotated, causing air in the outer space **46** to flow into the main internal space **38** through the left air opening **44** (see FIG. 2). This air flows through the main internal space **38** and then flows out from the main internal space **38** to the outer space **46** through the front air opening **42**. In this way, the motor **52** is cooled. A shaft **64** of the motor **52** extends in the right-left direction. As illustrated in FIG. 4, a right end of the shaft **64** is in the cover space **28**.

(47) The sprocket **54** is fixed to the right end of the shaft **64**. The saw chain **8** (see FIG. 1) is hung over the sprocket **54** from the guide bar **6**. When the motor **52** operates, the sprocket **54** rotates with the shaft **64**. Thus, the saw chain **8** is rotated along the periphery of the guide bar **6**.

(48) As illustrated in FIG. 3, the control unit **56** is disposed in the main internal space **38**. The control unit **56** is disposed closer to the upper wall **22b** of the body housing **22** than the motor **52** and the sprocket **54** (see FIG. 4) are. The control unit **56** is electrically connected to the motor **52**. The control unit **56** controls operation of the motor **52**. The control unit **56** is cooled by air flowing into the main internal space **38** in association with the operation of the motor **52** (rotation of the cooling fan).

(49) The battery attachment unit **58** is disposed in the secondary internal space **40**. The battery attachment unit **58** is disposed closer to the rear wall **22f** of the body housing **22** than the motor **52**, the sprocket **54** (see FIG. 4), and the control unit **56** are. Further, the battery attachment unit **58** is disposed closer to the lower wall **22c** of the body housing **22** than the control unit **56** is. When the battery pack B (see FIG. 2) is attached to the body **4** in the secondary internal space **40**, the battery attachment unit **58** is electrically connected to the battery pack B via a battery attachment terminal **66** of the battery attachment unit **58**. Further, the battery attachment unit **58** is electrically connected to the control unit **56**.

(50) The trigger switch **60** is disposed in the main internal space **38**. The trigger switch **60** is disposed closer to the rear wall **22f** of the body housing **22** than the battery attachment unit **58** is. Further, the trigger switch **60** is disposed closer to the lower wall **22c** of the body housing **22** than the control unit **56** is. The trigger switch **60** is electrically connected to the control unit **56**. When the trigger **26** is pushed in, the trigger switch **60** is pushed in by the trigger **26**. When the trigger switch **60** is pushed in, the control unit **56** detects the push-in of the trigger **26**.

(51) As illustrated in FIGS. 5 and 6, a first front communication opening **70** and a first rear communication opening **72** are defined in a lower portion of the right wall **22e** of the body housing **22** near its rear end, while a second front communication opening **74** and a second rear communication opening **76** are defined in a lower portion of the left wall **22d** of the body housing **22** near its rear end. The first front communication opening **70**, the first rear communication opening **72**, the second front communication opening **74**, and the second rear communication opening **76** are openings for discharging water in the internal space **36** (see FIG. 3) to the outer space **46**. Opening areas of the first front communication opening **70**, the first rear communication opening **72**, the second front communication opening **74**, and the second rear communication opening **76** are each smaller than each of an opening area of the front air opening **42** (see FIG. 1) and an opening area of the left air opening **44** (see FIG. 2). Further, diameters of the first front communication opening **70**, the first rear communication opening **72**, the second front communication opening **74**, and the second rear communication opening **76** are each, for example, in a range from 0.5 mm to 15 mm. The first front communication opening **70**, the first rear communication opening **72**, the second front communication opening **74**, and the second rear communication opening **76** have the same configuration. Thus, in the following description, the first front communication opening **70**, the first rear communication opening **72**, the second front

communication opening **74**, and the second rear communication opening **76** may simply be termed communication openings **78**.

(52) As illustrated in FIG. 5, the first front communication opening **70** and the first rear communication opening **72** are defined near a connection of the right wall **22e** to the lower wall **22c** of the body housing **22**. The connection of the right wall **22e** to the lower wall **22c** of the body housing **22** corresponds to a corner of the body housing **22**. As illustrated in FIG. 3, the first front communication opening **70** is positioned closer to the front wall **22a** of the body housing **22** than the first rear communication opening **72** is. The position of the first front communication opening **70** in the front-rear direction is substantially coincident with the position of the battery attachment unit **58** in the front-rear direction. The first front communication opening **70** and the first rear communication opening **72** are positioned closer to the lower wall **22c** of the body housing **22** than the electrical components **62** are. The first rear communication opening **72** is positioned closer to the rear wall **22f** of the body housing **22** than the battery attachment unit **58** is.

(53) As illustrated in FIG. 6, the second front communication opening **74** and the second rear communication opening **76** are defined near a connection of the left wall **22d** to the lower wall **22c** of the body housing **22**. The connection of the left wall **22d** to the lower wall **22c** of the body housing **22** corresponds to a corner of the body housing **22**. The second front communication opening **74** is positioned closer to the front wall **22a** (see FIG. 3) of the body housing **22** than the second rear communication opening **76** is. The second front communication opening **74** faces the first front communication opening **70** in the right-left direction and the second rear communication opening **76** faces the first rear communication opening **72** in the right-left direction, although this is not illustrated. Thus, the position of the second front communication opening **74** in the front-rear direction is substantially coincident with the position of the battery attachment unit **58** in the front-rear direction, the second front communication opening **74** and the second rear communication opening **76** are positioned closer to the lower wall **22c** (see FIG. 3) of the body housing **22** than the electrical components **62** (see FIG. 3) are, and the second rear communication opening **76** is positioned closer to the rear wall **22f** of the body housing **22** than the battery attachment unit **58** (see FIG. 3) is.

(54) As illustrated in FIGS. 5 and 6, the electric working machine **2** further includes a first front one-way valve **80**, a first rear one-way valve **82**, a second front one-way valve **84**, and a second rear one-way valve **86**. As illustrated in FIG. 5, the first front one-way valve **80** is disposed at the first front communication opening **70**. The first front one-way valve **80** is fixed to the right wall **22e** of the body housing **22**. The first rear one-way valve **82** is disposed at the first rear communication opening **72**. The first rear one-way valve **82** is fixed to the right wall **22e** of the body housing **22**. As illustrated in FIG. 6, the second front one-way valve **84** is disposed at the second front communication opening **74**. The second front one-way valve **84** is fixed to the left wall **22d** of the body housing **22**. The second rear one-way valve **86** is disposed at the second rear communication opening **76**. The second rear one-way valve **86** is fixed to the left wall **22d** of the body housing **22**.

(55) The first front one-way valve **80**, the first rear one-way valve **82**, the second front one-way valve **84**, and the second rear one-way valve **86** illustrated in FIGS. 5 and 6 have the same configuration. Thus, in the following description, the first front one-way valve **80**, the first rear one-way valve **82**, the second front one-way valve **84**, and the second rear one-way valve **86** may simply be termed one-way valves **90**.

(56) The one-way valves **90** are ball one-way valves. Each one-way valve **90** includes a fixation portion **92**, a connection portion **94**, and a valve portion **96**. The fixation portion **92** has a screw hole **92a** penetrating the fixation portion **92** in a thickness direction (in the right-left direction in FIGS. 5 and 6). The screw hole **92a** allows a screw **98** to be inserted therein. The screw **98** is inserted in the screw hole **92a** and then the screw **98** is screwed into the housing **22**, as a result of which the one-way valve **90** is fixed to the body housing **22**.

(57) The valve portion **96** is connected to the fixation portion **92** via the connection portion **94**. The valve portion **96** includes a base portion **100**, a sealing portion **102**, and a ball portion **104** (see FIG. 7).

(58) The base portion **100** has a substantially cylindrical shape. A stopper **106** is formed at one end of the base portion **100**. The stopper **106** closes a part of an opening of the base portion **100** at the one end. The stopper **106** prohibits the ball portion **104** from moving from the inside of the base portion **100** to the outside of the base portion **100**, while permitting water to move from the inside of the base portion **100** to the outside of the base portion **100**. As illustrated in FIG. 7, the base portion **100** is disposed at a communication opening **78**. The other end of the base portion **100** is in contact with the body housing **22**.

(59) The sealing portion **102** is disposed at the communication opening **78**. The sealing portion **102** is interposed between the base portion **100** and the body housing **22**. The sealing portion **102** is constituted, for example, of an elastic material. The sealing portion **102** has an annular shape and, in the present embodiment, is an O-ring.

(60) The ball portion **104** is disposed within the base portion **100**. The ball portion **104** is movable between the stopper **106** and the sealing portion **102**. For example, the ball portion **104** moves between the stopper **106** and the sealing portion **102** according to the orientation of the electric working machine **2**. Further, the ball portion **104** moves in the direction of gravity by gravity acting on the ball portion **104**. When the ball portion **104** is in contact with the sealing portion **102** as illustrated in FIG. 8, the one-way valve **90** is closed and thus the communication opening **78** is closed. Thus, the communication between the main internal space **38** and the outer space **46** is blocked. In this instance, water cannot enter the internal space **36** from the outer space **46** through the one-way valve **90** and the communication opening **78**. When the ball portion **104** is not in contact with the sealing portion **102** as illustrated in FIG. 7, for example, when the ball portion **104** is in contact with the stopper **106**, the one-way valve **90** is open and thus the communication opening **78** is open. Thus, the main internal space **38** is in communication with the outer space **46** through the communication opening **78**. In this instance, water within the internal space **36** can be discharged to the outer space **46** through the communication opening **78** and the one-way valve **90**.

(61) Next, orientations the electric working machine **2** can assume when cutting an object will be described. The electric working machine **2** illustrated in FIG. 1 is often used to cut wood. Since trees extend vertically upward from the ground, the electric working machine **2** is used not in the placement orientation illustrated in FIG. 3 (in the orientation where the lower wall **22c** of the body housing **22** faces the plane P) but in a first orientation or a second orientation most of the time. When the electric working machine **2** is in the first orientation as illustrated in FIG. 9, the right wall **22e** of the body housing **22** is oriented downward (in the direction of gravity), the left wall **22d** of the body housing **22** is oriented upward, the lower wall **22c** of the body housing **22** is oriented leftward, the upper wall **22b** of the body housing **22** is oriented rightward, the front wall **22a** (see FIG. 1) of the body housing **22** is oriented forward, and the rear wall **22f** (see FIG. 2) of the body housing **22** is oriented rearward. When the electric working machine **2** is in the second orientation as illustrated in FIG. 10, the left wall **22d** of the body housing **22** is oriented downward (in the direction of gravity), the right wall **22e** of the body housing **22** is oriented upward, the upper wall **22b** of the body housing **22** is oriented leftward, the lower wall **22c** of the body housing **22** is oriented rightward, the front wall **22a** of the body housing **22** is oriented forward, and the rear wall **22f** of the body housing **22** is oriented rearward. The second orientation is opposite to the first orientation.

(62) In FIGS. 9 and 10, the positions of the first front one-way valve **80** and the second front one-way valve **84** are indicated with dashed lines, and the positions of the motor **52**, the control unit **56**, and the battery attachment terminal **66** are indicated with dashed-dotted lines.

(63) As illustrated in FIG. 9, when the electric working machine **2** is in the first orientation, the first rear one-way valve **82** is positioned below the second rear one-way valve **86** and the first front one-

way valve **80** is positioned below the second front one-way valve **84**. The first front one-way valve **80** and the first rear one-way valve **82** are positioned below the motor **52**, the control unit **56**, the trigger switch **60**, and the battery attachment terminal **66**. The second front one-way valve **84** and the second rear one-way valve **86** are positioned above a lower half of the control unit **56**, the trigger switch **60**, and the battery attachment terminal **66**.

(64) As illustrated in FIG. 7, when the electric working machine **2** is in the first orientation, the ball portions **104** are in contact with the stoppers **106** in the first front one-way valve **80** and the first rear one-way valve **82**. Since the first front one-way valve **80** and the first rear one-way valve **82** are open, the internal space **36** is in communication with the outer space **46** through the first front communication opening **70** and the first rear communication opening **72**. Further, as illustrated in FIG. 8, the ball portions **104** are in contact with the sealing portions **102** in the second front one-way valve **84** and the second rear one-way valve **86**. Since the second front one-way valve **84** and the second rear one-way valve **86** are closed, the internal space **36** is not in communication with the outer space **46** through the second front communication opening **74** and the second rear communication opening **76**.

(65) When the electric working machine **2** is used in the first orientation, as illustrated in FIG. 9, to cut a tree outdoors during rain, rainwater enters the internal space **36** from the outer space **46** through the front air opening **42** (see FIG. 1) and the left air opening **44**. The rainwater concentrates to the right wall **22e** of the body housing **22**, for example, to the corner which is the connection of the right wall **22e** to the lower wall **22c** of the body housing **22**, by gravity. Since the first front one-way valve **80** and the first rear one-way valve **82** are open, the rainwater that has concentrated to the corner is discharged from the internal space **36** to the outer space **46** through the first front communication opening **70** and the first rear communication opening **72**. Further, since the second front one-way valve **84** and the second rear one-way valve **86** are closed, rainwater does not enter the internal space **36** from the outer space **46** through the second front communication opening **74** and the second rear communication opening **76**. Thus, the control unit **56**, the trigger switch **60**, and the battery attachment terminal **66** are suppressed from contacting rainwater.

(66) As illustrated in FIG. 10, when the electric working machine **2** is in the second orientation, the second rear one-way valve **86** is positioned below the first rear one-way valve **82** and the second front one-way valve **84** is positioned below the first front one-way valve **80**. The second front one-way valve **84** and the second rear one-way valve **86** are positioned below an upper half of the control unit **56**, the trigger switch **60**, and the battery attachment terminal **66**. The first front one-way valve **80** and the first rear one-way valve **82** are positioned above the control unit **56**, the trigger switch **60**, and the battery attachment terminal **66**.

(67) As illustrated in FIG. 7, when the electric working machine **2** is in the second orientation, the ball portions **104** are in contact with the stoppers **106** in the second front one-way valve **84** and the second rear one-way valve **86**. Since the second front one-way valve **84** and the second rear one-way valve **86** are open, the internal space **36** is in communication with the outer space **46** through the second front communication opening **74** and the second rear communication opening **76**.

Further, as illustrated in FIG. 8, the ball portions **104** are in contact with the sealing portions **102** in the first front one-way valve **80** and the first rear one-way valve **82**. Since the first front one-way valve **80** and the first rear one-way valve **82** are closed, the internal space **36** is not in communication with the outer space **46** through the first front communication opening **70** and the first rear communication opening **72**.

(68) When the electric working machine **2** is used in the second orientation, as illustrated in FIG. 10, to cut a tree outdoors during rain, rainwater enters the internal space **36** from the outer space **46** through the front air opening **42** (see FIG. 1). The rainwater concentrates to the left wall **22d** of the body housing **22**, for example, to the corner which is the connection of the left wall **22d** to the lower wall **22c** of the body housing **22**. Since the second front one-way valve **84** and the second

rear one-way valve **86** are open, the rainwater that has concentrated to the corner is discharged from the internal space **36** to the outer space **46** through the second front communication opening **74** and the second rear communication opening **76**. Further, since the first front one-way valve **80** and the first rear one-way valve **82** are closed, rainwater does not enter the internal space **36** from the outer space **46** through the first front communication opening **70** and the first rear communication opening **72**. Thus, the motor **52**, the control unit **56**, the trigger switch **60**, and the battery attachment terminal **66** are suppressed from contacting rainwater.

(69) (Effects)

(70) The electric working machine **2** according to the present embodiment includes the electrical components **62**; the internal space **36** (an example of first space) in which the electrical components **62** are disposed; the partition wall **23** separating the internal space **36** from the outer space **46** (an example of second space) different from the internal space **36** and including the first front communication opening **70** (an example of first communication opening) communicating the internal space **36** and the outer space **46**; and the first front one-way valve **80** (an example of first one-way valve) disposed at the first front communication opening **70**.

(71) According to the configuration above, when liquid is in the internal space **36**, opening the first front one-way valve **80** allows the liquid to be discharged from the internal space **36** to the outer space **46** through the first front one-way valve **80**. Further, when liquid is in the outer space **46**, closing the first front one-way valve **80** suppresses entry of the liquid into the internal space **36** from the outer space **46** through the first front one-way valve **80**.

(72) Further, the first front one-way valve **80** opens and closes according to the orientation of the electric working machine **2**.

(73) According to the configuration above, liquid can be discharged from the internal space **36** to the outer space **46** and entry of liquid into the internal space **36** from the outer space **46** can be suppressed simply by changing the orientation of the electric working machine **2**.

(74) Further, the partition wall **23** separates the internal space **36** from the outer space **46** (an example of third space) different from the internal space **36**. The partition wall **23** further includes the second front communication opening **74** (an example of second communication opening) communicating the internal space **36** and the outer space **46**. The electric working machine **2** further includes the second front one-way valve **84** (an example of second one-way valve) disposed at the second front communication opening **74** and configured to open and close according to the orientation of the electric working machine **2**. When the electric working machine **2** is in the first orientation, the first front one-way valve **80** is open and the second front one-way valve **84** is closed. When the electric working machine **2** is in the second orientation, the first front one-way valve **80** is closed and the second front one-way valve **84** is open.

(75) According to the configuration above, when the electric working machine **2** is in the first orientation, liquid can be discharged from the internal space **36** to the outer space **46** through the first front one-way valve **80** and entry of liquid into the internal space **36** from the outer space **46** through the second front one-way valve **84** can be suppressed. Further, when the electric working machine **2** is in the second orientation, liquid can be discharged from the internal space **36** to the outer space **46** through the second front one-way valve **84** and entry of liquid into the internal space **36** from the outer space **46** through the first front one-way valve **80** can be suppressed.

(76) Further, when the electric working machine **2** is in the first orientation, the first front one-way valve **80** is positioned below the second front one-way valve **84** in the direction of gravity. When the electric working machine **2** is in the second orientation, the second front one-way valve **84** is positioned below the first front one-way valve **80** in the direction of gravity.

(77) According to the configuration above, liquid within the internal space **36** can be concentrated to near the first front one-way valve **80** when the electric working machine **2** is in the first orientation. The liquid can thus be discharged from the internal space **36** to the outer space **46** through the first front one-way valve **80**. Further, the liquid within the internal space **36** can be

concentrated to near the second front one-way valve **84** when the electric working machine **2** is in the second orientation. The liquid can thus be discharged from the internal space **36** to the outer space **46** through the second front one-way valve **84**.

(78) The space with which the internal space **36** communicates through the first front communication opening **70** and the space with which the internal space **36** communicates through the second front communication opening **74** are the same outer space **46**.

(79) According to the configuration above, liquid in the internal space **36** can be discharged to the single space.

(80) Further, the electric working machine **2** further includes the front handle **14** and the rear handle **24** (an example of handle) configured to be gripped by the user during use.

(81) According to the configuration above, the user can easily change the orientation of the electric working machine **2** by gripping the front handle **14** and the rear handle **24**.

(82) Further, the first front one-way valve **80** is configured to open and close by gravity.

(83) According to the configuration above, a pressure required to open and close the first front one-way valve **80** can be reduced, as compared with one-way valves configured to open and close by means other than gravity, such as a duckbill one-way valve, an umbrella one-way valve, etc. Since opening and closing of the first front one-way valve **80** is facilitated, discharge of liquid from the internal space **36** to the outer space **46** is facilitated.

(84) Further, the electrical components **62** include the battery attachment terminal **66** (an example of electrical connection member) configured to electrically connect to the battery pack B (an example of power supply source). When the electric working machine **2** is in the first orientation, the first front communication opening **70** is positioned below the battery attachment terminal **66** in the direction of gravity.

(85) According to the configuration above, when the electric working machine **2** is in the first orientation, the battery attachment terminal **66** can be suppressed from submerging in liquid and the liquid can be discharged from the internal space **36** to the outer space **46**.

(86) Further, the electric working machine **2** further includes the saw chain **8** (an example of working unit). The electrical components **62** include the control unit **56** configured to control operation of the saw chain **8**. When the electric working machine **2** is in the first orientation, the first front communication opening **70** is positioned below the control unit **56** in the direction of gravity.

(87) According to the configuration above, when the electric working machine **2** is in the first orientation, the control unit **56** can be suppressed from submerging in liquid and the liquid can be discharged from the internal space **36** to the outer space **46**.

(88) Further, the partition wall **23** further includes the front air opening **42** (an example of air opening) through which air flows into the internal space **36**. The opening area of the first front communication opening **70** is smaller than the opening area of the front air opening **42**.

(89) According to the configuration above, liquid can be discharged from the internal space **36** to the outer space **46** and entry of liquid into the internal space **36** from the outer space **46** can be suppressed, as well as a sufficient amount of air can flow into the internal space **36** through the front air opening **42**.

(90) Further, the outer space **46** is external to the electric working machine **2**.

(91) According to the configuration above, liquid in the internal space **36** can be discharged to the outside of the electric working machine **2**.

(92) In one embodiment of the electric working machine **2**, the number of the one-way valves **90** is not limited to four but may be three or less, or five or more.

(93) In one embodiment of the electric working machine **2**, the one-way valves **90** are not limited to ball one-way valves but may be one-way valves of another type, such as duckbill one-way valves or umbrella one-way valves.

(94) In one embodiment of the electric working machine **2**, the space with which the internal space

36 communicates through the first front communication opening **70** may be different from the space with which the internal space **36** communicates through the second front communication opening **74**. For example, the space with which the internal space **36** communicates through the first front communication opening **70** may be the cover space **28** and the space with which the internal space **36** communicates through the second front communication opening **74** may be the outer space **46**.

(95) In one embodiment of the electric working machine **2**, the electric working machine **2** is not limited to a handheld chain saw but may be a handheld electric working machine of another type, such as a pole saw, a blower, a grass cutter, a high-pressure washer, a spray, or a hedge trimmer. Alternatively, the electric working machine **2** is not limited to a handheld electric working machine but may be a push-along electric working machine or a ride-on electric working machine, such as a lawn mower, a scarifier, or a tiller.

(96) In one embodiment of the electric working machine **2**, the electric working machine **2** may include a built-in battery. Alternatively, the electric working machine **2** may supply electric power to the motor **52** from an external power supply via a power cable.

Claims

1. An electric working machine comprising: at least one electrical component; a first space in which the at least one electrical component is disposed; a partition wall separating the first space from a second space different from the first space, the partition wall including a first communication opening communicating the first space and the second space; and a first one-way valve disposed at the first communication opening, wherein: the first one-way valve is configured to open and close according to an orientation of the electric working machine, the partition wall separates the first space from a third space different from the first space, the partition wall further includes a second communication opening communicating the first space and the third space, the electric working machine further comprises a second one-way valve disposed at the second communication opening and configured to open and close according to the orientation of the electric working machine, when the electric working machine is in a first orientation, the first one-way valve is open and the second one-way valve is closed, and when the electric working machine is in a second orientation, the first one-way valve is closed and the second one-way valve is open.
2. The electric working machine according to claim 1, wherein: when the electric working machine is in the first orientation, the first one-way valve is positioned below the second one-way valve in a direction of gravity, and when the electric working machine is in the second orientation, the second one-way valve is positioned below the first one-way valve in the direction of gravity.
3. The electric working machine according to claim 1, wherein the second space and the third space are the same.
4. The electric working machine according to claim 1, further comprising a handle configured to be gripped by a user during use.
5. The electric working machine according to claim 1, wherein the first one-way valve is configured to open and close by gravity.
6. The electric working machine according to claim 1, wherein: the at least one electrical component comprises an electrical connection member configured to electrically connect to a power supply source, and when the electric working machine is in the first orientation, the first communication opening is positioned below the electrical connection member in a direction of gravity.
7. The electric working machine according to claim 1, further comprising a working unit, wherein: the at least one electrical component comprises a control unit configured to control operation of the working unit, and when the electric working machine is in the first orientation, the first communication opening is positioned below the control unit in a direction of gravity.

8. The electric working machine according to claim 1, wherein: the partition wall further includes an air opening through which air flows into the first space, and an opening area of the first communication opening is smaller than an opening area of the air opening.

9. The electric working machine according to claim 1, wherein the second space is an outer space external to the electric working machine.

10. The electric working machine according to claim 2, wherein: the second space and the third space are the same, the electric working machine further comprises a handle configured to be gripped by a user during use, the first one-way valve is configured to open and close by gravity, the at least one electrical component comprises an electrical connection member configured to electrically connect to a power supply source, when the electric working machine is in the first orientation, the first communication opening is positioned below the electrical connection member in the direction of gravity, the electric working machine further comprises a working unit, the at least one electrical component comprises a control unit configured to control operation of the working unit, when the electric working machine is in the first orientation, the first communication opening is positioned below the control unit in the direction of gravity, the partition wall further includes an air opening through which air flows into the first space, an opening area of the first communication opening is smaller than an opening area of the air opening, and the second space is an outer space external to the electric working machine.
