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VEHICLE

Abstract

Provided is a vehicle including a battery, a charging inlet, a charging unit configured to convert electric power supplied to the charging inlet from an outside and supply the converted electric power to the battery to charge the battery, an engine, and a ventilation flow path connected to a crank chamber of the engine. The ventilation flow path includes a specific portion disposed along a surface of the charging unit.

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Background/Summary

CROSS-REFERENCE TO RELATED APPLICATION

[0001] This application claims priority to Japanese Patent Application No. 2024-019769 filed on Feb. 13, 2024. The disclosure of the above-identified application, including the specification, drawings, and claims, is incorporated by reference herein in its entirety.

BACKGROUND

1. Technical Field

[0002] The present disclosure relates to a vehicle.

2. Description of Related Art

[0003] A vehicle disclosed in Japanese Unexamined Patent Application Publication No. 2022-185513 (JP 2022-185513 A) includes a ventilation flow path connected to a crank chamber of an engine. The ventilation flow path discharges a blow-by gas from the crank chamber. Further, the vehicle includes an electric heater that heats the ventilation flow path. In a cold region, moisture may freeze inside the ventilation flow path, and the ventilation flow path may be blocked. In the vehicle of JP 2022-185513 A, with heating of the ventilation flow path using the electric heater after the engine is started, the freezing of the moisture in the ventilation flow path is suppressed.

SUMMARY

[0004] In the vehicle of JP 2022-185513 A, the electric heater is operated after the engine is started. For this reason, a temperature of the ventilation flow path may be low immediately after the engine is started. Thus, the blow-by gas may flow into the low-temperature ventilation flow path immediately after the engine is started, and the moisture may be frozen in the ventilation flow path. The present specification proposes a vehicle that suppresses the freezing of the moisture in the ventilation flow path immediately after the engine is started.

[0005] A first aspect of the present disclosure relates to a vehicle including a battery, a charging inlet, a charging unit, an engine, and a ventilation flow path. The charging inlet is configured to convert electric power supplied to the charging inlet from an outside and supply the converted electric power to the battery to charge the battery. The ventilation flow path is connected to a crank chamber of the engine. The ventilation flow path includes a specific portion disposed along a surface of the charging unit.

[0006] In the vehicle according to the aspect, the specific portion may extend along any surface of a front surface, a rear surface, a right-side surface, a left-side surface, an upper surface, and a lower surface of the charging unit.

[0007] In the vehicle according to the aspect, a PCV (Positive Crank Case Ventilation) valve may or may not be provided in the ventilation flow path. Further, in the vehicle according to the aspect, the ventilation flow path may include two systems of a first ventilation flow path in which a PCV valve is provided and a second ventilation flow path in which the PCV valve is not provided. In this case, the ventilation flow path may be any one of the flow paths of two systems or may be both.

[0008] In the vehicle according to the aspect, the vehicle may further include an intake flow path that is disposed along a front surface of the charging unit and connected to an intake port of the engine. The specific portion of the ventilation flow path may extend along a side surface of the charging unit, and a front end of the specific portion may be connected to the intake flow path.

[0009] With the vehicle having the configuration as described above, it is possible to effectively heat a connection portion of the ventilation flow path and the intake flow path.

[0010] In the vehicle according to the aspect, the engine and the charging unit may be disposed side by side along a vehicle width direction in a compartment of the vehicle.
[0011] In the vehicle according to the aspect, the vehicle may further include an electric power supply outlet disposed in a vehicle cabin of the vehicle. The charging unit may be configured to execute an operation of converting electric power output from the battery and supplying the converted electric power to the electric power supply outlet.
[0012] With the vehicle having the configuration as described above, the charging unit can heat the ventilation flow path while the vehicle travels.
[0013] In the vehicle according to the aspect, the specific portion may be disposed at a position overlapping the charging unit in a height direction.
[0014] In the vehicle according to the aspect, the specific portion may extend to an end portion of the charging unit.
[0015] With the vehicle according to the aspect as described above, the charging unit charges the battery while the vehicle is stopped. The charging unit is operated by the electric power supplied from the outside via the charging inlet, and thus can be operated while the vehicle is stopped. With the operation of the charging unit while the vehicle is stopped, the charging unit generates heat. Since the specific portion of the ventilation flow path is disposed along the surface of the charging unit, the specific portion of the ventilation flow path is heated by the heat generated from the charging unit. As described above, in the vehicle, it is possible to preheat the ventilation flow path with the heat generated from the charging unit while the vehicle is stopped. Therefore, it is possible to suppress the freezing of the moisture in the ventilation flow path at the time of the start of the engine.

Description

BRIEF DESCRIPTION OF THE DRAWINGS
[0016] Features, advantages, and technical and industrial significance of exemplary embodiments of the present disclosure will be described below with reference to the accompanying drawings, in which like signs denote like elements, and wherein:
[0017] FIG. **1** is a schematic diagram showing a vehicle according to an embodiment as an example of the present disclosure;
[0018] FIG. **2** is a plan view of a front compartment shown in FIG. **1** as viewed from above;
[0019] FIG. **3** is a diagram showing disposition of members at a position of a III-III line of FIG. **2**;
[0020] FIG. **4** is a circuit diagram of an electric circuit connected to a battery shown in FIG. **1**;
[0021] FIG. **5** is a circuit diagram of a bi-directional charging circuit housed in a charging unit shown in FIG. **4**; and
[0022] FIG. **6** is a schematic diagram showing an intake system of an engine provided in the vehicle.
DETAILED DESCRIPTION OF EMBODIMENTS
[0023] A vehicle **10** of the present embodiment shown in FIG. **1** is a plug-in hybrid electric vehicle (PHEV). In each drawing, a direction FR indicates a front of the vehicle, a direction RR indicates a rear of the vehicle, a direction LH indicates a left of the vehicle, a direction RH indicates a right of the vehicle, a direction UP indicates above the vehicle, and a direction DW indicates below the vehicle.
[0024] The vehicle **10** includes a vehicle body **12**. A cabin **12***c* and a front compartment **12***a*, which is located in front of the cabin **12***c*, are provided in the vehicle body **12**. The cabin **12***c* is configured to allow a user to get on. The vehicle body **12** includes a floor panel **12***b* and a dash panel **12***d*. The floor panel **12***b* constitutes a floor of the cabin **12***c*. The dash panel **12***d* is interposed between the cabin **12***c* and the front compartment **12***a*. The vehicle **10** includes front

wheels **14***f* and rear wheels **14***r*.
[0025] The vehicle **10** includes a battery **16**. The battery **16** is disposed under the floor panel **12***b*. The battery **16** is not particularly limited, and may be, for example, a lithium-ion battery or an all-solid battery.
[0026] As shown in FIG. **2** and FIG. **3**, a transaxle **20** and an engine **50** are provided in the front compartment **12***a*. A motor for traveling **20***a* and a speed reducer are built into the transaxle **20**. The motor for traveling **20***a* is connected to a pair of front wheels **14***f* via the speed reducer. The engine **50** is a heat engine that generates power by burning fuel, and is not particularly limited. Examples thereof include a gasoline engine, a diesel engine, and a hydrogen engine. The engine **50** is connected to the front wheels **14***f* via the speed reducer (not shown). The engine **50** and the motor for traveling **20***a* cooperate with each other to drive the front wheels **14***f*.
[0027] FIG. **4** shows an electric circuit connected to the battery **16** and the motor for traveling **20***a*. As shown in FIG. **4**, the vehicle **10** includes a system main relay **48**, a power control unit (PCU) **22**, a charging unit **30**, a charging inlet **42**, and an electric power supply outlet **40**.
[0028] The PCU **22** is connected to the motor for traveling **20***a*. Further, the PCU **22** is connected to the battery **16** via the system main relay **48**. The PCU **22** converts direct-current electric power, which is supplied from the battery **16**, into alternating-current electric power and supplies the alternating-current electric power to the motor for traveling **20***a* to operate the motor for traveling **20***a*. The PCU **22** controls an amplitude and a frequency of the alternating current supplied to the motor for traveling **20***a* to control a torque and a rotation speed of the motor for traveling **20***a*. As shown in FIG. **3**, the PCU **22** is disposed in the front compartment **12***a*. The PCU **22** is disposed on an upper portion of the motor for traveling **20***a*.
[0029] The charging inlet **42** is provided in the vehicle body **12**. The charging inlet **42** is provided at a position accessible from the outside of the vehicle body **12**. The charging inlet **42** can be connected to an external alternating-current power source **46**. The external alternating-current power source **46** is, for example, a commercial power source for home use. The charging inlet **42** of the present embodiment is connected to the external alternating-current power source **46** via a cable. Note that, as another embodiment, the charging inlet **42** may be wirelessly connected to the external alternating-current power source **46**.
[0030] The electric power supply outlet **40** is disposed in the cabin **12***c*. The electric power supply outlet **40** can be connected to an electric machine. The electric power supply outlet **40** outputs the alternating-current electric power to the electric machine. The electric machine includes, for example, a home appliance, a personal computer, a smartphone, and a tablet terminal.
[0031] The charging unit **30** is connected to the battery **16** via the system main relay **48**. Further, the charging unit **30** is connected to the charging inlet **42** and the electric power supply outlet **40**. The charging unit **30** can execute a charging operation and an electric power supply operation. The charging unit **30** executes the charging operation when the vehicle **10** is stopped and the alternating-current power source **46** is connected to the charging inlet **42**. In the charging operation, the charging unit **30** converts the alternating-current electric power, which is supplied from the alternating-current power source **46** to the charging inlet **42**, into the direct-current electric power and supplies the direct-current electric power to the battery **16** to charge the battery **16**. Further, the charging unit **30** executes the electric power supply operation in a state where ignition of the vehicle **10** is turned on. In the electric power supply operation, the charging unit **30** converts the direct-current electric power, which is supplied from the battery **16**, into the alternating-current electric power and supplies the alternating-current electric power to the electric power supply outlet **40**. As shown in FIGS. **2** and **3**, the charging unit **30** is disposed in the front compartment **12***a*. The charging unit **30** is disposed on an upper portion of the PCU **22**. In the front compartment **12***a*, the engine **50** and the charging unit **30** are disposed side by side in a vehicle width direction.
[0032] The charging unit **30** includes a casing **30***a* and a bi-directional charging circuit **30***b* housed in the casing **30***a*. As shown in FIG. **5**, the bi-directional charging circuit **30***b* includes an insulating

transformer **36** and conversion circuits **31** to **33**.
[0033] The insulating transformer **36** includes a core **36***c*, a primary coil **36***a*, and a secondary coil **36***b*. The primary coil **36***a* and the secondary coil **36***b* are wound around the core **36***c*.
[0034] The conversion circuit **31** is connected to the charging inlet **42** and the electric power supply outlet **40** via a filter circuit **34**. The conversion circuit **31** includes a plurality of switching elements **31***a*. A flyback diode is connected in parallel to each of the switching elements **31***a*.
[0035] The conversion circuit **32** is connected to the conversion circuit **31**. Further, the conversion circuit **32** is connected to the primary coil **36***a* of the insulating transformer **36**. The conversion circuit **32** includes a plurality of switching elements **32***a*. The flyback diode is connected in parallel to each of the switching elements **32***a*.
[0036] The conversion circuit **33** is connected to the secondary coil **36***b* of the insulating transformer **36**. Further, the conversion circuit **33** is connected to the battery **16** via the system main relay **48**. The conversion circuit **33** includes a plurality of switching elements **33***a*. The flyback diode is connected in parallel to each of the switching elements **33***a*.
[0037] A rightward arrow in FIG. **5** shows an outline of the charging operation. In the charging operation, the alternating-current electric power is supplied to the charging inlet **42**. The conversion circuit **31** converts the alternating-current electric power, which is supplied from the charging inlet **42**, into the direct-current electric power. The conversion circuit **32** converts the direct-current electric power, which is output from the conversion circuit **31**, into high-frequency alternating-current electric power, and causes the alternating current to flow through the primary coil **36***a*. Therefore, the alternating current flows through the secondary coil **36***b*. The conversion circuit **33** converts the alternating-current electric power, which is supplied from the secondary coil **36***b*, into the direct-current electric power and supplies the direct-current electric power to the battery **16**. Therefore, the battery **16** is charged.
[0038] A leftward arrow in FIG. **5** shows an outline of the electric power supply operation. In the electric power supply operation, the direct-current electric power is supplied from the battery **16** to the conversion circuit **33**. The conversion circuit **33** converts the direct-current electric power, which is supplied from the battery **16**, into the high-frequency alternating-current electric power, and causes the alternating current to flow through the secondary coil **36***b*. Therefore, the alternating current flows through the primary coil **36***a*. The conversion circuit **32** converts the alternating-current electric power, which is supplied from the primary coil **36***a*, into the direct-current electric power. The conversion circuit **31** converts the direct-current electric power, which is output from the conversion circuit **32**, into the alternating-current electric power and supplies the alternating-current electric power to the electric power supply outlet **40**.
[0039] As described above, the charging unit **30** (that is, the bi-directional charging circuit **30***b*) can selectively execute the charging operation and the electric power supply operation.
[0040] FIG. **6** schematically shows an intake system of the engine **50**. As shown in FIG. **6**, the engine **50** includes a combustion chamber **52** and a crank chamber **54**. The crank chamber **54** is provided in a crankcase **55** and houses a crankshaft **56**. The crank chamber **54** is separated from the combustion chamber **52** by a piston **53**. The crank chamber **54** stores engine oil. An intake port **58** and an exhaust port **59** are provided in the combustion chamber **52**. The vehicle **10** includes an intake flow path **60**, a first ventilation flow path **61**, and a second ventilation flow path **62**. The intake flow path **60** is connected to the intake port **58** of the engine **50**. The intake flow path **60** supplies air to the intake port **58**. The first ventilation flow path **61** and the second ventilation flow path **62** are connected to the crank chamber **54** of the engine **50**. The first ventilation flow path **61** and the second ventilation flow path **62** ventilate the crank chamber **54**. Here, each of the “first ventilation flow path” and the “second ventilation flow path” is an example of “ventilation flow path” in the present disclosure.
[0041] The intake flow path **60** includes an intake manifold **63**, a throttle body **64**, an intake duct **65**, and an air cleaner **66**. A downstream end of the intake manifold **63** is connected to the intake

port **58** of the engine **50**. An upstream end of the intake manifold **63** is connected to a downstream end of the intake duct **65** via the throttle body **64**. A throttle valve is provided in the throttle body **64**. The intake duct **65** may be referred to as an intake pipe or an intake hose. An air cleaner **66** is provided at an upstream end of the intake duct **65**. The air taken in from the outside of the vehicle **10** flows into the intake flow path **60** via the air cleaner **66**. As shown by an arrow **100**, the air is supplied to the intake port **58** via the intake flow path **60**.

[0042] In the present embodiment, the first ventilation flow path **61** is configured by a positive crank case ventilation (PCV) hose. An upstream end of the first ventilation flow path **61** is connected to the crank chamber **54**. A PCV valve **61***a* is provided at a connection portion of the first ventilation flow path **61** and the crank chamber **54**. A downstream end of the first ventilation flow path **61** is connected to the intake manifold **63**.

[0043] In the present embodiment, the second ventilation flow path **62** is configured by the PCV hose. A downstream end of the second ventilation flow path **62** is connected to the crank chamber **54**, and an upstream end of the second ventilation flow path **62** is connected to the intake duct **65**.

[0044] During the operation of the engine **50**, a blow-by gas flows from the combustion chamber **52** to the crank chamber **54** through a gap between the piston **53** and a cylinder. As described below, the first ventilation flow path **61** and the second ventilation flow path **62** discharge the blow-by gas from the crank chamber **54** to the intake flow path **60**. In a state where the engine **50** is operated at a low output (for example, idling state or low-speed traveling state), a pressure in the intake manifold **63** is low, and thus the PCV valve **61***a* is opened. Therefore, as indicated by an arrow **102** in FIG. **6**, the blow-by gas flows from the crank chamber **54** to the intake manifold **63** via the first ventilation flow path **61**. Further, as the blow-by gas flows through the first ventilation flow path **61**, as indicated by an arrow **104**, the air flows from the intake duct **65** to the crank chamber **54** via the second ventilation flow path **62**. The blow-by gas discharged to the intake manifold **63** is sent to the combustion chamber **52** together with the air. In a state where the engine **50** is operated at a high output, the pressure in the intake manifold **63** is high, and thus the PCV valve **61***a* is closed. When the pressure in the crank chamber **54** is increased in this state, as indicated by an arrow **106** in FIG. **6**, the blow-by gas flows back to the second ventilation flow path **62**. That is, the blow-by gas flows from the crank chamber **54** to the intake duct **65** via the second ventilation flow path **62**. The blow-by gas discharged to the intake duct **65** is sent to the combustion chamber **52**.

[0045] FIG. **2** shows a disposition of the second ventilation flow path **62** and the intake flow path **60** in the front compartment **12***a*. As described above, the second ventilation flow path **62** is configured by the PCV hose. The second ventilation flow path **62** extends toward the charging unit **30** from a connection portion **62***a* to the engine **50** along the vehicle width direction. The second ventilation flow path **62** is bent at a bent portion **62***b* near the charging unit **30**, and extends toward the front of the vehicle from the bent portion **62***b* along a right-side surface of the casing **30***a* of the charging unit **30** (that is, a surface on a right RH side). In the following, a portion extending along the side surface of the charging unit **30** in the second ventilation flow path **62** is referred to as a specific portion **62***c*. The specific portion **62***c* extends to an end portion of the front of the charging unit **30**. In another embodiment, the direction in which the specific portion **62***c* extends is not limited to a vehicle front-rear direction, and the specific portion **62***c* may extend along the vehicle width direction or an upper and lower direction. As shown in FIG. **3**, the specific portion **62***c* is disposed at a position overlapping the charging unit **30** in a height direction, and is disposed between the engine **50** and the charging unit **30**. A shield member is not provided between the specific portion **62***c* and the right-side surface of the charging unit **30**, and the specific portion **62***c* directly faces the right-side surface of the charging unit **30**. As shown in FIG. **2**, the intake duct **65** is disposed in front of the charging unit **30** and extends along the vehicle width direction along a front surface of the charging unit **30** (that is, a surface on a front FR side). Similarly to the specific portion **62***c* of the second ventilation flow path **62**, the intake duct **65** is disposed at a position

overlapping the charging unit **30** in the height direction. A front end (that is, a connection portion **62***d*) of the specific portion **62***c* is connected to the intake duct **65**. Therefore, the entire specific portion **62***c* from the bent portion **62***b* to the connection portion **62***d* is disposed near the charging unit **30**.

[0046] In a cold region, the temperature of the ventilation flow path is low while the vehicle is stopped. Then, when the engine is started and the blow-by gas flows through the ventilation flow path, moisture in the blow-by gas may be frozen in the ventilation flow path, and thus the ventilation flow path may be blocked. On the contrary, in the vehicle **10** of the present embodiment, the freezing of the moisture in the second ventilation flow path **62** is suppressed, as described below.

[0047] In the vehicle **10** of the present embodiment, when an external power source is connected to the charging inlet **42** while the vehicle is stopped, the charging operation for the battery **16** is executed by the charging unit **30**. The charging unit **30** (particularly, the switching elements **31***a* to **33***a* and the insulating transformer **36**) generates heat in the charging operation. When the charging unit **30** generates the heat, the specific portion **62***c* of the second ventilation flow path **62** disposed along the surface of the charging unit **30** is heated. Therefore, when the engine **50** is started and the blow-by gas flows into the second ventilation flow path **62**, the freezing of the moisture in the second ventilation flow path **62** is suppressed. In particular, in the present embodiment, since the intake flow path **60** is disposed along the front surface of the charging unit **30** and the specific portion **62***c* is connected to the intake flow path **60** at the front end of the specific portion **62***c*, the entire specific portion **62***c* including the connection portion **62***d* is heated by the charging unit **30**. The front end (that is, the connection portion **62***d*) of the specific portion **62***c* is a most downstream portion of the blow-by gas discharged from the engine **50**, and is a portion where the blow-by gas is likely to be at a lowest temperature. With the configuration of the present embodiment, since the charging unit **30** can heat the connection portion **62***d*, it is possible to effectively suppress the freezing of the connection portion **62***d*. As described above, with the vehicle **10** of the present embodiment, it is possible to suppress the freezing of the moisture in the second ventilation flow path **62** immediately after the start of the engine **50**.

[0048] Further, in the vehicle **10** of the present embodiment, the charging unit **30** executes the electric power supply operation to the electric power supply outlet **40** while the vehicle travels. Therefore, the charging unit **30** generates the heat even while the vehicle travels, and thus it is possible to suppress the freezing of the second ventilation flow path **62**.

[0049] In the present embodiment described above, the second ventilation flow path **62** is disposed along the surface of the charging unit **30**, but the first ventilation flow path **61** may be disposed along the surface of the charging unit **30** instead of the second ventilation flow path **62**. In this case, it is possible to suppress the freezing of the moisture in the first ventilation flow path **61**. Further, both the first ventilation flow path **61** and the second ventilation flow path **62** may be disposed along the surface of the charging unit **30**. Further, in the above embodiment, although the shield member is not provided between the specific portion **62***c* and the charging unit **30**, various members (not shown) may be disposed between the specific portion **62***c* and the charging unit **30** as long as heat transfer is possible from the charging unit **30** to the specific portion **62***c*.

[0050] Further, in the above embodiment, the specific portion **62***c* of the second ventilation flow path **62** extends along the right-side surface of the charging unit **30**, but the specific portion **62***c* may extend along another surface (for example, a front surface, a rear surface, a left-side surface, an upper surface, or a lower surface) of the charging unit **30**. Further, a configuration may be employed in which the disposition of FIG. **2** is rotated by 90 degrees or 180 degrees. Further, in the present embodiment, the vehicle is a front-engine/front-wheel drive (FF) vehicle, but the vehicle may have another drive method.

[0051] Although the embodiments of the disclosure of the present specification have been described in detail above, the embodiments are merely examples and do not limit the scope of the

claims. The techniques described in the claims include various modifications and changes of the specific examples exemplified above. The technical elements described in the present specification or the drawings exhibit technical usefulness alone or in various combinations, and are not limited to the combinations described in the claims at the time of filing. Further, the techniques exemplified in the present specification or the drawings achieve a plurality of objectives at the same time, and achieving one of the objectives itself has technical usefulness.

Claims

1. A vehicle comprising: a battery; a charging inlet; a charging unit configured to convert electric power supplied to the charging inlet from an outside and supply the converted electric power to the battery to charge the battery; an engine; and a ventilation flow path connected to a crank chamber of the engine, wherein the ventilation flow path includes a specific portion disposed along a surface of the charging unit.
2. The vehicle according to claim 1, wherein the specific portion extends along any surface of a front surface, a rear surface, a right-side surface, a left-side surface, an upper surface, and a lower surface of the charging unit.
3. The vehicle according to claim 1, wherein a Positive Crank Case Ventilation valve is provided in the ventilation flow path.
4. The vehicle according to claim 1, wherein the ventilation flow path includes two systems of a first ventilation flow path in which a Positive Crank Case Ventilation valve is provided and a second ventilation flow path in which the Positive Crank Case Ventilation valve is not provided.
5. The vehicle according to claim 1, further comprising an intake flow path that is disposed along a front surface of the charging unit and connected to an intake port of the engine, wherein: the specific portion of the ventilation flow path extends along a side surface of the charging unit; and a front end of the specific portion is connected to the intake flow path.
6. The vehicle according to claim 1, wherein the engine and the charging unit are disposed side by side along a vehicle width direction in a compartment of the vehicle.
7. The vehicle according to claim 1, further comprising an electric power supply outlet disposed in a vehicle cabin of the vehicle, wherein the charging unit is configured to execute an operation of converting electric power output from the battery and supplying the converted electric power to the electric power supply outlet.
8. The vehicle according to claim 1, wherein the specific portion is disposed at a position overlapping the charging unit in a height direction.
9. The vehicle according to claim 1, wherein the specific portion extends to an end portion of the charging unit.