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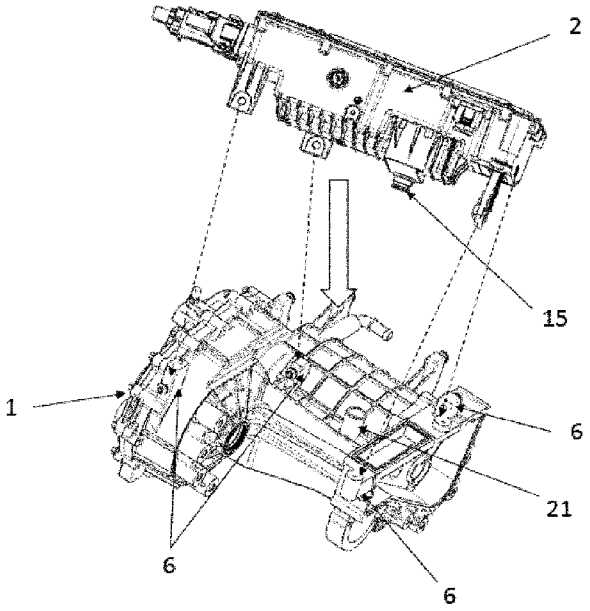

Fig. 6

(57) Abstract: The present disclosure relates to a drive system for an electric vehicle, an electric vehicle, and a method for assembling a drive system of an electric vehicle. The drive system comprises: a motor-reducer assembly, comprising a motor-reducer housing, and an electric motor and a reducer disposed in the motor-reducer housing; a first electrical assembly, comprising a first electrical housing detachably connected to the motor-reducer housing, and a first electrical component disposed in the first electrical housing; and a second electrical assembly, comprising a second electrical housing detachably connected to the motor-reducer housing, and a second electrical component disposed in the second electrical housing, wherein the first electrical housing and second electrical housing are independent of each other, and disposed side by side at one side of the motor-reducer housing.

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DRIVE SYSTEM FOR ELECTRIC VEHICLE, ELECTRIC VEHICLE, AND DRIVE SYSTEM ASSEMBLY METHOD

TECHNICAL FIELD

[0001] The present disclosure relates to a drive system for an electric vehicle, an electric vehicle, and a method for assembling a drive system of an electric vehicle.

BACKGROUND

[0002] As the state promotes energy conservation and emissions reduction and requires control of atmospheric pollution, the electric vehicle market is growing rapidly, and electric vehicles are set to become a mainstream product in the future motor vehicle market. The electric motor and its drive system, and the battery and its management system, are important constituent parts of an electric vehicle. On-board chargers (OBC), DC-DC converters, inverters, high-voltage power distribution units (PDU), high-voltage DC power supplies (HCDC), fusible devices, relays, electric heaters (PTC), fast chargers and compressor controllers, etc. are important components of electric vehicle drive systems.

[0003] These components have different functions. For example, on-board chargers (OBC) and DC-DC converters output low voltages or operate at low voltages, whereas inverters are high-voltage components which receive high-voltage DC power. Furthermore, the abovementioned components have different failure rates. For example, on-board chargers (OBC) and DC-DC converters have high failure rates, whereas inverters, etc. have lower failure rates.

[0004] With advances in technology, it has already become possible in recent years to integrate the abovementioned components and combine them with the electric motor to form an electric drive assembly. However, known solutions still pose difficulties in terms of assembly, disassembly and maintenance.

SUMMARY OF THE DISCLOSURE

[0005] For the above reasons, the objective of the present disclosure is to provide a drive system for an electric vehicle, an electric vehicle, and an assembly

method for a drive system of an electric vehicle, wherein the drive system can be assembled, disassembled and maintained simply and conveniently at a low cost.

[0006] The abovementioned objective is achieved by means of a drive system for an electric vehicle, an electric vehicle, and a method for assembling a drive system of an electric vehicle as described below.

[0007] The present disclosure relates to a drive system for an electric vehicle, the drive system comprising: a motor-reducer assembly, comprising a motor-reducer housing, and an electric motor and a reducer disposed in the motor-reducer housing; a first electrical assembly, comprising a first electrical housing detachably connected to the motor-reducer housing, and a first electrical component disposed in the first electrical housing; and a second electrical assembly, comprising a second electrical housing detachably connected to the motor-reducer housing, and a second electrical component disposed in the second electrical housing, wherein the first electrical housing and second electrical housing are independent of each other, and disposed side by side at one side of the motor-reducer housing.

[0008] In an embodiment, the first electrical component comprises a component used to receive high-voltage DC power as an input, and the second electrical component comprises a component used for voltage conversion.

[0009] In an embodiment, the first electrical component comprises a motor controller, and the second electrical component comprises a DCDC converter and an on-board charger.

[0010] In an embodiment, the first electrical component further comprises at least one of the following: a power distribution unit, a high-voltage DC power supply, a fusible device, a relay, an electric heater, a fast charger, and a compressor controller.

[0011] In an embodiment, the motor-reducer housing comprises a reducer housing and a motor housing; the first electrical housing and the second electrical housing are located above the motor-reducer housing and disposed transversely to the reducer housing or the motor housing.

[0012] In an embodiment, a first support for supporting the first electrical housing is provided at the top of the motor-reducer housing, and the first electrical housing is mounted to the first support in a first direction by means of a first fixing

member.

[0013] In an embodiment, a second support for supporting the second electrical housing is provided at the top of the motor-reducer housing, and the second electrical housing is mounted to the second support in a second direction transverse to the first direction by means of a second fixing member.

[0014] In an embodiment, the second support has protruding parts, and the second electrical housing is provided with recesses which cooperate with the protruding parts.

[0015] In an embodiment, the recesses are disposed on a bottom wall and/or a side wall of the second electrical housing.

[0016] In an embodiment, the electric motor is electrically connected to the first electrical component, and the first electrical component is electrically connected to the second electrical component.

[0017] In an embodiment, a first wiring harness connecting hole is provided on a side wall of the first electrical housing that is adjacent to the second electrical housing, a second wiring harness connecting hole is provided on a side wall of the second electrical housing that is adjacent to the first electrical housing, and the second electrical component is electrically connected to the first electrical component by means of a wiring harness passing through the first wiring harness connecting hole and the second wiring harness connecting hole.

[0018] In an embodiment, the motor-reducer housing, the first electrical housing and the second electrical housing are respectively provided with cooling channels which are in fluid communication with each other.

[0019] In an embodiment, a first cooling channel connecting hole is provided on a side wall of the first electrical housing that is adjacent to the second electrical housing, and a second cooling channel connecting hole is provided on a side wall of the second electrical housing that is adjacent to the first electrical housing, the first cooling channel connecting hole being aligned with the second cooling channel connecting hole.

[0020] The present disclosure further relates to an electric vehicle, comprising the drive system described above.

[0021] The present disclosure further relates to a method for assembling a

drive system of an electric vehicle, and the method comprises:

mounting an electric motor and a reducer in a motor-reducer housing; mounting a first electrical component in a first electrical housing; mounting a second electrical component in a second electrical housing; mounting the first electrical housing at one side of the motor-reducer housing in a first direction; and mounting the second electrical housing at said side of the motor-reducer housing in a second direction, such that the second electrical housing and the first electrical housing are disposed side by side, wherein the second direction is transverse to the first direction.

[0022] The beneficial effects of embodiments of the present disclosure are that the system can be assembled, disassembled and maintained simply and conveniently at a low cost, is easy to transport, and can ensure that basic functions are not affected by component damage.

BRIEF DESCRIPTION OF THE DRAWINGS

[0023] A better understanding of the advantages and objectives of the present disclosure can be gained from preferred embodiments of the present disclosure as described in detail below in conjunction with the drawings. In order to better illustrate the relationships among the components in the drawings, the drawings are not drawn to scale. In the drawings:

[0024] Fig. 1 shows a schematic drawing of a drive system for an electric vehicle according to an embodiment of the present disclosure, viewed from one direction.

[0025] Fig. 2 shows a schematic drawing of a drive system for an electric vehicle according to an embodiment of the present disclosure, viewed from another direction.

[0026] Fig. 3 shows a schematic drawing of the top of part of a drive system for an electric vehicle according to an embodiment of the present disclosure.

[0027] Fig. 4 shows a side view of a drive system for an electric vehicle according to an embodiment of the present disclosure.

[0028] Fig. 5 shows a partial schematic drawing of a drive system for an electric vehicle according to an embodiment of the present disclosure.

[0029] Fig. 6 shows a schematic drawing of fitting of a first electrical

assembly of a drive system for an electric vehicle according to an embodiment of the present disclosure.

[0030] Fig. 7 shows a schematic drawing of fitting of a second electrical assembly of a drive system for an electric vehicle according to an embodiment of the present disclosure.

DESCRIPTION OF THE EMBODIMENTS

[0031] In order to clarify the objective, technical solution and advantages of the present disclosure, the technical solution of embodiments of the present disclosure is described clearly and completely below in conjunction with the drawings accompanying particular embodiments of the present disclosure. In the drawings, identical reference numerals denote identical parts. It must be explained that the embodiments described are some, not all, of the embodiments of the present disclosure. All other embodiments obtained by those skilled in the art based on the described embodiments of the present disclosure without the need for inventive effort shall fall within the scope of protection of the present disclosure.

[0032] Unless otherwise defined, the technical or scientific terms used herein shall have the common meanings understood by those skilled in the art. “First”, “second” and similar words used in the description and claims of the patent application of the present disclosure do not indicate any order, quantity or importance, being merely used to distinguish between different component parts. Likewise, words such as "a" or "one" do not necessarily represent a quantity limit. Words such as "comprising", "including” or "having" mean that the element or object preceding the word covers the elements or objects and equivalents thereof listed after the word, without excluding other elements or objects. Words such as "connection” or "communication”, rather than being limited to the physical or mechanical connection or communication shown in a drawing, may include connection or communication equivalent thereto, irrespective of whether it is direct or indirect. “Upper”, “lower”, “left”, “right”, etc. are only used to indicate a relative positional relationship, and when the absolute position of the described object changes, the relative positional relationship might also change accordingly.

[0033] Various embodiments of the present disclosure are described in detail

below with reference to Figs. 1 - 7.

[0034] As shown in Figs. 1 - 4, a drive system comprised in an electric vehicle according to the present disclosure comprises a motor-reducer assembly, a first electrical assembly and a second electrical assembly. The motor-reducer assembly comprises a motor-reducer housing 1, as well as an electric motor and a reducer disposed in the motor-reducer housing 1. The first electrical assembly comprises a first electrical housing 2 detachably connected to the motor-reducer housing 1, and a first electrical component disposed in the first electrical housing 2. The second electrical assembly comprises a second electrical housing 3 detachably connected to the motor-reducer housing 1, and a second electrical component disposed in the second electrical housing 3. The first electrical housing 2 and second electrical housing 3 are independent of each other, and disposed side by side at one side of the motor-reducer housing 1. Specifically, as shown in Fig. 1, the first electrical housing 2 and second electrical housing 3 are disposed at the top of the motor-reducer housing 1. The statement that the first electrical housing 2 and second electrical housing 3 are independent of each other means that they can be separated from each other without affecting each other.

[0035] In some embodiments, the first electrical component may comprise a component used to receive high-voltage DC power as an input, and the second electrical component may comprise a component used for voltage conversion. For example, the first electrical component may be a high-voltage component with a high-voltage input, or an electrical component which uses a drive battery voltage directly as an operating voltage, and the second electrical component may be a low-voltage component with a low-voltage output.

[0036] In other embodiments, the first electrical component may comprise a motor controller, and the second electrical component may comprise a DCDC converter and an on-board charger (OBC).

[0037] The first electrical component may also comprise at least one of the following: a power distribution unit (e.g. a high-voltage power distribution unit, i.e. PDU), a high-voltage DC power supply (HVDC), a fusible device, a relay, an electric heater (PTC), a fast charger, and a compressor controller.

[0038] The motor controller is an inverter, used for converting DC power

stored in the drive battery to AC power of variable frequency and variable voltage, so as to control the rotation speed and torque of the electric motor. The inverter of the electric vehicle will adjust the amplitude and frequency of the AC power; the frequency controls the speed of the electric vehicle, and the amplitude controls the magnitude of the driving force of the electric vehicle.

[0039] The DC-DC converter can convert a voltage from a DC power supply to any DC voltage, to provide required power for a power steering system, in-vehicle air conditioning, and other auxiliary equipment. The DC-DC converter receives an input from the drive battery, and supplies power for on-board electrical equipment. For example, the DC-DC converter can output a low voltage of about 12 V, which can supply power for a low-voltage storage battery.

[0040] The on-board charger is an electrical energy conversion apparatus on the electric vehicle, used for controlling and adjusting charging of the drive battery; a grid voltage is inputted to the on-board charger via an AC charging pile on the ground and an AC charging port, and thereby charges the drive battery.

[0041] The power distribution unit or high-voltage power distribution unit is connected to the drive battery, motor controller and inverter, etc. of the electric vehicle, and provides functions for a high-voltage system of the electric vehicle, such as charging/discharging control, high-voltage component power-up control, circuit overload short circuit protection, high-voltage sampling and low-voltage control, thus protecting and monitoring the operation of the high-voltage system.

[0042] The electric heater (positive temperature coefficient) is a thermistor, which heats up when energized to heat air flowing therethrough, so as to provide the functions of adjustable warm airflow and glass demisting/defrosting.

[0043] The DC-DC converter and on-board charger mentioned above have high failure rates, and often need to be removed from the drive system for overhaul or replacement. Furthermore, in terms of function, the DC-DC converter and on-board charger are less important than other electrical components, especially the motor controller. Having the DC-DC converter and on-board charger disposed in the second electrical housing, and having other non-failure-prone or functionally more important electrical components disposed in the first electrical housing which is independent of the second electrical housing, enables the drive system to be

assembled, disassembled and maintained more easily, and costs can thereby be lowered. Specifically, only the second electrical housing need be disassembled to perform overhaul or maintenance. Since a housing is used to mount the DC-DC converter and on-board charger, transportation is easier. Further, with the configuration described above, a conventional production line may be re-used, with no need to modify the entire production line; it is feasible to merely add a station for assembling the second electrical housing.

[0044] As shown in Figs. 1 and 3, the motor-reducer housing 1 comprises a reducer housing 4 and a motor housing 5; the first electrical housing 2 and the second electrical housing 3 are located above the motor-reducer housing 1 and disposed transversely to the reducer housing 4 or motor housing 5. For example, the first electrical housing 2 and the second electrical housing 3 are arranged side by side above the motor-reducer housing 1, and the direction in which they are arranged side by side is transverse to, in particular perpendicular to the direction of extension of the reducer housing 4 or motor housing 5, in particular the electric motor.

[0045] In some embodiments, as shown in Fig. 2, a first support 6 is provided at the top of the motor-reducer housing 1, for supporting the first electrical housing 2. As shown in Fig. 3, the first electrical housing 2 is mounted to the first support 6 by means of a first fixing member 7; as shown in Fig. 6, the first electrical housing 2 is mounted to the first support 6 in a first direction. The first direction is the direction of the large solid-line arrow in Fig. 6, specifically the direction from the top of the reducer housing 4 or the motor housing 5 towards the bottom thereof. The dotted arrows in Fig. 6 show the mounting of multiple first fixing members 7 to first supports 6 corresponding thereto schematically. For example, the first supports 6 are provided with threaded holes, and the first fixing members 7 are screws or bolts. The number and manner of distribution of the first supports 6 depends on the specific situation, and is not restricted herein.

[0046] In some embodiments, as shown in Fig. 5, a second support 8 is provided at the top of the motor-reducer housing 1, for supporting the second electrical housing 3. Mounting to the second support 8 is achieved by means of a second fixing member 9. As shown in Fig. 7, the second electrical housing 3 is

mounted to the second support 8 in a second direction transverse to the first direction. The second direction is a direction from the motor housing 5 towards the reducer housing 4, e.g. perpendicular to the direction of extension of the electric motor, as indicated by the large solid-line arrow in Fig. 7. The dotted lines in Fig. 7 show the mounting of multiple second fixing members 9 to second supports 8 corresponding thereto schematically. The second direction may be transverse to the first direction; for example, the two directions are perpendicular to each other. Having the different electrical housings mounted in different directions makes assembly, disassembly and maintenance of the drive system more efficient.

[0047] For example, the second support 8 has protruding parts 17, 19, and the second electrical housing 3 is provided with recesses 18, 20 which cooperate with the protruding parts. The recesses 18, 20 are disposed on a bottom wall and/or side wall of the second electrical housing 3. For example, the recess 18 may take the form of a slot, and performs a guiding and stopping function during mounting of the second electrical housing 3. For example, the second supports 8 are provided with threaded holes, and the second fixing members 9 are screws or bolts. The number and manner of distribution of the second supports 8 depends on the specific situation, and is not restricted herein.

[0048] The electric motor located in the motor housing 5 is electrically connected to the first electrical component in the first electrical housing 2, and the first electrical component is electrically connected to the second electrical component in the second electrical housing 3. As shown in Figs. 5 and 7, a first wiring harness connecting hole 10 is provided on a side wall of the first electrical housing 2 that is adjacent to the second electrical housing 3, a second wiring harness connecting hole 11 is provided on a side wall of the second electrical housing 3 that is adjacent to the first electrical housing 2, and the second electrical component is electrically connected to the first electrical component by means of a wiring harness passing through the first wiring harness connecting hole 10 and the second wiring harness connecting hole 11. For example, the first electrical component has a first electric interface disposed in the first electrical housing 2, the second electrical component has a second electric interface disposed in the second electrical housing 3, and the wiring harness (consisting of electric wires,

for example) connects the first electric interface to the second electric interface; when necessary, for example when disassembly/overhaul is being performed, the wiring harness may be separated from the first electric interface or the second electric interface. In the drive system of the present disclosure, when the second electrical component is damaged, the first electrical component in the first electrical housing can still ensure that the drive system operates for a period of time, thus ensuring basic functionality.

[0049] To achieve superior and efficient cooling, the motor-reducer housing 1, the first electrical housing 2 and the second electrical housing 3 are respectively provided with cooling channels 14, 15, 16 which are in fluid communication with each other, as shown in Figs. 3 - 7. A position which the cooling channel 15 of the first electrical housing 2 flows through corresponds to a position where the inverter for example is located; for example, most of the cooling channel 15 is located on a bottom wall of the first electrical housing 2. Most of the cooling channel 16 of the second electrical housing 3 may be located on the bottom wall of the second electrical housing.

[0050] To achieve the circulation, a first cooling channel connecting hole 12 is provided on a side wall of the first electrical housing 2 that is adjacent to the second electrical housing 3, as shown in Fig. 5, and a second cooling channel connecting hole 13 is provided on a side wall of the second electrical housing 3 that is adjacent to the first electrical housing 2, as shown in Fig. 7, the first cooling channel connecting hole 12 being aligned with the second cooling channel connecting hole 13. The first cooling channel connecting hole 12 and the first wiring harness connecting hole 10 are disposed on the same side wall. The second cooling channel connecting hole 13 and the second wiring harness connecting hole 11 are disposed on the same side wall. Once the first electrical housing 2 and the second electrical housing 3 have been respectively mounted on the motor-reducer housing 1, a connecting hole 21 of the cooling channel 14 of the motor-reducer housing 1 is sealed to a port of the cooling channel 15 of the first electrical housing 2, and the first cooling channel connecting hole 12 is sealed to the second cooling channel connecting hole 13.

[0051] A liquid used for cooling in the cooling channels may be water or oil.

When water is used to cool the electric motor, it is possible that the reducer housing 4 and the motor housing 5 are not in fluid communication with each other, and the reducer uses oil for cooling. When oil is used for cooling, it is possible that the reducer housing 4 and the motor housing 5 are in fluid communication with each other, and the reducer and the electric motor both use oil for cooling. For example, oil or water may flow through the cooling channel 16 of the second electrical housing 3 first, then into the cooling channel 15 of the first electrical housing 2 via the second cooling channel connecting hole 13 and the first cooling channel connecting hole 12, then into the cooling channel 14 of the motor-reducer housing 1 via the connecting hole 21 of the motor-reducer housing, for example cooling the electric motor along an axial helical channel in the motor housing 5, and then flow out through an outlet of the cooling channel 14 on the motor housing 5. Similarly, oil or water could also flow through the cooling channel of the first electrical housing 2 first, then into the cooling channel of the second electrical housing 3 via the first cooling channel connecting hole 12 and the second cooling channel connecting hole 13, and then into the cooling channel of the motor-reducer housing 1 to cool the electric motor. It should be understood that the abovementioned cooling path may be configured according to cooling requirements and cooling components, and is not restricted herein.

[0052] A method for assembling a drive system of an electric vehicle as provided in the present disclosure may comprise the following steps: mounting an electric motor and a reducer in the motor-reducer housing 1; mounting a first electrical component in the first electrical housing 2; mounting a second electrical component in the second electrical housing 3; mounting the first electrical housing 2 at one side of the motor-reducer housing 1 in a first direction; and mounting the second electrical housing 3 at said side of the motor-reducer housing 1 in a second direction, such that the second electrical housing 3 and the first electrical housing 2 are disposed side by side. As shown in Figs. 6 and 7 and as stated above, the second direction is transverse to the first direction; for example, the two directions are perpendicular to each other.

[0053] The above-described drive system of the present disclosure can be assembled, disassembled and maintained simply and conveniently at a low cost, is

easy to transport, and can ensure that basic functions are not affected by component damage. The electric vehicle and the method for assembling a drive system of an electric vehicle according to the present disclosure have corresponding advantages.

[0054] Moreover, the technical features disclosed above are not limited to the disclosed combinations with other features, and those skilled in the art could also combine technical features in other ways according to the disclosed objective, to achieve the objective of the present disclosure.

WHAT IS CLAIMED IS:

1. A drive system for an electric vehicle, characterized in that the drive system comprises:

a motor-reducer assembly, comprising a motor-reducer housing (1), and an electric motor and a reducer disposed in the motor-reducer housing (1);

a first electrical assembly, comprising a first electrical housing (2) detachably connected to the motor-reducer housing (1), and a first electrical component disposed in the first electrical housing (2); and

a second electrical assembly, comprising a second electrical housing (3) detachably connected to the motor-reducer housing (1), and a second electrical component disposed in the second electrical housing (3),

wherein the first electrical housing (2) and second electrical housing (3) are independent of each other, and disposed side by side at one side of the motor-reducer housing (1).

2. The drive system according to claim 1, characterized in that the first electrical component comprises a component used to receive high-voltage DC power as an input, and the second electrical component comprises a component used for voltage conversion.

3. The drive system according to claim 1, characterized in that the first electrical component comprises a motor controller, and the second electrical component comprises a DCDC converter and an on-board charger.

4. The drive system according to claim 3, characterized in that the first electrical component further comprises at least one of the following: a power distribution unit, a high-voltage DC power supply, a fusible device, a relay, an electric heater, a fast charger, and a compressor controller.

5. The drive system according to claim 1, characterized in that the motor-reducer housing (1) comprises a reducer housing (4) and a motor housing (5); the first electrical housing (2) and the second electrical housing (3) are located above the motor-reducer housing (1) and disposed transversely to the reducer housing (4) or the motor housing (5).

6. The drive system according to claim 5, characterized in that a first support

(6) for supporting the first electrical housing (2) is provided at the top of the motor-reducer housing, and the first electrical housing (2) is mounted to the first support (6) in a first direction by means of a first fixing member (7).

7. The drive system according to claim 6, characterized in that a second support (8) for supporting the second electrical housing (3) is provided at the top of the motor-reducer housing, and the second electrical housing (3) is mounted to the second support (8) in a second direction transverse to the first direction by means of a second fixing member (9).

8. The drive system according to claim 7, characterized in that the second support (8) has protruding parts (17, 19), and the second electrical housing (3) is provided with recesses (18, 20) which cooperate with the protruding parts.

9. The drive system according to claim 8, characterized in that the recesses (18, 20) are disposed on a bottom wall and/or a side wall of the second electrical housing (3).

10. The drive system according to claim 1, characterized in that the electric motor is electrically connected to the first electrical component, and the first electrical component is electrically connected to the second electrical component.

11. The drive system according to claim 10, characterized in that a first wiring harness connecting hole (10) is provided on a side wall of the first electrical housing (2) that is adjacent to the second electrical housing (3), a second wiring harness connecting hole (11) is provided on a side wall of the second electrical housing (3) that is adjacent to the first electrical housing (2), and the second electrical component is electrically connected to the first electrical component by means of a wiring harness passing through the first wiring harness connecting hole and the second wiring harness connecting hole.

12. The drive system according to claim 1, characterized in that the motor-reducer housing (1), the first electrical housing (2) and the second electrical housing (3) are respectively provided with cooling channels (14, 15, 16) which are in fluid communication with each other.

13. The drive system according to claim 12, characterized in that a first cooling channel connecting hole (12) is provided on a side wall of the first electrical housing (2) that is adjacent to the second electrical housing (3), and a

second cooling channel connecting hole (13) is provided on a side wall of the second electrical housing (3) that is adjacent to the first electrical housing (2), the first cooling channel connecting hole being aligned with the second cooling channel connecting hole.

14. An electric vehicle, characterized in that the electric vehicle comprises the drive system according to any one of the preceding claims 1 - 13.

15. A method for assembling a drive system of an electric vehicle, characterized in that the method comprises:

mounting an electric motor and a reducer in a motor-reducer housing (1);

mounting a first electrical component in a first electrical housing (2);

mounting a second electrical component in a second electrical housing (3);

mounting the first electrical housing (2) at one side of the motor-reducer housing (1) in a first direction; and

mounting the second electrical housing (3) at said side of the motor-reducer housing (1) in a second direction, such that the second electrical housing (3) and the first electrical housing (2) are disposed side by side,

wherein the second direction is transverse to the first direction.

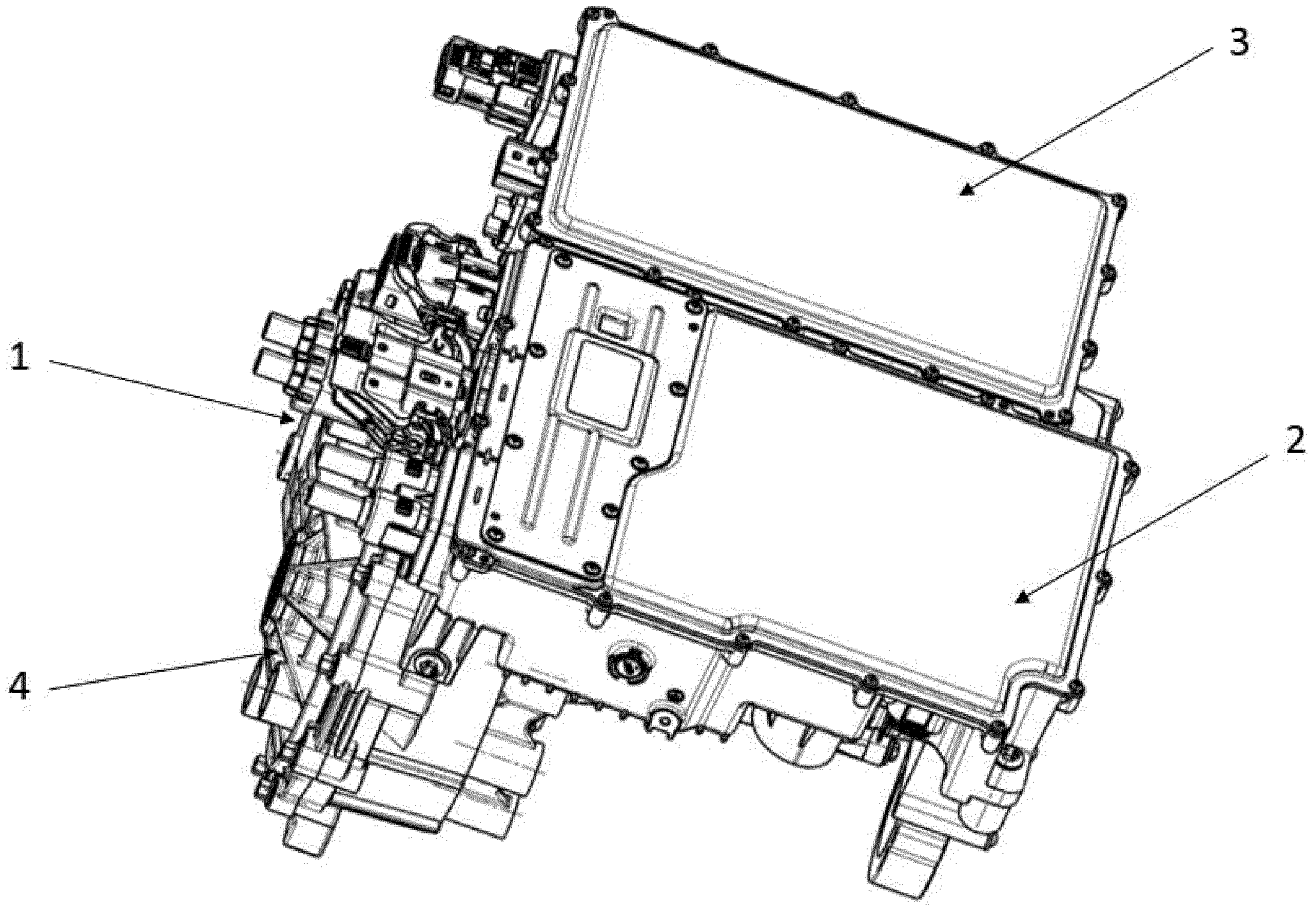

Fig. 1

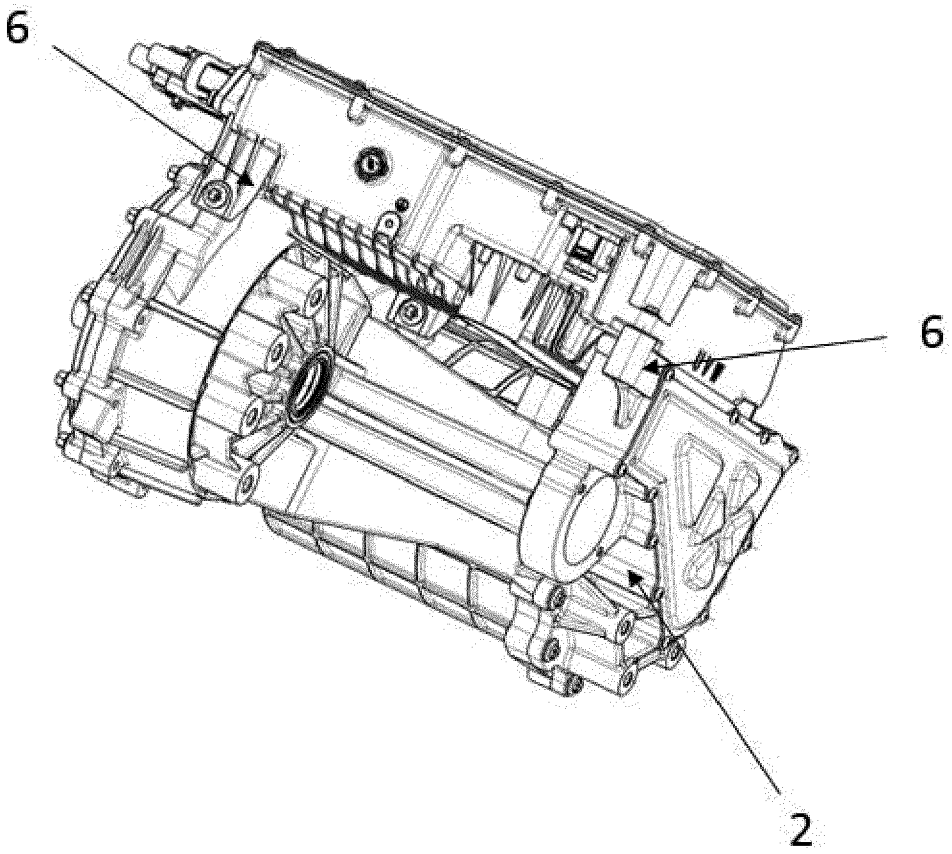

Fig. 2

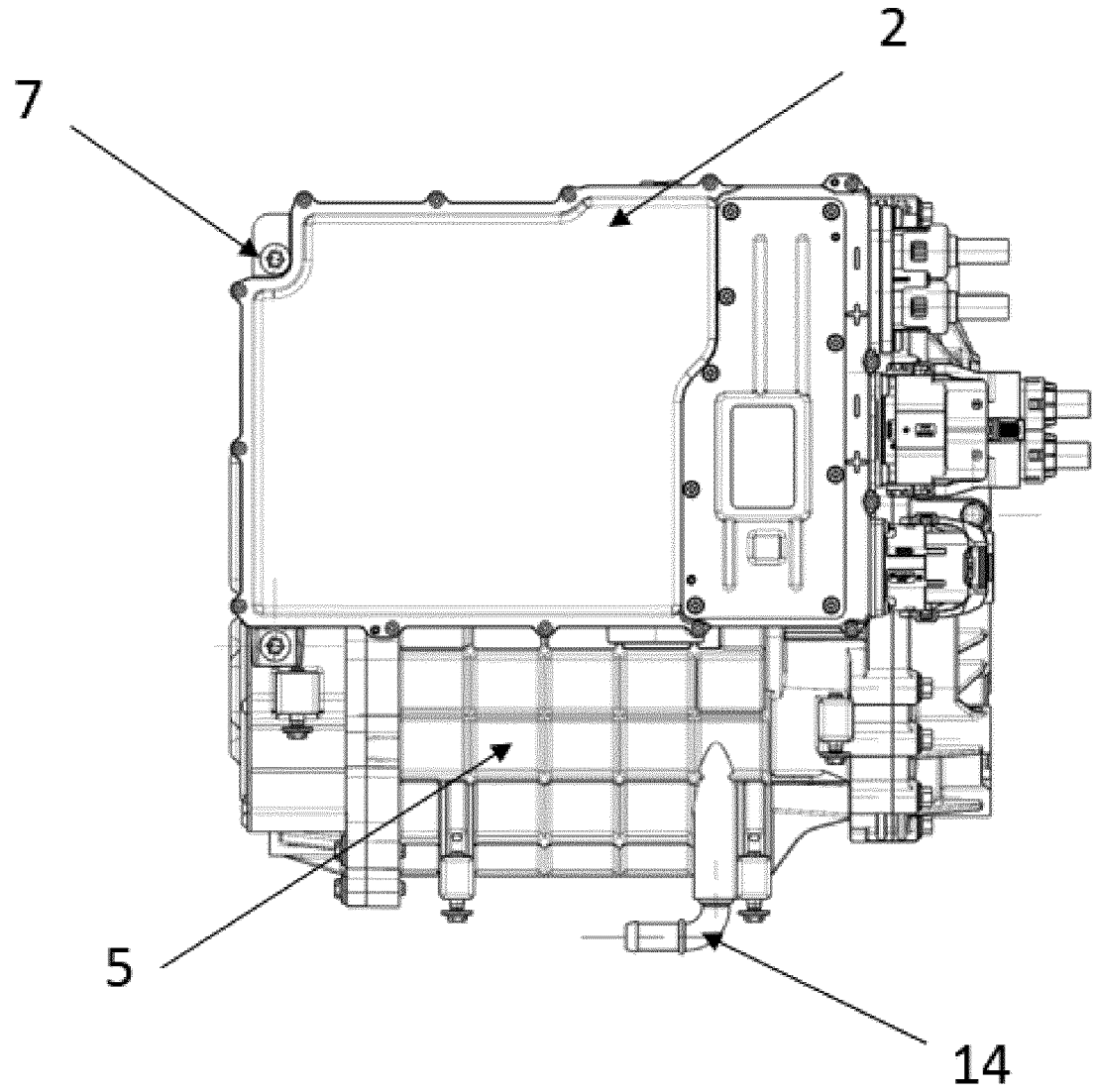

Fig. 3

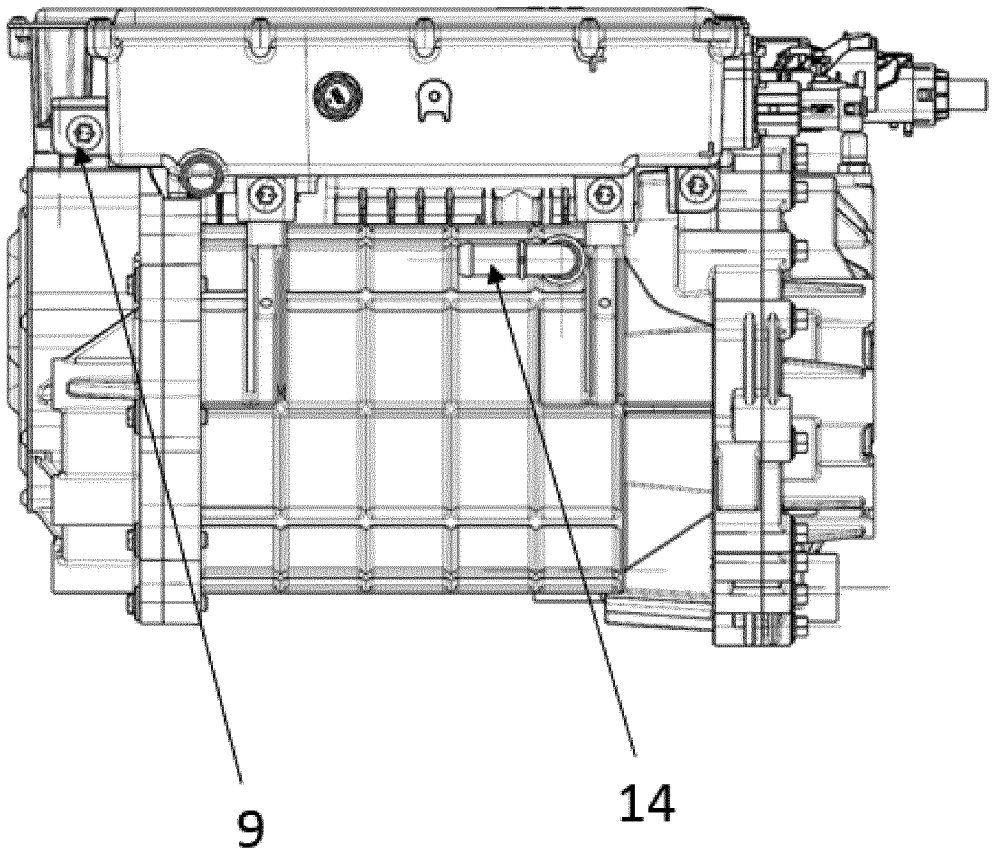

Fig. 4

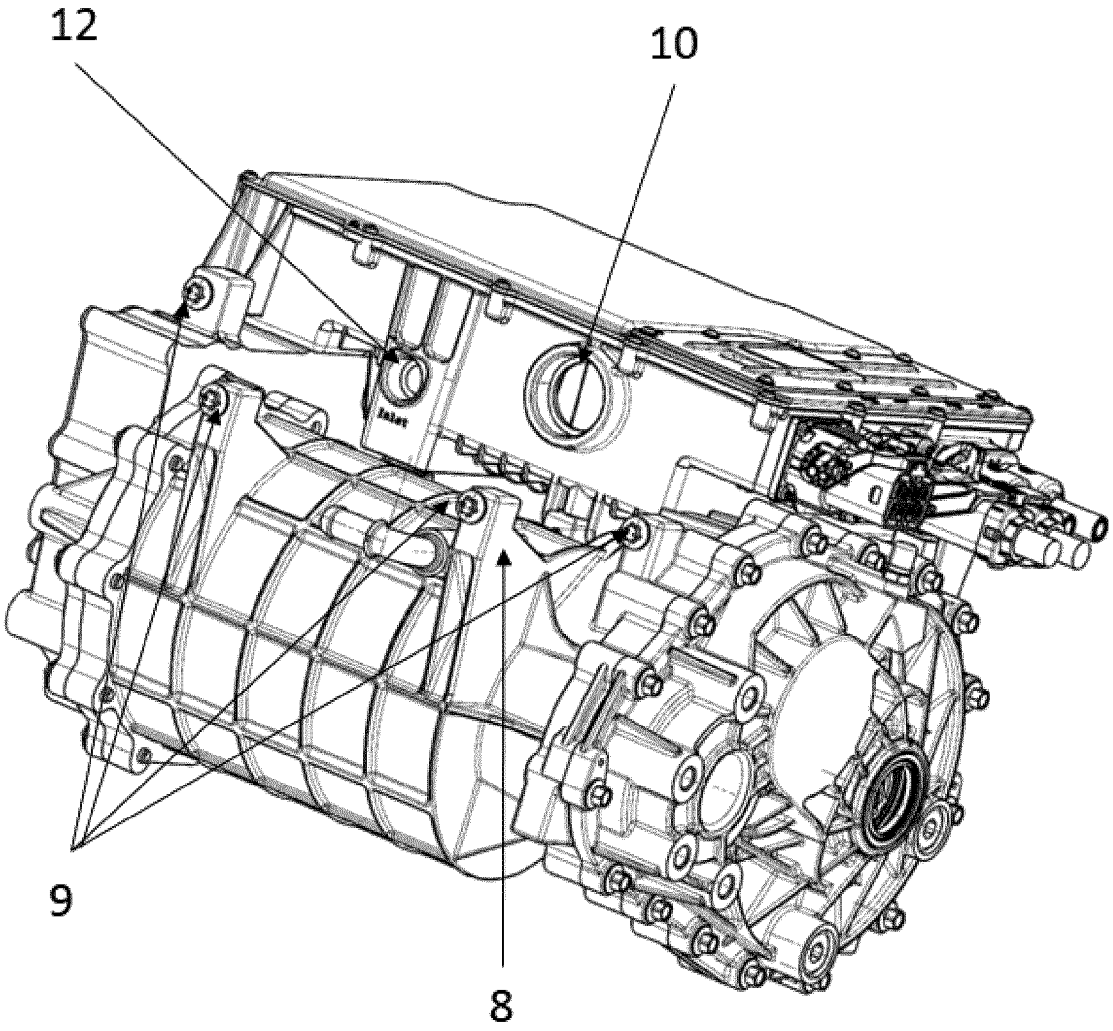

Fig. 5

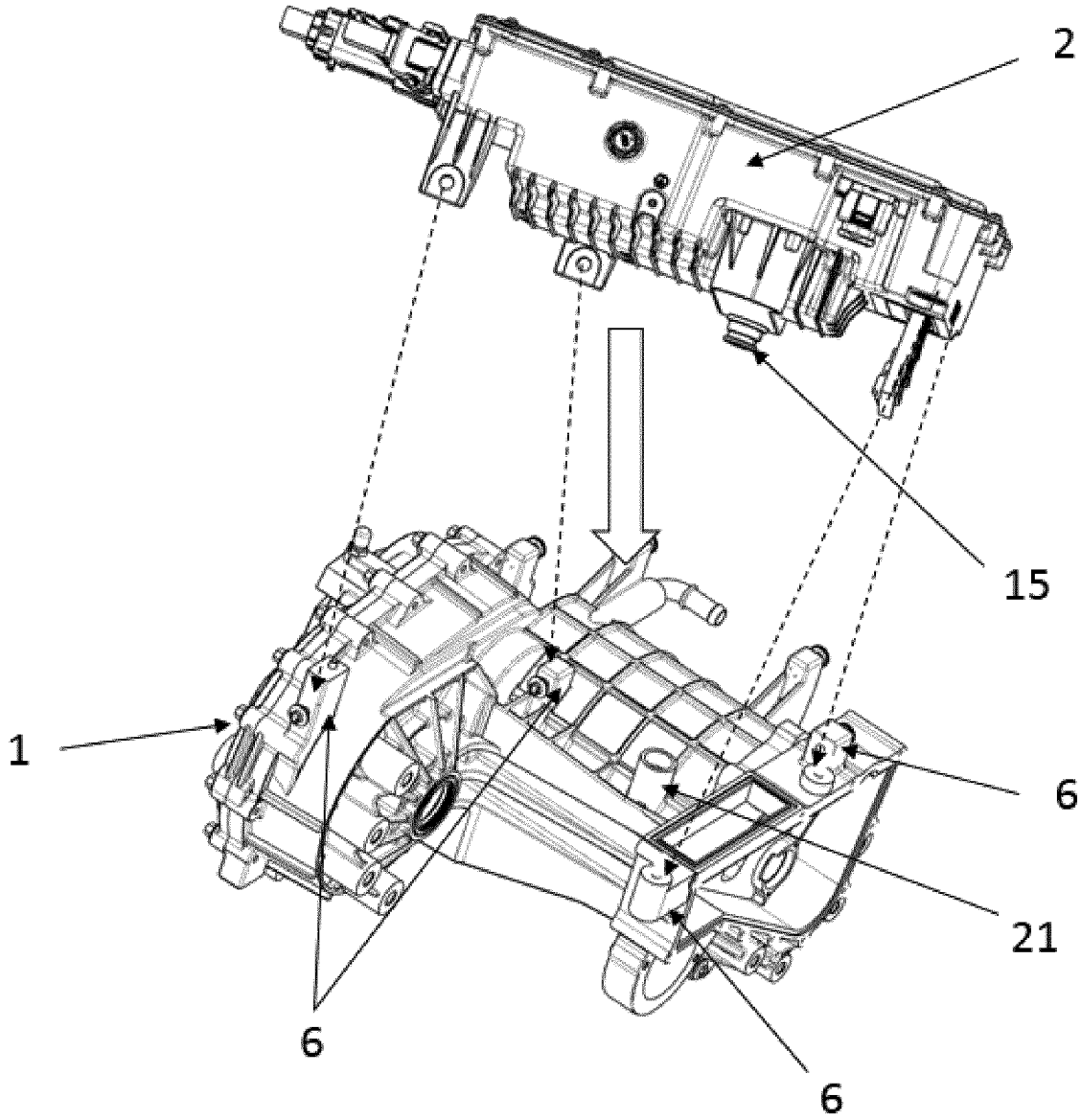

Fig. 6

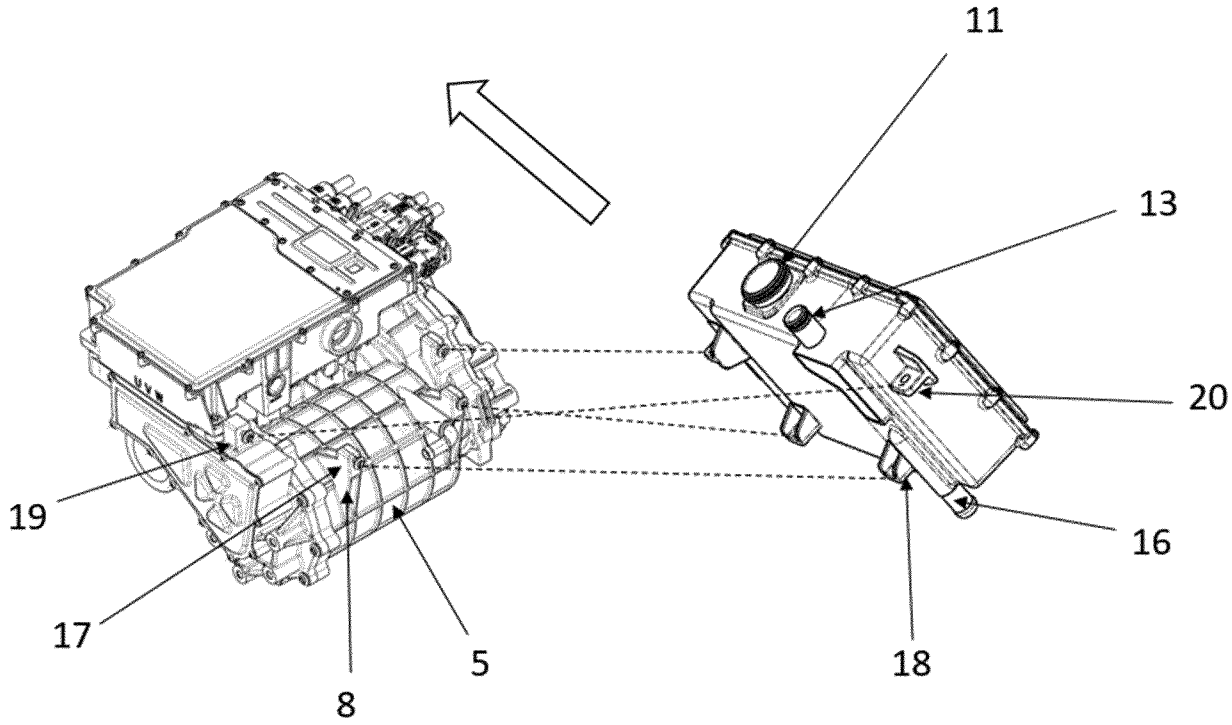

Fig. 7

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2024/059880

A. CLASSIFICATION OF SUBJECT MATTER

INV. B60K6/405 H02K7/00 H02K11/33
ADD. B60K6/48 H02K9/19 H02M7/00

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

B60K H02K H02M

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

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

EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	EP 3 988 362 A1 (MAZDA MOTOR [JP]) 27 April 2022 (2022-04-27)	1,2, 5-11,14, 15
A	paragraphs [0048], [0051]; figures	3,4,12, 13
	- - - - -	
X	EP 2 741 412 B1 (HITACHI AUTOMOTIVE SYSTEMS LTD [JP]) 23 August 2017 (2017-08-23)	1,2,5-7, 10-14
A	paragraph [0019]; figures	3,4,8,9, 15
	- - - - -	
X	US 2014/239750 A1 (NAGAO MITSUNORI [JP] ET AL) 28 August 2014 (2014-08-28) figures 1,2,8	1,10-14
	- - - - -	

☐ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

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"Y" document of particular relevance;; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
9 July 2024	24/07/2024

Name and mailing address of the ISA/	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Ulivieri, Enrico

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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/EP2024/059880

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