

High Voltage Interlock Apparatus and Method

TECHNICAL FIELD

5 The present invention generally relates to a high voltage interlock and particularly, but not exclusively, a high voltage interlock for testing an integrity of a high voltage electrical system of a vehicle.

BACKGROUND

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An alternative fuel vehicle, such as a hybrid vehicle, comprises a high-voltage (HV) electrical system. The high voltage electrical system operates at a voltage which is unsafe for human exposure, for example 300V. In the event of servicing or maintenance of the vehicle it may be necessary to interact with components of the HV electrical system, such as by removing and replacing one or more connectors joining HV components to the electrical system. Furthermore in the event of an accident the HV electrical system may become damaged. Therefore it is necessary to determine an integrity of the HV electrical system before energising the electrical system to the operating voltage.

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20 It is an object of embodiments of the invention to at least mitigate one or more of the problems of the prior art. It is an object of embodiments of the invention to provide improved interlocking of a HV electrical system of a vehicle.

SUMMARY OF THE INVENTION

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Aspects of the invention are defined in the appended claims.

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According to another aspect of the present invention there is provided a high-voltage interlock (HVI) for a vehicle comprising a means for causing a test signal to be applied to an electrical bus of the HV electrical system, a communication means for receiving voltage data indicative of one or more voltages measured within the electrical system and a control means for determining an integrity of the electrical system based on the received data. The HVI may comprise a voltage measuring means for measuring a voltage of the HV electrical system 100 and providing voltage data to the communication means.

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According to another aspect of the invention there is provided a high-voltage (HV) interlock for a vehicle, comprising a test signal component arranged to cause a test signal to be

applied to a HV DC bus of a vehicle, wherein the test signal has a maximum test voltage of less than an operating voltage of the HV DC bus; a communication component arranged to receive voltage data indicative of one or more voltages measured at locations in the HV DC bus; and a controller arranged to determine, based on the voltage data, an integrity of a HV electrical system of the vehicle. Advantageously the HV interlock directly determines the integrity of the HV DC bus from voltage measurements performed on the bus of the test voltage which is less than the operating voltage of the HV DC bus and thus safer for exposure to humans. The HV DC bus may include cabling and connectors of the bus. Embodiments of the invention do not require further cabling and connectors to be added to the vehicle such as to support a test circuit. The test signal component may comprise a pre-charging circuit arranged to pre-charge the HV DC bus to the test voltage. Application of the test signal to the HV DC bus may improve a speed of initialisation of the HV DC bus by reducing a pre-charge time required for the HV DC bus.

According to another aspect of the invention there is provided a method of determining an integrity of a high-voltage (HV) electrical system of a vehicle, comprising applying a test signal to a HV DC bus of a vehicle, the test signal having a maximum test voltage of less than an operating voltage of the HV DC bus; receiving data indicative of one or more voltages measured at respective locations on the HV DC bus; and determining an integrity of the HV electrical system based on the received data.

According to another aspect of the invention there is provided a vehicle, comprising a high-voltage (HV) electrical system comprising a HV DC bus connected to one or more HV loads a HV interlock of any of the aforementioned aspects arranged to cause a test signal to be applied to the HV DC bus, and to receive voltage data from the one or more HV loads indicative of a measured voltage of the HV DC bus at the load and to determine an integrity of the HV DC based thereon.

Within the scope of this application it is expressly intended that the various aspects, embodiments, examples and alternatives set out in the preceding paragraphs, in the claims and/or in the following description and drawings, and in particular the individual features thereof, may be taken independently or in any combination. Features described in connection with one embodiment are applicable to all embodiments, unless such features are incompatible.

BRIEF DESCRIPTION OF THE DRAWINGS

One or more embodiments of the invention will now be described, by way of example only, with reference to the accompanying drawings, in which:

Figure 1 shows a schematic of a portion of a high-voltage (HV) electrical system of a vehicle according to an embodiment of the invention;

Figure 2 shows a schematic of a portion of a high-voltage (HV) electrical system of a vehicle according to an embodiment of the invention; and

Figure 3 shows a schematic of a portion of a high-voltage (HV) electrical system of a vehicle according to an embodiment of the invention.

DETAILED DESCRIPTION

Figure 1 illustrates a portion of a high-voltage (HV) electrical system 100 of a vehicle comprising high-voltage interlock (HVI) 110 according to an embodiment of the invention. The HVI 110 is arranged to prevent operation of the HV electrical system of the vehicle in a damaged or malfunctioning state. Although not specifically shown in Figure 1 the HVI 110 according to an embodiment of the invention comprises a means for causing a test signal to be applied to an electrical bus of the HV electrical system, a communication means for receiving voltage data indicative of one or more voltages measured within the electrical system 100 and a control means for determining an integrity of the electrical system based on the received data. In some embodiments the HVI 110 comprises a voltage measuring means for measuring a voltage of the HV electrical system 100 and providing voltage data to the communication means.

The electrical system 100 comprises a HV battery module 120, one or more HV DC loads 130 and an inverter module 140 which is electrically connected to a motor 150 by a three-phase AC bus 160. In order to control operation of the motor 150 the inverter module 140 may comprise a controller 141, a plurality of gate drivers 142 and three-phase power electronics 143 for powering the motor via the three-phase bus 160. The vehicle is an alternative fuel vehicle such as an electric vehicle, a hybrid vehicle or a fuel cell vehicle. The motor may therefore be used to drive the vehicle. It should be understood that the motor may instead be a generator or a combined motor-generator.

The HV battery module 120 is connected to a HV DC bus 125 of the vehicle for providing HV DC electrical power to the at least one HV DC load 130 and the inverter module 140. The

HV battery module 120 comprises one or more bus isolation contactors 121 for isolating the HV battery module 120 from the HV DC bus 125. In the embodiment shown in Figure 1, the battery module 120 comprises two bus isolation contactors 121, one arranged on each of the HV DC bus HV+ and HV- lines. It is necessary to isolate the HV battery module 120 from the HV DC bus 125 since the HV battery module 120 operatively provides a voltage, such as 100V+, which is potentially unsafe for human exposure. The HV battery module 120 may provide an operating DC voltage of 300V, although it will be realised that this is merely an example and other voltages are also useful.

The HV DC load 130 is connected to the HV DC bus 125 by means of a connector 131 which may be removeable from the HV DC bus 125 to facilitate servicing or replacement of the load 130. The HV DC load 130 is also communicably connected to a communication bus 170 of the vehicle which may be, for example, a CAN bus 170. The communication bus 170 allows various components of the vehicle to communicate, such as the HV DC load 130 to communicate with other components of the vehicle including the HVI 110 and HV battery module 120 which are also connected to the communication bus 170. The HV DC load 130 may be, for example, an air conditioning or power steering unit of the vehicle, although this is not restrictive.

In the embodiment shown in Figure 1, the HVI 110 is arranged in the HV battery module 120. It will be realised that the HVI 110 may be arranged outside of the HV battery module 120, for example external to and communicatively coupled to the HV battery module 120. The HVI 110 is arranged to control the HV battery module 120 to reduce a risk of accidental exposure of a vehicle user, such as a driver or passenger of the vehicle, to high voltage electrical energy in situations including, but not limited to, when a high voltage connector 131 is removed from the HV DC bus 125 or the HV electric system 100 is damaged. In particular the HVI 110 may be operational during an initialisation or start-up phase of the HV DC bus 125 and/or during operation of the HV electric system 100. The HVI 110 is arranged to determine an integrity of the HV DC bus 125 before the HV DC operating voltage is applied from the HV battery module 120 to the HV DC bus 125.

In embodiments of the invention the integrity of the HV DC bus 125 is determined directly by applying a test signal to the HV DC bus 125. In contrast, prior art techniques may infer a condition of the HV DC bus 125 by testing a low-voltage circuit which is associated with the HV DC bus, such as a low voltage circuit associated with connectors 131 via which the HV DC bus 125 connects to HV DC loads 130.

The test signal comprises a test voltage which is deemed to be safe for exposure to humans. The test voltage is lower than the normal operating voltage of the HV DC bus 125. For example, the test voltage may be up to 60V DC. Alternatively the test voltage may be up to 30V AC. The test voltage may be between 12V and 60V DC in some embodiments. The test
5 signal may also have a maximum safe current of, for example, 2 Amps, although it will be realised that other values may be utilised. In the embodiment described with reference to Figure 1 the test voltage is provided from the HV DC battery module 120 although in an embodiment described with reference to Figure 3 the test voltage is provided from a low-voltage source.

10 The test signal is applied from the HV battery module 120 to the HV DC bus 125 under control of the HVI 110. Once the test signal is applied to the HV DC bus 125, the voltage on the HV DC bus 125 is measured at one or more points or locations on the HV DC bus 125. In one embodiment the voltage on the HV DC bus may be measured at one or more parallel
15 paths in the HV DC bus to provide distributed diagnostic coverage. In one embodiment the voltage on the HV DC bus 125 may be measured at each parallel path in the HV DC bus 125. In one embodiment some, or all, of the DC HV DC loads 130 connected to the HV DC bus 125 comprises a means for measuring the voltage on the HV DC bus 125 in the form of a voltage measurement module 135. The inverter module 140 may also comprise a voltage
20 measurement module 145 to measure the DC voltage provided to the inverter module 140. Although not shown in Figure 1 the HVI 110 may also comprise a voltage measurement module.

The voltage measurement modules 135, 145 are arranged to measure the DC voltage
25 provided on the HV DC bus 125 and to communicate information indicative of the measured voltage to the HVI 110. The information may be communicated via the communication bus 170. Therefore the HVI 110 is arranged to control the application of the test voltage to the HV DC bus 125 and to receive information indicative of the measured voltage at the location of each HV DC load 130 and the inverter module 140 to determine if the HV DC bus 125 is
30 operational. In this way the HVI 110 is able to directly determine the integrity or continuity of the HV DC bus 125 by means of the test signal applied thereto. If the HVI 110 receives information indicative of a voltage at one of the HV DC loads 130 or the inverter module 140 differing from the test voltage applied to the HV DC bus 125 then the HVI 110 determines that the HV DC bus 125 is subject to a malfunction. The HVI 110 may determine whether the
35 differing voltage differs from the test voltage by more than a predetermined threshold. For example, if the connector 131 to the HV DC load 130 is removed from the HV DC bus 125

then the voltage measurement module 135 of the HV DC load 130 would not measure the test voltage applied to HV DC bus 125.

In one embodiment, once the test voltage is applied to the HV DC bus 125 the inverter module 140 is arranged to test an operation of the AC bus 160 provided to the motor 150. The inverter module 140 is arranged to determine a continuity of one or more of the phases provided to the motor 160. The inverter module 140 may determine the continuity of the one or more phases by measurement of a current or a voltage of the phase(s). The inverter module 140 may measure the current or voltage of each of a plurality of phases or phase-pairs, for example three phases, provided to the motor 150. The controller 141 of the inverter module 140 is arranged to cause the power electronics 143 to apply a voltage to selected phases of the AC bus 160 and motor 150, for example, phases PH1 and PH2, and to measure a current through the selected phases. The voltage applied to the selected phases may be the test signal having the maximum test voltage previously described. In one embodiment, the controller 141 sequentially energises pairs of the phases, for example, PH1 and PH2; PH2 and PH3; and PH1 and PH3 and measures the current drawn through each. It will also be realised that the current may be measured in other locations, such as within the motor 150 or the HV battery module 120. Information indicative of the current drawn through the phases is communicated from the inverter module 140 to the HVI 110 via the communication bus 170. If the HVI 110 receives information indicative of one or more of the measured currents through the motor 150 and AC bus 160 differing from an expected value, such as by more than a predetermined value, then the HVI 110 determines that the AC bus 160 and/or motor 150 is subject to a malfunction. For example, if a connector 144 between the inverter module 140 and the AC bus 160 or a connector 161 between the inverter module 140 and the AC bus 160 is removed the HVI 110 determines a malfunction based on the measured current(s).

If the HVI 110 determines that the DC bus 125, AC bus 160 and motor 150 are operational, the HVI 110 is arranged to cause the operating HV DC voltage to be applied to the DC bus 125. As will be explained, since the HV DC bus 125 is already provided with the test voltage, the DC bus may be energised more quickly to the operating voltage.

Figure 2 illustrates the electrical system 100 of Figure 1 wherein the HV battery module 120 comprises a pre-charge module 210. The electrical system 100 comprises the same parts as described with reference to Figure 1 unless otherwise stated and these are not re-numbered in Figure 2 for clarity. It will be appreciated that the pre-charge module 210 does not replace the HVI 110 but is additional to, in some embodiments, although the HVI 110 is

not illustrated in Figure 2. The pre-charge module 210 may be formed within the HVI 110 or communicably coupled thereto. The pre-charge module 210 is arranged to apply the test voltage to the HV DC bus 125 under the control of, or in response to the HVI 110.

5 The pre-charge module 210 comprises a controller 220 which is arranged to operatively output a pre-charge control signal to one or more gate drivers 230 for controlling a power stage 240 which controls a flow of current through a primary winding of a decoupling transformer 250 which decouples the HV DC bus 125 from the HV battery module 120.

10 The pre-charge control signal may be pulse-width modulated (PWM) to control the gate driver 230. The pre-charge control signal controls a rate at which the HV DC bus 125 is charged to the test voltage. Pre-charging the HV DC bus 125 prevents an excess current being drawn from the HV battery module 120 when the HV DC bus is energised. The HV DC bus 125 is charged to the test voltage by the pre-charge module 210 under control of, or in
15 response to, the HVI 110. Following the HV DC bus 125, and in some embodiments the AC bus 160 and motor 150, being verified by the HVI 110, the working voltage is applied to the HV DC bus 125 by the HV battery module 120. Advantageously it is then only necessary to charge the HV DC bus 125 from the test voltage to the HV operating voltage which reduces a time before the HV load 130 and/or inverter module 140 are operational.

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Figure 3 illustrates a portion of a high voltage (HV) electrical system 300 of a vehicle according to an embodiment of the invention. Unless otherwise described the electrical system 300 is as previously described with reference to Figure 1 and like parts are not identified with reference numerals or further described for clarity.

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The electrical system 300 shown in Figure 3 comprises a HV DC battery module 320 for providing a HV DC bus 325 with an operating voltage which may be, but is not limited to, for example, 300V. The HV DC battery module 320 comprises a controller 321 for controlling switching of the HV DC battery module 320 to apply the HV DC operating voltage to the HV
30 DC bus 325, for example by controlling one or more electrical contactors as previously described. The controller 321 is arranged to control the contactors responsive to one or more signals received via a communication bus 370, such as a CAN bus, of the vehicle. Thus switching of the HV DC battery module 320 is responsive to the controller 321.

35 The electrical system 300 comprises a low-voltage (LV) battery 330 for providing a low-voltage to one or more components of the vehicle. The LV may provide, but is not limited to, 12V.

The electrical system 300 comprises a high-voltage interlock (HVI) 340 for providing the HV DC bus 325 test signal from the LV battery 330. The test signal may comprise a test voltage between the low-voltage of the LV battery 330 and a lower than a normal operating voltage of the HV DC bus 325. As previously described, the test voltage may be up to 60V DC and may also have a maximum safe current of, for example, 2 Amps, although other voltages and currents may be useful.

The module comprises a means for generating the test voltage in the form of a test voltage generating component 341 for generating the test voltage from the low voltage supply from the LV battery 330, and power generation component for generating the LV voltage from the HV DC supply, for example to recharge the LV battery 330.

The test voltage generating component 341 may be arranged to pre-charge the HV DC bus 325 to the test voltage. The test voltage generating component 341 may be a DC-DC convertor arranged to generate a larger voltage than the LV supply voltage. For example, the test voltage generating component 341 may be arranged to generate the test voltage of 60V from the LV supply of 12V, although it will be realised that these voltages are only examples and other voltages may be useful. The test voltage generating component 341 in the form of the DC-DC convertor may also convert 342 the HV DC voltage to the LV supply voltage to charge the LV battery.

The HVI 340 is arranged to determine that the HV DC bus 325 is subject to a malfunction based on one or more measured voltages, as previously explained with reference to Figure 1. Furthermore, the HVI 340 may, in some embodiments, determine an abnormal condition associated with the AC bus and motor based on one or more measured currents, as previously described.

In a further embodiment of the invention a test signal applied to the HVDC bus is generated by a motor-generator of the vehicle. Although not specifically shown in the figures, in one embodiment the motor-generator may be arranged to generate the test signal having a maximum test voltage of less than an operating voltage of the HV DC bus. The motor-generator may generate the test voltage based on motion of a combustion engine connected to the motor-generator through a clutch or otherwise. For example, the vehicle may be configured to be operational in a non-electric mode, for example powered by a combustion engine of the vehicle. The combustion engine may either directly or indirectly cause the

motor-generator to generate the test voltage. In some embodiments, the motor-generator may generate the test voltage based on motion of the vehicle.

5 The motor-generator may generate a voltage higher than test voltage which is reduced for application to the HV DC bus. A controller of the HVI may control the application of the test voltage to the HV DC bus in order to determine the integrity of the HV DC bus as described above. If the HV DC bus is determined to be operational the vehicle is configured to begin operation in an electric or hybrid-electric mode.

10 It will be appreciated that the HVI of the foregoing embodiments is not restricted to a single component and may comprise more than one component. For example, the test signal component, the communication component and the controller may be separate components that are operatively be coupled together.

15 It will be appreciated that embodiments of the present invention can be realised in the form of hardware, software or a combination of hardware and software. Any such software may be stored in the form of volatile or non-volatile storage such as, for example, a storage device like a ROM, whether erasable or rewritable or not, or in the form of memory such as, for example, RAM, memory chips, device or integrated circuits or on an optically or
20 magnetically readable medium such as, for example, a CD, DVD, magnetic disk or magnetic tape. It will be appreciated that the storage devices and storage media are embodiments of machine-readable storage that are suitable for storing a program or programs that, when executed, implement embodiments of the present invention. Accordingly, embodiments may provide a program comprising code for implementing a system or method as claimed in any
25 preceding claim and a machine readable storage storing such a program. Embodiments of the present invention may be conveyed electronically via any medium such as a communication signal carried over a wired or wireless connection and embodiments suitably encompass the same.

30 All of the features disclosed in this specification (including any accompanying claims, abstract and drawings), and/or all of the steps of any method or process so disclosed, may be combined in any combination, except combinations where at least some of such features and/or steps are mutually exclusive.

35 Each feature disclosed in this specification (including any accompanying claims, abstract and drawings), may be replaced by alternative features serving the same, equivalent or similar purpose, unless expressly stated otherwise. Thus, unless expressly stated otherwise,

each feature disclosed is one example only of a generic series of equivalent or similar features.

5 The invention is not restricted to the details of any foregoing embodiments. The invention extends to any novel one, or any novel combination, of the features disclosed in this specification (including any accompanying claims, abstract and drawings), or to any novel one, or any novel combination, of the steps of any method or process so disclosed. The claims should not be construed to cover merely the foregoing embodiments, but also any embodiments which fall within the scope of the claims.

CLAIMS

1. A high-voltage (HV) interlock for a vehicle, comprising:

5 a test signal component arranged to cause a test signal to be applied to a HV DC bus of a vehicle, wherein the test signal has a maximum test voltage of less than an operating voltage of the HV DC bus;

10 a communication component arranged to receive voltage data indicative of one or more voltages measured at locations in the HV DC bus; and

a controller arranged to determine, based on the voltage data, an integrity of a HV electrical system of the vehicle.

15 2. The high-voltage interlock system of claim 1, wherein the controller is arranged to determine the integrity of the HV electrical system when each measured voltage is above a predetermined value.

20 3. The high-voltage interlock of claim 1 or 2, wherein the controller is arranged to output a signal to cause an operating voltage to be applied to the HV DC bus in dependence on determining the integrity of the HV DC bus.

4. The high-voltage interlock of claim 1, 2 or 3, wherein the voltage data is received from one or more HV modules connected to the HV DC bus.

25 5. The high-voltage interlock of any preceding claim, comprising a voltage measuring component for measuring a voltage of the HV DC bus and outputting voltage data to the communication component.

30 6. The high-voltage interlock of any preceding claim, wherein the test voltage is less than 60V DC.

35 7. The high-voltage interlock of any preceding claim, wherein the communication component is arranged to receive current data indicative of one or more currents in a HV AC system of the vehicle.

8. The high-voltage interlock of claim 7, wherein the one or more currents comprise one or more of a plurality of phase currents in a motor of the HV AC system.

9. The high-voltage interlock of claim 7 or 8, wherein the controller is arranged to determine the integrity of the HV electrical system of the vehicle when each current is within one or more predetermined limits.
- 5 10. The high-voltage interlock of any preceding claim, wherein the test signal is generated from a HV power source of the vehicle.
11. The high-voltage interlock of any of claims 1 to 9, wherein the test signal is generated from a low-voltage power source of the vehicle.
- 10 12. The high-voltage interlock of any preceding claim, wherein the test signal component comprises a pre-charging circuit arranged to pre-charge the HV DC bus to the test voltage.
- 15 13. The high-voltage interlock of any preceding claim communicably coupleable to a communication bus of the vehicle to receive the voltage data.
14. A vehicle, comprising:
- 20 a high-voltage (HV) electrical system comprising a HV DC bus connected to one or more HV loads;
- a HV interlock system comprising a HVI according to any preceding claim and a voltage measurement module arranged to measure a voltage of the HV DC bus at the HV load,
- 25 wherein the HVI is arranged to cause a test signal to be applied to the HV DC bus, and to receive voltage data from the voltage measurement module indicative of a measured voltage of the HV DC bus at the load and to determine an integrity of the HV DC based thereon.
- 30 15. The vehicle of claim 14, comprising an AC inverter module for providing HV AC to a motor of the vehicle, wherein the inverter module is arranged to energise at least a portion of a HV AC electrical system and to communicate data indicative of at least one current in the HV AC system to the HV interlock.
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16. A method of determining an integrity of a high-voltage (HV) electrical system of a vehicle, comprising:

applying a test signal to a HV DC bus of a vehicle, the test signal having a maximum test voltage of less than an operating voltage of the HV DC bus;

receiving data indicative of one or more voltages measured at respective locations on the HV DC bus; and

determining an integrity of the HV electrical system based on the received data.

17. The method of claim 16, wherein the determining the integrity of the HV electrical system comprises comparing the data against a predetermined threshold.

18. The method of claim 16 or 17, comprising:

receiving data indicative of one or more currents measured in a HV AC system of the vehicle; and

determining the integrity of the HV electrical system based, in part, on the received data.

19. The method of claim 18, comprising:

selecting first and second phases of a motor of the HV AC system and energising the first and second phases;

measuring a current through the first and second phases and transmitting data indicative of the current.

20. The method of any of claims 16 to 19, comprising pre-charging the HV DC bus to a voltage up to the maximum test voltage.

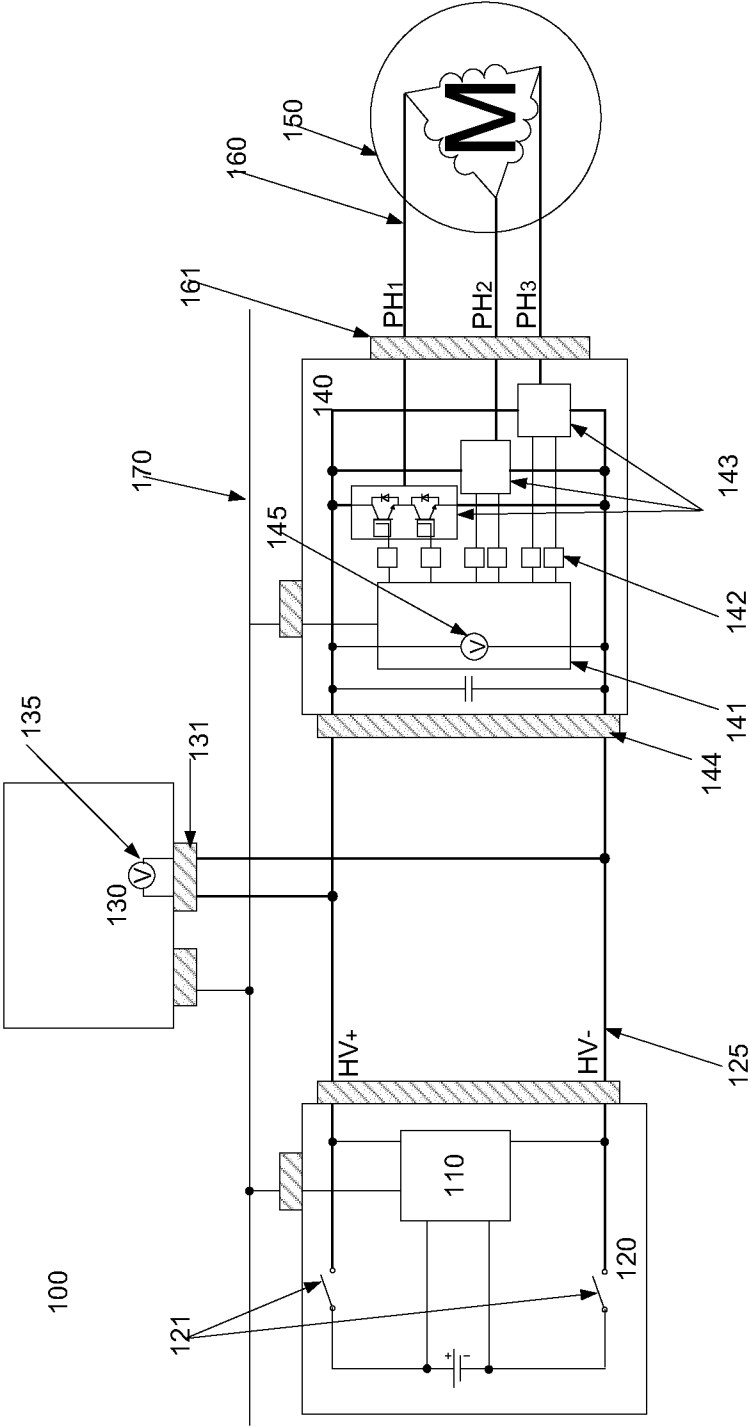


Fig 1

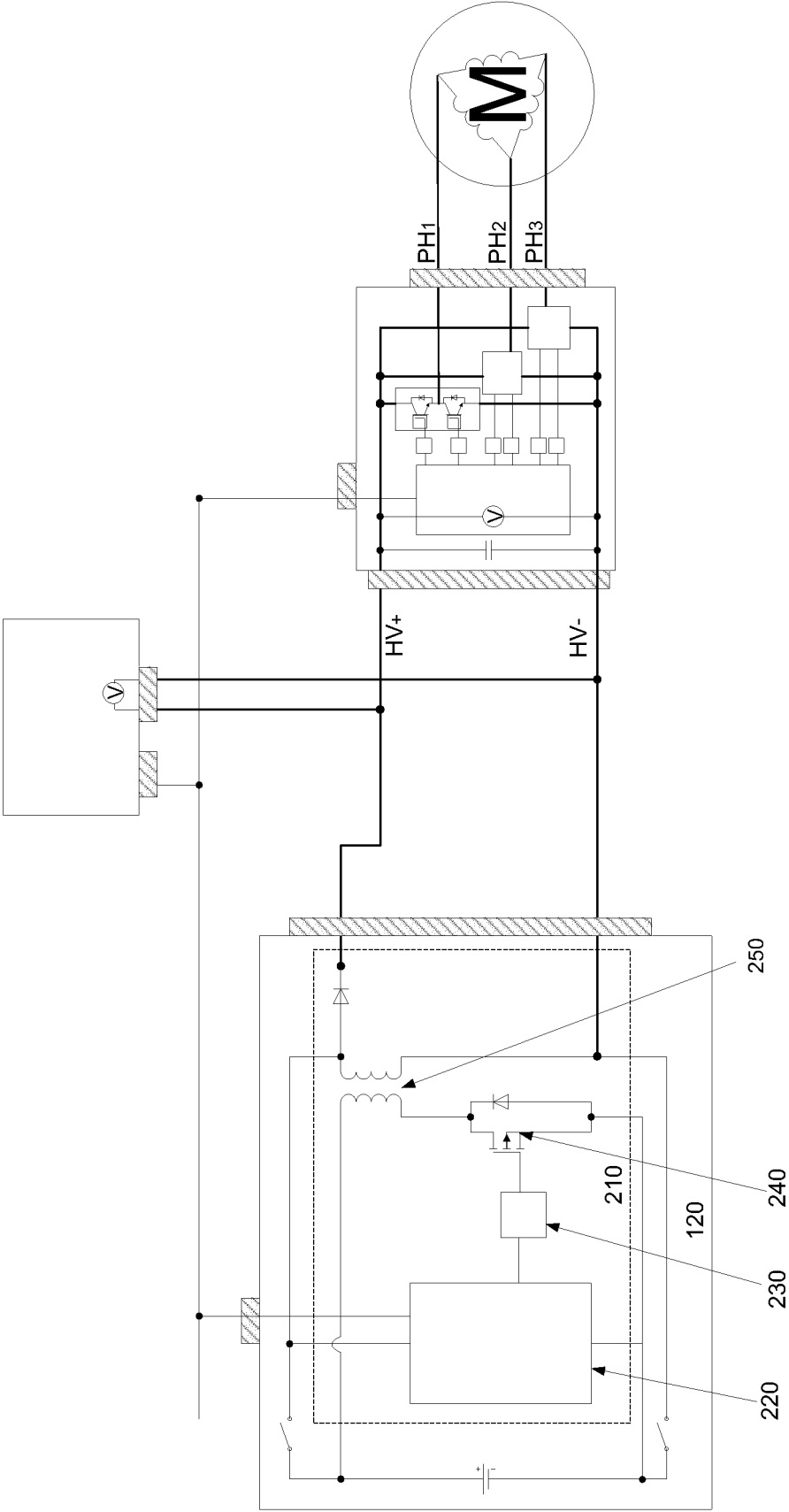


Fig 2

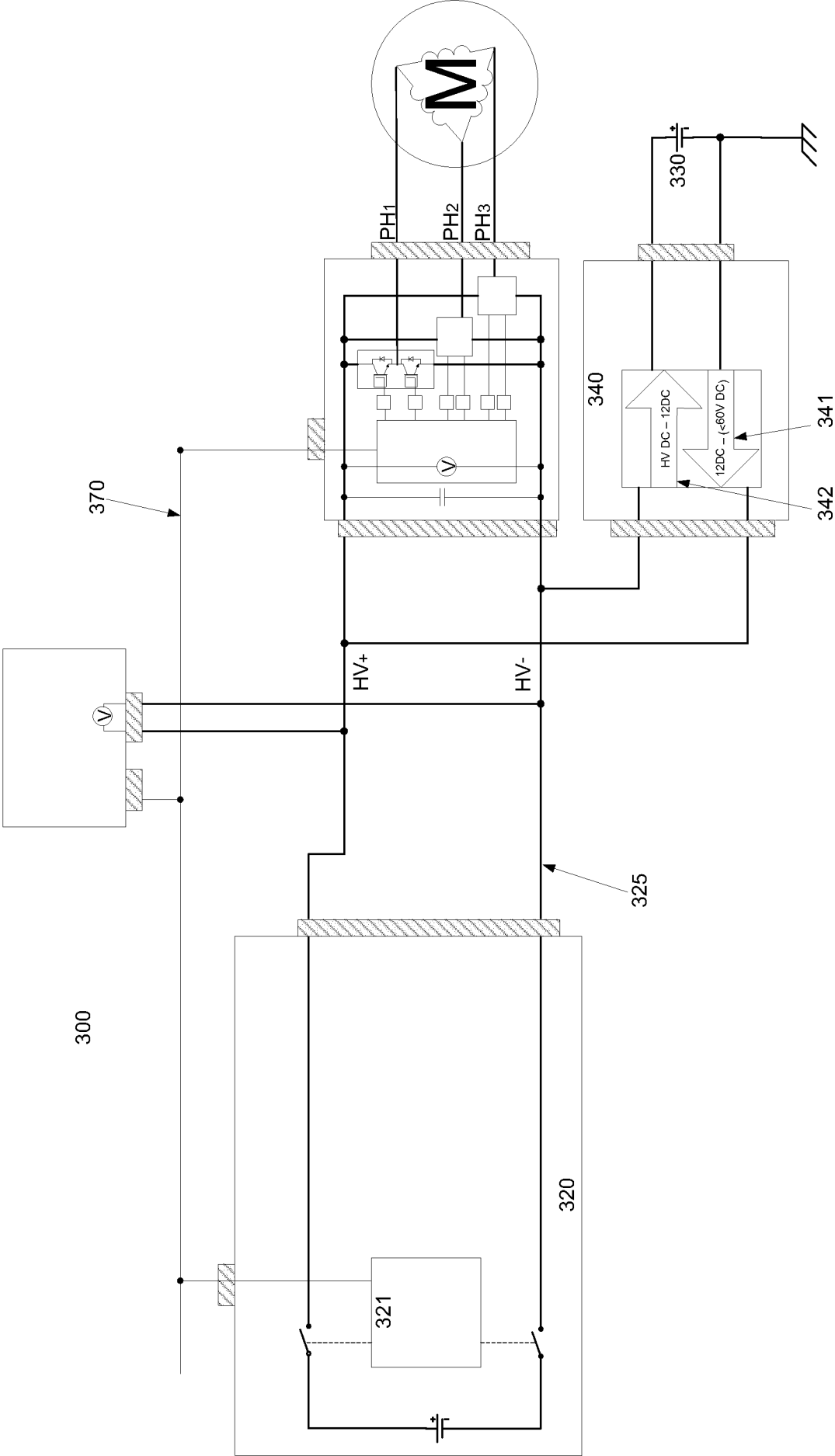


Fig 3

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2014/067682

A. CLASSIFICATION OF SUBJECT MATTER
INV. G01R31/02 G01R31/04
ADD.

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)
G01R

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, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 2013/068021 A1 (VOLVO LASTVAGNAR AB [SE]; ENGDAHL HENRIK [SE]) 16 May 2013 (2013-05-16) abstract page 6, line 11 - line 19 page 9, line 1 - page 11, line 4; figure 1 -----	1-20
X	CN 103 072 485 A (HUIZHOU EPOWER ELECTRONIC CO) 1 May 2013 (2013-05-01) the whole document See also abstract in online available databases (EPO/WPI) ----- -/-	1-20



Further documents are listed in the continuation of Box C.



See patent family annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

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"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"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

21 November 2014

Date of mailing of the international search report

01/12/2014

Name and mailing address of the ISA/

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Authorized officer

Bergado Colina, J

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2014/067682

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2014/067682

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/EP2014/067682

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