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(54) **Electric power generating set, and related control device**

(57) An electric power generating set, provided with at least one combustible fluid supply duct, which leads to at least one engine (2) for delivering mechanical energy, and a current generator (3), which is coupled to the engine (2) and is capable of converting the mechanical energy delivered by the engine (2) into electric power, to be supplied to at least one respective storage unit (4). At least one solenoid valve (5) is usually along the duct and is controlled by a respective controller (6) that can be connected in parallel to the generator (3) and to the storage unit (4); such solenoid valve (5) is usually arranged in a first configuration, for blocking the duct, in order to prevent the supply of the engine (2), and is movable on command toward a second configuration, for the free

passage of the combustible fluid, and vice versa.

The set comprises a component (7) for one-way clearance to the flow of current, which is arranged along an electrical line (8a, 8b) for connection between an electric pole (9a, 9b) of the solenoid valve (5) and a corresponding common electric pole (10a, 10b) of the controller (6) and of the storage unit (4), for one-way clearance to the flow of current from the positive electric pole (9a) of the solenoid valve (5) to the positive common electric pole (10a) of the controller (6) and of the storage unit (4) or for one-way clearance to the flow of current from the negative common electric pole (10b) of the controller (6) and of the storage unit (4) to the negative electric pole (9b) of the solenoid valve (5).

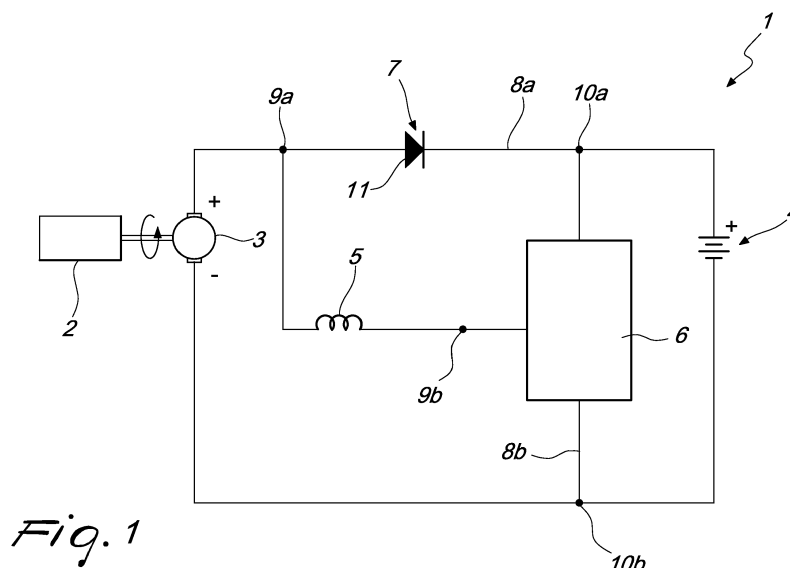


Fig. 1

Description

[0001] The present invention relates to an electric power generating set, and related control device.

[0002] Usually, means of transport such as camper vans, caravans, motor homes and the like are provided with electric power generating sets, i.e. with apparatuses that can, for example, recharge electrical energy storage units, for the purpose of ensuring the correct operation of the numerous utilities (lighting, heating, television, refrigerator etc.) with which such vehicles are provided.

[0003] As is known, such sets involve the use of an (internal combustion) engine and an electricity generator (a dynamo or an alternator), which is arranged downstream of the engine, in order to convert the mechanical energy provided by the latter to the electric power desired.

[0004] Usually, control of the engine and of the generator is entrusted to a controller, which is responsible, among other functions, for regulating the flow of fuel to the engine, according to specific requirements.

[0005] Such implementation solution is not however devoid of drawbacks.

[0006] Not infrequently in fact, during the useful life of the means of transport on which the set is installed, malfunctions of various types arise in the internal combustion engine, in the current generator and/or along the inner ducts traveled by the fuel.

[0007] In such an eventuality, the controller is responsible for detecting the malfunction and cutting off the supply of fuel, which can no longer be burned by the engine; occasionally however, as a consequence of such malfunction or due to an independent event, the controller also has a malfunction (a second malfunction), which is such as to inhibit its ability to detect the unwanted arrest of the engine.

[0008] Therefore, the controller will not cut off the supply of fuel, which, being no longer burned by the engine, can accumulate within it and in the ducts, until it spills over, with evident risks for the integrity of the set proper and, especially, the safety of the occupants.

[0009] The aim of the present invention is to solve the above mentioned problems, by providing an electric power generating set that can be controlled in an optimal manner, even in the presence of malfunctions.

[0010] Within this aim, an object of the invention is to provide a device that ensures the optimal control of an electric power generating set, even in the presence of malfunctions.

[0011] A further object of the invention is to provide an electric power generating set that is capable of guarding against the danger of egress of fuel, in the event of malfunctions.

[0012] A further object of the invention is to provide an electric power generating set that ensures a high reliability of operation.

[0013] Another object of the invention is to provide an electric power generating set that can be easily imple-

mented using elements and materials that are readily available on the market.

[0014] Another object of the invention is to provide an electric power generating set that is low cost and safely applied.

[0015] This aim and these objects are achieved by an electric power generating set, provided with at least one combustible fluid supply duct, which leads to at least one engine for delivering mechanical energy, and a current generator, which is coupled to said engine and is capable of converting the mechanical energy delivered by said engine into electric power, to be supplied to at least one respective storage unit, at least one solenoid valve being arranged along said duct and being controlled by a respective controller that can be connected in parallel to said generator and to the storage unit, said solenoid valve being usually arranged in a first configuration, for blocking said duct, in order to prevent the supply of said engine, and being movable on command toward a second configuration, for the free passage of the combustible fluid, and vice versa, characterized in that it comprises a component for one-way clearance to the flow of current, which is arranged along an electrical line for connection between an electric pole of said solenoid valve and a corresponding common electric pole of said controller and of the storage unit, for one-way clearance to the flow of current from said positive electric pole of said solenoid valve to said positive common electric pole of said controller and of the storage unit or for one-way clearance to the flow of current from said negative common electric pole of said controller and of the storage unit to said negative electric pole of said solenoid valve.

[0016] This aim and these objects are also achieved by a control device for electric power generating sets, comprising at least one controller for electric power generating sets, which are provided with at least one combustible fluid supply duct which leads to at least one engine for delivering mechanical energy, and with a current generator, which is coupled to the engine and is capable of converting the mechanical energy delivered by the engine into electric power, to be supplied to at least one respective storage unit, which can be connected in parallel to said controller and to the generator, said controller controlling at least one solenoid valve, which can be arranged along said duct and is usually arranged in a first configuration, for blocking the duct, in order to prevent the supply of the engine and can move on command toward a second configuration, for the free passage of the combustible fluid and vice versa, characterized in that it comprises a component for one-way clearance to the flow of current, which is arranged along an electrical line for connection between an electric pole of said solenoid valve and a corresponding common electric pole of said controller and of the storage unit, for one-way clearance to the flow of current from said positive electric pole of said solenoid valve to said positive common electric pole of said controller and of the storage unit or for one-way clearance to the flow of current from said negative com-

mon electric pole of said controller and of the storage unit to said negative electric pole of said solenoid valve.

[0017] Further characteristics and advantages of the invention will become better apparent from the description of two preferred, but not exclusive, embodiments of the electric power generating set (and related control device) according to the invention, illustrated by way of non-limiting example in the accompanying drawings wherein:

Figure 1 is a schematic circuit diagram of the electric power generating set according to the invention, in the first embodiment;

Figure 2 is a schematic circuit diagram of the electric power generating set according to the invention, in the second embodiment.

[0018] With reference to the figures, the reference numeral 1 generally designates an electric power generating set, which is provided, according to substantially conventional methods, with at least one combustible fluid supply duct, which leads to at least one engine 2, which is capable of dispensing mechanical energy, and of a current generator 3, which is coupled to the engine 2 and capable of converting the mechanical energy delivered by the engine 2 into electric power.

[0019] In this manner, the generator 3 can supply electricity to at least one respective storage unit 4.

[0020] The electric power generating set 1 can thus be applied, preferably but not exclusively, to means of transport such as camper vans, caravans, motor homes and the like, for example for recharging the electricity storage units 4, with which such vehicles are equipped, for the purpose of ensuring the correct operation of the numerous utilities (lighting, heating, television, refrigerator etc.) with which they are provided.

[0021] The above mentioned storage unit 4 can also be constituted by the starter battery that is associated with the power plant of the means of transport, just as the possibility is not excluded of providing sets 1 which come under the scope of protection claimed herein, and are intended to charge two or more storage units 4, and possibly also other types of user loads.

[0022] It should be made clear from this point onward that although the use of the set 1 for means of transport such as those mentioned above constitutes the preferred application of the invention, and for this reason reference will be made predominantly to this application in the present discussion, the possibility is not ruled out of using the set 1 according to the invention in different sectors of application, while remaining within the scope of protection claimed herein.

[0023] In any case, at least one solenoid valve 5 is arranged along the duct, and is controlled by a respective controller 6, which in turn can be connected in parallel to the generator 3 and to the storage unit 4.

[0024] In more detail, the solenoid valve 5 (which can also be chosen to be conventional) is usually arranged in a first configuration, for blocking the duct, so as to

prevent the supply of the engine 2, by obstructing the passage of combustible fluid along the duct. Furthermore, the solenoid valve 5 can move on command toward a second configuration, for the free passage of the combustible fluid (in order to allow the supply of the engine 2 and the delivery of electric power by the generator 3 and by the set 1), and vice versa.

[0025] So in fact, during the normal operation of the set 1, the controller 6 is independently capable of commanding the solenoid valve 5, and thus of bringing it from the first to the second configuration, or vice versa, according to specific requirements, in order to deny or allow the supply of the engine 2 with the combustible fluid.

[0026] According to the invention, the electric power generating set 1 comprises a component 7 for one-way clearance to the flow of current, which is arranged along an electrical line 8a, 8b for connection between an electric pole 9a, 9b of the solenoid valve 5 and a corresponding common electric pole 10a, 10b of the controller 6 and of the storage unit 4. In this manner, the component 7 can provide one-way clearance to the flow of current from the positive electric pole 9a of the solenoid valve 5 to the positive common electric pole 10a of the controller 6 and of the storage unit 4, or it can provide one-way clearance to the flow of current from the negative common electric pole 10b of the controller 6 and of the storage unit 4 to the negative electric pole 9b of the solenoid valve 5.

[0027] More precisely, in the embodiment in Figure 1, the component 7 is arranged along a first electrical line 8a for connection between the positive electric pole 9a of the solenoid valve 5 and the positive common electric pole 10a of the controller 6 and of the storage unit 4. In such embodiment, the component 7 ensures one-way clearance to the flow of current from the positive electric pole 9a of the solenoid valve 5 to the positive common electric pole 10a of the controller 6 and of the storage unit 4, while it prevents the flow in the opposite direction (with the useful effects that will be highlighted in the following pages).

[0028] Vice versa, in the embodiment in Figure 2 (which does not exhaust the possible embodiments while remaining within the scope of protection claimed herein), the component 7 is arranged along a second electrical line 8b for connection between the negative electric pole 9b of the solenoid valve 5 and the negative common electric pole 10b of the controller 6 and of the storage unit 4. In this second embodiment, the component 7 ensures one-way clearance to the flow of current from the negative common electric pole 10b of the controller 6 and of the storage unit 4 to the negative electric pole 9b of the solenoid valve 5, thus preventing the flow in the opposite direction (thus being able to count on the previously mentioned positive effects, associated with the first embodiment, as will become better apparent hereinafter).

[0029] It should be noted from this point onward that the component 7 can be any, according to specific application requirements, and for example it can be selected from among a diode 11, a thyristor and a MOSFET

(also known as a MOS transistor, which contains a diode 11 within it and is provided with a gate that can be used as an additional control terminal).

[0030] By using a thyristor, in one of its variants (for example a GTO, or "Gate Turn Off") it is possible to subject the one-way clearance to the flow of current to a further triggering signal.

[0031] In particular, in the preferred embodiment, which is shown in the accompanying Figure 1 by way of non-limiting example of the application of the invention, the component 7 for one-way clearance is a diode 11.

[0032] The engine 2 can be any, and can be for example any internal combustion engine, running on any desired combustible fluid, according to specific requirements.

[0033] With further reference to the preferred application, the engine 2 is however a two-stroke engine running on LPG, which in fact thus constitutes the combustible fluid, and which is supplied to the engine 2 through the supply duct.

[0034] The choice of such type of engine 2 in fact ensures compactness, low noise, reduced vibrations, reliability, and absence of scheduled maintenance. Furthermore, in order to reduce the vertical space occupation, the possibility exists that the engine 2 is arranged with its cylinder horizontal, at least during use.

[0035] The generator 3 can be an alternator, but in the preferred application, introduced previously, it is constituted by a dynamo. This solution makes it possible to have direct current directly at the outlet, without requiring the interposition of a rectifier, thus having available, relatively simply, a powerful electric motor device, to be used also for starting the electric power generating set 1, without having to resort to a traditional starting motor, thus obtaining a reduction of space occupation, weight, cost, and a mechanical and electrical simplification.

[0036] The control device for electric power generating sets thus comprises at least one controller 6 for electric power generating sets 1 that are provided with at least one combustible fluid supply duct, which leads to at least one engine 2, which is capable of delivering mechanical energy.

[0037] The electric power generating set 1 is furthermore provided with a current generator 3, which is coupled to the engine 2 and is capable of converting the mechanical energy delivered by the engine 2 into electric power, to be supplied to at least one respective storage unit 4, which can be connected in parallel to the controller 6 and to the generator 3.

[0038] The controller 6 controls at least one solenoid valve 5, which can be arranged along the duct and is usually arranged in a first configuration, for blocking the duct, in order to prevent the supply of the engine 2. The solenoid valve 5 can move on command toward a second configuration, for the free passage of the combustible fluid, and vice versa.

[0039] According to the invention, the control device comprises a component 7 for one-way clearance to the

flow of current, which is arranged along an electrical line 8a, 8b for connection between an electric pole 9a, 9b of the solenoid valve 5 and a corresponding common electric pole 10a, 10b of the controller 6 and of the storage unit 4. More precisely, the component 7 can ensure one-way clearance to the flow of current from the positive electric pole 9a of the solenoid valve 5 to the positive common electric pole 10a of the controller 6 and of the storage unit 4, while preventing the flow of current in the opposite direction.

[0040] Alternatively, the component 7 can provide one-way clearance to the flow of current from the negative common electric pole 10b of the controller 6 and of the storage unit 4 to the negative electric pole 9b of the solenoid valve 5, while preventing the flow of current in the opposite direction.

[0041] In particular, as has been seen, the component 7 for one-way clearance can be of any type, according to specific requirements, while remaining within the scope of protection claimed herein, and for example it can be chosen from among a diode 11, a thyristor and a MOSFET.

[0042] Preferably, the component 7 for one-way clearance is in any case a diode 11.

[0043] Operation of the electric power generating set (and of the control device) according to the invention is the following.

[0044] During normal operation of the electric power generating set 1 according to the invention, when the generator 3 is dispensing current, the latter can flow along the connecting electrical lines 8a, 8b (obviously as well as the remaining electrical connections); thus, both the controller 6, with the solenoid valve 5 controlled by it, and the storage unit 4, can be powered.

[0045] In such condition, as previously noted in the foregoing pages, the controller 6 can command the transition of the solenoid valve 5 from the first configuration to the second, and vice versa, and thus control the cutoff or supply of the engine 2, in order to deny or allow the delivery of electric power by the generator 3, associated with the engine 2, according to specific requirements.

[0046] To this end, the solenoid valve 5 can be provided with a solenoid that, when current flows through it (following a command imparted by the controller 6), is capable of attracting a baffle that is usually arranged to block the duct, thus causing the transition to the second configuration and allowing the combustible fluid to flow through the duct, to supply the engine 2.

[0047] In order to obtain such result, as can be seen from the accompanying Figure 1, the positive electric pole 9a of the solenoid valve 5 (and of the solenoid) can be directly connected to the positive electrical terminal of the generator 3, while the negative electric pole 9b of the solenoid valve 5 (and of the solenoid) is directly connected to the controller 6.

[0048] Alternatively, as in Figure 2, the positive electric pole 9a of the solenoid valve 5 (and of the solenoid) can be connected to the controller 6 (obviously suitably mod-

ified, with respect to the previous case), while the negative electric pole 9b of the solenoid valve 5 (and of the solenoid) is directly connected to the negative electrical terminal of the generator 3.

[0049] Obviously, it is sufficient that the controller 6 cuts off the flow of current, in order to cause the automatic restoration of the first configuration and thus the interruption of the supply of the engine 2.

[0050] If any problem or malfunction arises which affects the set 1 (the engine 2 and/or the generator 3 and/or the supply duct, etc), and is in any case such as to determine an unwanted interruption of the operation of the engine 2, then by way of the specific arrangement of the connections between the elements involved, the consequent automatic failure to supply current by the generator 3, also determines the automatic failure to supply power to the solenoid valve 5, which thus is brought automatically to the first configuration (or maintains it), independently of any commands of the controller 6.

[0051] It should be noted in fact that in both of the embodiments described above (and illustrated in the two accompanying figures), in the event of failure to supply current by the generator 3, the solenoid valve 5 automatically has no power supply, independently of the behavior of the controller 6 (which can still be powered by the storage unit 4).

[0052] Therefore, in the event of problems and malfunctions, the solenoid valve 5 automatically cuts off and prevents the flow of fluid along the duct, even if, owing to a further malfunction, the arrest of the engine 2 is not detected by the controller 6, and thus the latter is not capable of sending the corresponding command to the solenoid valve 5.

[0053] More precisely in fact, in the embodiment in Figure 1, the decoupling between the positive electric pole 9a of the solenoid valve 5 and the positive common electric pole 10a of the controller 6 and of the storage unit 4, which is obtained thanks to the diode 11 (or other component 7 for one-way clearance), prevents the flow of current from the storage unit 4 to the solenoid valve 5 which thus, in the absence of electricity from the generator 3, has absolutely no power supply. This therefore makes it possible to provide an electric power generating set 1 that can be controlled in an optimal manner, even in the presence of malfunctions (and/or, similarly, it makes it possible to provide a device that is capable of optimally controlling the set 1).

[0054] Similarly, also in the embodiment in Figure 2, the decoupling between the negative electric pole 9b of the solenoid valve 5 and the negative common electric pole 10b of the controller 6 and of the storage unit 4, which is obtained thanks to the diode 11 (or other component 7 for one-way clearance), prevents the flow of current from the storage unit 4 to the solenoid valve 5. Thus, once again, in the event of failure to supply current by the generator 3, the solenoid valve 5 will have no power supply and thus it is brought to (or is maintained in) the first configuration, thus achieving the results men-

tioned earlier for the previous embodiment.

[0055] In any case thus, it is certain that in the presence of any malfunction of the engine 2 or of the generator 3 connected thereto, with the latter stopping the supply of current, the solenoid valve 5 will automatically cut off the supply of LPG (or other combustible fluid), irrespective of the behavior of the controller 6.

[0056] Thus the danger is guarded against that, in the event of malfunctions, the combustible fluid, no longer burned by the engine 2, can spill over and cause serious damage to the set 1 and/or pose a risk to the personal safety of the occupants of the vehicle on which the set 1 is installed.

[0057] In practice it has been found that the electric power generating set (and the control device) according to the invention fully achieves the set aim, in that the use of a component for one-way clearance to the flow of current, which is arranged along an electrical line for connection between an electric pole of the solenoid valve and a corresponding common electric pole of the controller and of the storage unit, makes it possible to provide an electric power generating set that can be controlled in an optimal manner, even in the presence of malfunctions.

[0058] The invention, thus conceived, is susceptible of numerous modifications and variations, all of which are within the scope of the appended claims. Moreover, all the details may be substituted by other, technically equivalent elements.

[0059] In the embodiments illustrated, individual characteristics shown in relation to specific examples may in reality be interchanged with other, different characteristics, existing in other embodiments.

[0060] In practice, the materials employed, as well as the dimensions, may be any according to requirements and to the state of the art.

[0061] The disclosures in Italian Patent Application No. BO2013A000582 from which this application claims priority are incorporated herein by reference.

[0062] Where technical features mentioned in any claim are followed by reference signs, those reference signs have been included for the sole purpose of increasing the intelligibility of the claims and accordingly, such reference signs do not have any limiting effect on the interpretation of each element identified by way of example by such reference signs.

Claims

1. An electric power generating set, provided with at least one combustible fluid supply duct, which leads to at least one engine (2) for delivering mechanical energy, and a current generator (3), which is coupled to said engine (2) and is capable of converting the mechanical energy delivered by said engine (2) into electric power, to be supplied to at least one respective storage unit (4), at least one solenoid valve (5)

- being arranged along said duct and being controlled by a respective controller (6) that can be connected in parallel to said generator (3) and to the storage unit (4), said solenoid valve (5) being usually arranged in a first configuration, for blocking said duct, in order to prevent the supply of said engine (2), and being movable on command toward a second configuration, for the free passage of the combustible fluid, and vice versa, **characterized in that** it comprises a component (7) for one-way clearance to the flow of current, which is arranged along an electrical line (8a, 8b) for connection between an electric pole (9a, 9b) of said solenoid valve (5) and a corresponding common electric pole (10a, 10b) of said controller (6) and of the storage unit (4), for one-way clearance to the flow of current from said positive electric pole (9a) of said solenoid valve (5) to said positive common electric pole (10a) of said controller (6) and of the storage unit (4) or for one-way clearance to the flow of current from said negative common electric pole (10b) of said controller (6) and of the storage unit (4) to said negative electric pole (9b) of said solenoid valve (5).
2. The electric power generating set according to claim 1, **characterized in that** said one-way clearance component (7) is selected from among a diode (11), a thyristor and a MOSFET.
 3. The electric power generating set according to one or more of the preceding claims, **characterized in that** said one-way clearance component (7) is a diode (11).
 4. The electric power generating set according to one or more of the preceding claims, **characterized in that** said component (7) is arranged along a first said electrical line (8a) for connection between said positive electric pole (9a) of said solenoid valve (5) and said positive common electric pole (10a) of said controller (6) and of the storage unit (4), for one-way clearance to the flow of current from said positive electric pole (9a) of said solenoid valve (5) to said positive common electric pole (10a) of said controller (6) and of the storage unit (4).
 5. The electric power generating set according to one or more of claims 1 to 4 and as an alternative to claim 5, **characterized in that** said component (7) is arranged along a second said electrical line (8b) for connection between said negative electric pole (9b) of said solenoid valve (5) and said negative common electric pole (10b) of said controller (6) and of the storage unit (4), for one-way clearance to the flow of current from said negative common electric pole (10b) of said controller (6) and of the storage unit (4) to said negative electric pole (9b) of said solenoid valve (5).
 6. The electric power generating set according to one or more of the preceding claims, **characterized in that** said engine (2) is a two-stroke engine running on LPG, which constitutes said combustible fluid, which is supplied to said engine (2) by said supply duct.
 7. The electric power generating set according to one or more of the preceding claims, **characterized in that** said current generator (3) is a dynamo.
 8. A control device for electric power generating sets, comprising at least one controller (6) for electric power generating sets (1), which are provided with at least one combustible fluid supply duct which leads to at least one engine (2) for delivering mechanical energy, and with a current generator (3), which is coupled to the engine (2) and is capable of converting the mechanical energy delivered by the engine (2) into electric power, to be supplied to at least one respective storage unit (4), which can be connected in parallel to said controller (6) and to the generator (3), said controller (6) controlling at least one solenoid valve (5), which can be arranged along said duct and is usually arranged in a first configuration, for blocking the duct in order to prevent the supply of the engine (2) and can move on command toward a second configuration for the free passage of the combustible fluid and vice versa, **characterized in that** it comprises a component (7) for one-way clearance to the flow of current, which is arranged along an electrical line (8a, 8b) for connection between an electric pole (9a, 9b) of said solenoid valve (5) and a corresponding common electric pole (10a, 10b) of said controller (6) and of the storage unit (4), for one-way clearance to the flow of current from said positive electric pole (9a) of said solenoid valve (5) to said positive common electric pole (10a) of said controller (6) and of the storage unit (4) or for one-way clearance to the flow of current from said negative common electric pole (10b) of said controller (6) and of the storage unit (4) to said negative electric pole (9b) of said solenoid valve (5).
 9. The control device according to claim 8, **characterized in that** said one-way clearance component (7) is selected from among a diode (11), a thyristor and a MOSFET.
 10. The control device according to one or more of claims 8 and 9, **characterized in that** said one-way clearance component (7) is a diode (11).

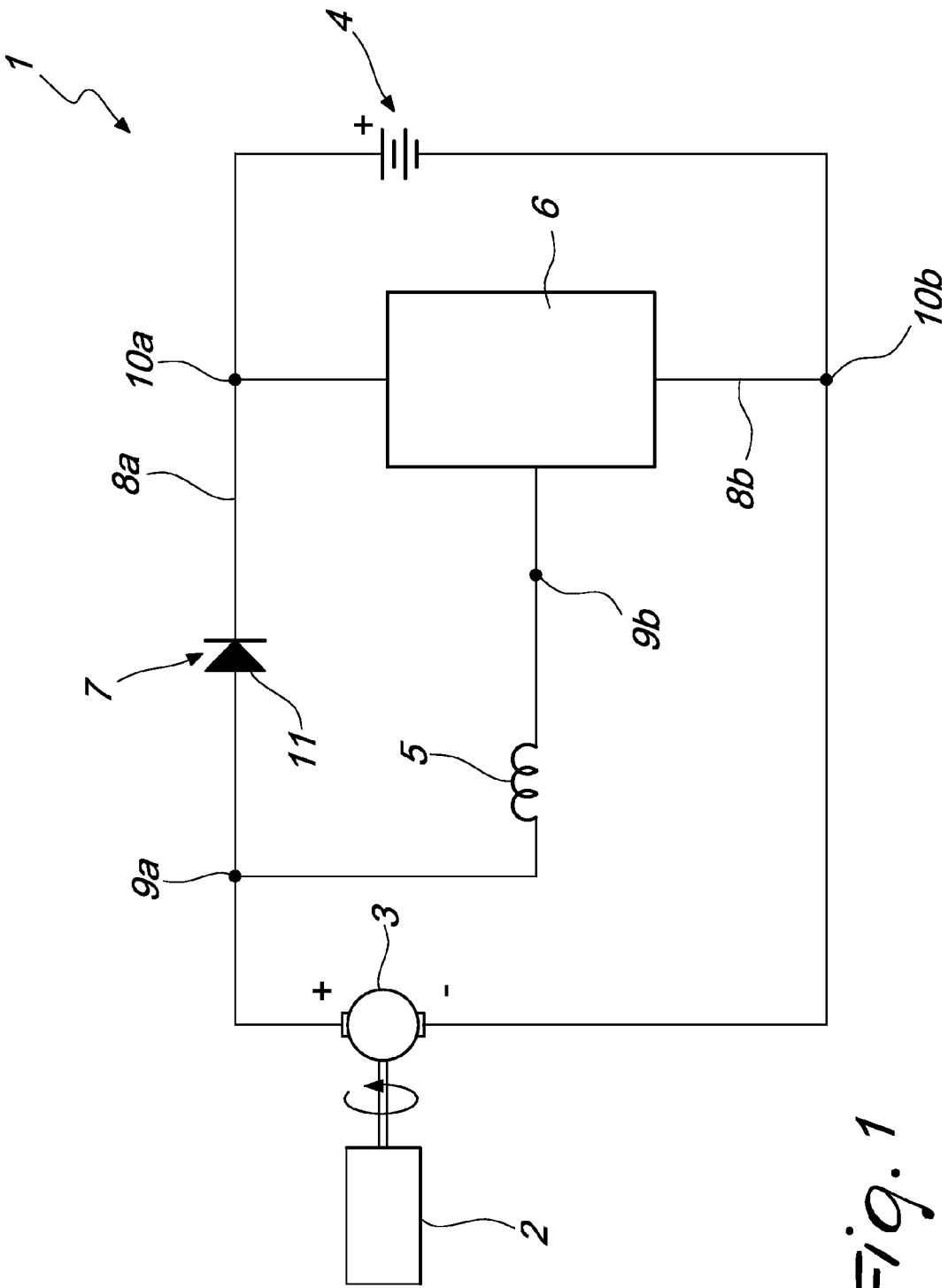


Fig. 1

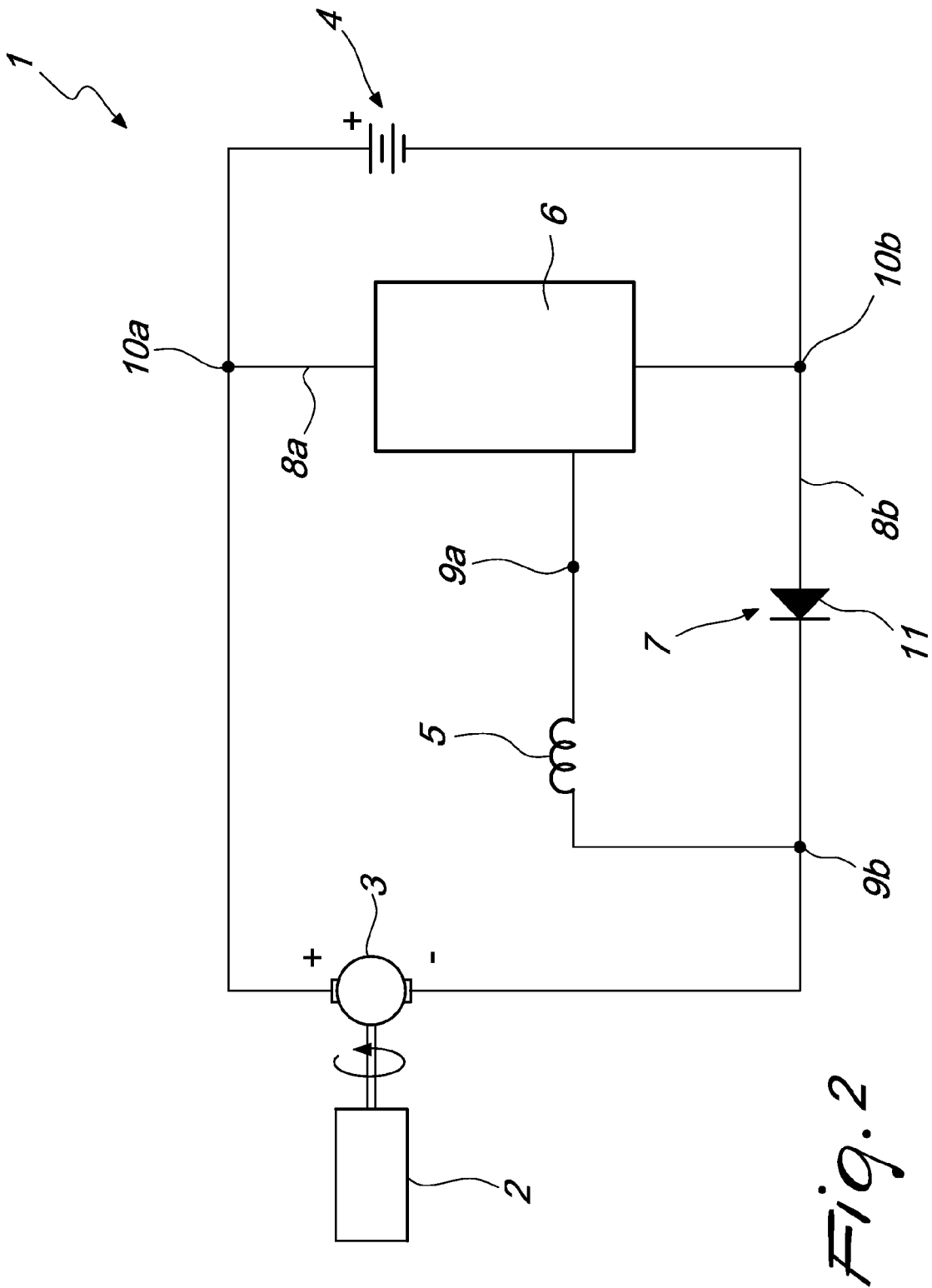


Fig. 2



EUROPEAN SEARCH REPORT

 Application Number
EP 14 18 9639

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The present search report has been drawn up for all claims			
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**ANNEX TO THE EUROPEAN SEARCH REPORT
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EP 14 18 9639

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For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

REFERENCES CITED IN THE DESCRIPTION

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