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(54) ELECTRIC POWER GENERATING SET FOR MEANS OF TRANSPORT

(57) An electric power generating set for means of transport, which comprises in series a primary engine (2), to deliver mechanical energy, an alternator (3), to convert the mechanical energy delivered by the primary engine (2) into electric power, with first voltage and frequency values, and a converter (4), to vary the first values and then transfer energy to at least one electrical load (6) that can be installed on the means of transport, with second voltage and frequency values.

The generating set comprises an electronic control and management unit (7), which is functionally associated with the converter (4) and with an actuator (8) for actuating a regulator (9) of the number of revolutions of the primary engine (2), in order to adapt the number of revolutions, by way of the regulator (9), to the energy demands of the load (6).

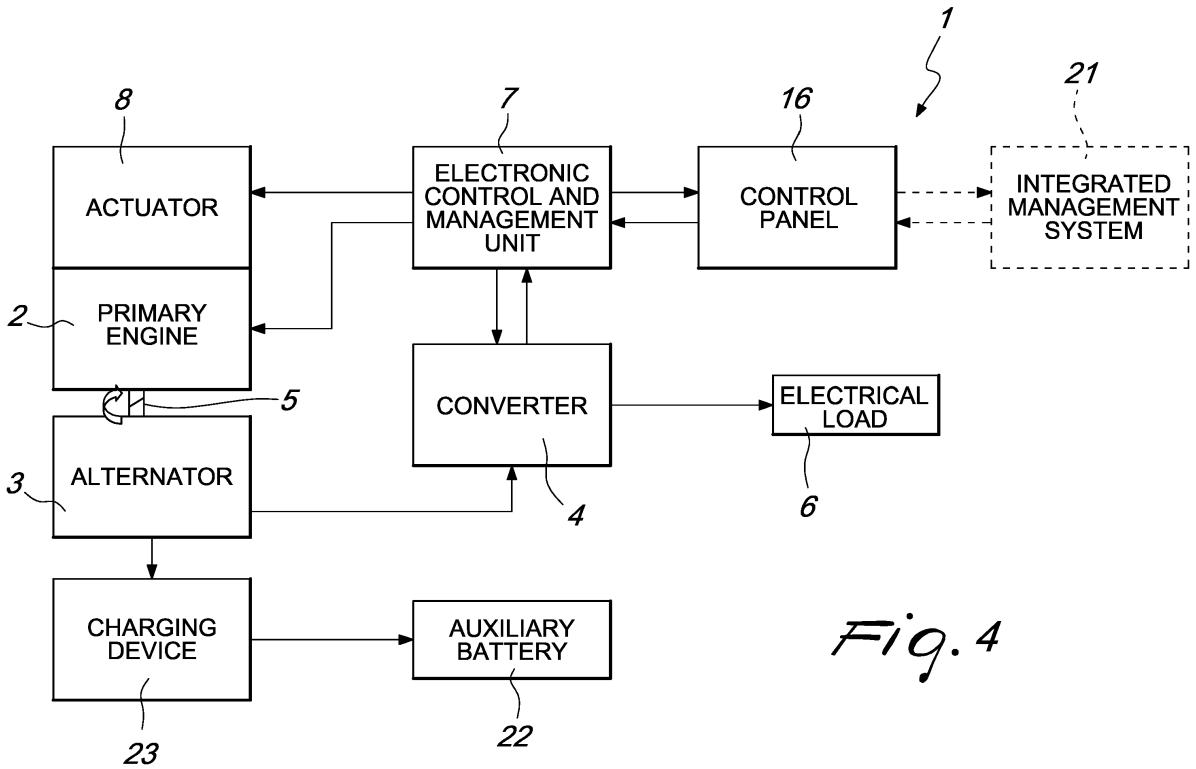

Fig. 4

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Description

[0001] The present invention relates to an electric power generating set for means of transport.

[0002] As is known, the term "recreational vehicle" identifies the category of vehicles that comprises camper vans, caravans, motor homes and the like, which are all fitted out so as to enable one or more individuals to stay in it for a certain time.

[0003] In order to enable the electric power supply of the numerous user devices provided inside the vehicle, which are geared to ensuring a pleasant stay for the occupants, such vehicles are usually provided with electric power generating sets.

[0004] Such devices are in fact capable, for example, of ensuring the correct operation of the television, of the refrigerator, of the systems for lighting and heating of the inhabitable compartments, etc.

[0005] In an embodiment that is now widespread, electric power generating sets comprise a diesel engine which, with its output shaft, is connected directly or by way of transmission elements to an alternator, which converts the mechanical energy provided by the engine into the desired electric power.

[0006] Downstream of the alternator, and electrically connected to the latter, is a converter (an inverter) which receives electric power with variable frequency and voltage and supplies it to the user devices with fixed frequency and voltage, therefore irrespective of the load applied.

[0007] The outline architecture described above can moreover be found in the electric power generating sets that are sometimes installed on other means of transport, such as for example watercraft.

[0008] In any case, in order to be capable of ensuring the power supply of the various types of load that can be found in recreational vehicles (and also in other means of transport), the engines of electric power generating sets are configured to operate at a constant number of revolutions of the engine (of its output shaft), and this number is chosen to be sufficiently high in order to meet the peaks of energy demand, which occur when user devices are operated which necessitate more energy for their operation.

[0009] Such implementation solution is however not devoid of drawbacks.

[0010] First of all, it should be noted that evidently high-rev operation leads to excessive consumption of fuel, in all circumstances where the type of the loads applied and the actual operating conditions require less energy.

[0011] Furthermore, a high-rev rotation inevitably corresponds to accentuated noise, a factor that is particularly unwelcome in the application in question, since evidently this disturbs the occupants of the vehicle.

[0012] In addition, it should not be forgotten that the operating conditions to which the engines of conventional generating sets are subjected place appreciable stress on the mechanical parts, exposing them to phenomena of premature wear and deterioration (and increasing the risk of malfunctions and outages).

[0013] The aim of the present invention is to solve the above mentioned problems, by providing an electric power generating set that is versatile and capable of adapting to actual operating conditions.

[0014] Within this aim, an object of the invention is to provide an electric power generating set the operation of which is associated with a contained level of noise and of fuel consumption.

[0015] Another object of the invention is to provide an electric power generating set that ensures a high reliability of operation and which is less subject to malfunctions, wear and deterioration, with respect to conventional generating sets.

[0016] Another object of the invention is to provide an electric power generating set that adopts an alternative technical and structural architecture to those of conventional generating sets.

[0017] Another object of the invention is to provide an electric power generating set that is low cost, is safe in use, and can be easily implemented using elements and materials that are readily available on the market.

[0018] This aim and these and other objects which will become better apparent hereinafter are achieved by an electric power generating set for means of transport, comprising in series a primary engine, for delivering mechanical energy, an alternator, for converting the mechanical energy delivered by said primary engine into electric power, with first voltage and frequency values, and a converter, for varying said first values and transferring the energy to at least one electrical load that can be installed on the means of transport, with second voltage and frequency values, characterized in that it comprises an electronic control and management unit, which is functionally associated with said converter and with an actuator for actuating a regulator of the number of revolutions of said primary engine, in order to adapt said number of revolutions, by way of said regulator, to the energy demands of the at least one load.

[0019] Further characteristics and advantages of the invention will become better apparent from the detailed description that follows of a preferred, but not exclusive, embodiment of the electric power generating set according to the invention, which is illustrated by way of non-limiting example in the accompanying drawings, wherein:

Figure 1 is a perspective view of an electric power generating set according to the invention;
Figure 2 is a front elevation view of the electric power generating set of Figure 1;
Figure 3 is a greatly enlarged detail of Figure 2;
Figure 4 is a block diagram of the electric power generating set of Figure 1;
Figure 5 is a perspective view of an additional component of the electric power generating set according to the invention.

[0020] With reference to the figures, an electric power

generating set for means of transport is generally designated by the reference numeral 1.

[0021] It should be noted from this point onward that in the preferred application, the means of transport on board of which the generating set 1 is intended to operate are recreational vehicles, such as camper vans, caravans, motor homes and the like.

[0022] In such context in fact, the generating set 1 can supply power particularly advantageously and efficaciously to the various electrical utilities usually provided on such vehicles (as will be clarified below).

[0023] That notwithstanding, the protection claimed herein should be understood to be extended to cover the use of the generating set 1 in different contexts, to ensure the supply of electric power on other means of transport, such as for example watercraft of any type, or other vehicles and other mobile means, according to the specific applicative requirements.

[0024] The generating set 1 comprises therefore in series a primary engine 2, an alternator 3 and a converter 4 (an inverter for example).

[0025] The primary engine 2, typically an internal combustion engine and in the preferred application a Diesel engine (while not ruling out different implementation choices and/or methods of power supply, which in any case are included in the scope of protection claimed herein), is adapted to provide mechanical energy (according to methods that are known per se). The mechanical energy is in fact transferred to the alternator 3 by way of a shaft 5, which is oriented at will and connected to the alternator 3 proper directly (with keying) or by way of respective transmission elements (belts, gearwheels, chains etc).

[0026] In turn, the alternator 3 converts the mechanical energy delivered by the primary engine 2 into electric power, which has first voltage and frequency values (which are typically variable).

[0027] The converter 4, arranged downstream of the alternator 3, receives electric power from the latter and varies the aforementioned first values thereof, so as to transfer electric power to at least one electrical load 6, which can be installed on the means of transport, with second voltage and frequency values, which are typically fixed (the second voltage value can for example be equal to 230 V).

[0028] It should be noted that the electrical load 6 can be constituted by any device, apparatus or other type of user device, which on the recreational vehicle (or other means of transport) needs electric power for its operation.

[0029] Purely for the purposes of example, it is therefore possible that the generating set 1 can deliver electric power in order to ensure the correct operation of a television receiver, of a satellite dish, of a decoder, of a refrigerator, of another domestic appliance, of the systems for lighting and/or conditioning and/or heating of the inhabitable compartments of the vehicle, etc.

[0030] Obviously, in the preferred application the generating set 1 is intended to supply power (simultaneously or at successive times) to two or more different loads 6, by way of adapted connections.

[0031] According to the invention, the generating set 1 comprises an electronic control and management unit 7, which can be chosen from an electronic controller, a computer, a personal computer, and the like.

[0032] The electronic unit 7 is functionally associated with the converter 4 and to an actuator 8 for actuating a regulator 9 of the number of revolutions of the primary engine 2 (and of the shaft 5 in particular).

[0033] By acting on the regulator 9, it is thus possible to adjust the number of revolutions (and the power supply of the primary engine 2) to the specific energy demands of the associated loads 6.

[0034] It should be noted therefore from this point onward that, by virtue of the peculiar implementation choice described above, it is possible to achieve the set aim: according to the practical methods that will be illustrated below (in a possible, non-limiting embodiment), the electronic unit 7 manages and actuates the operation of the primary engine 2 and of the converter 4, according to requirements of the applied load 6.

[0035] This makes it possible to reduce the number of revolutions of the shaft 5, when downstream a load 6 with low energy demands needs to operate, thus limiting the use of operating speeds with a high number of revolutions solely to cases in which the loads 6 actually need a greater amount of electric power.

[0036] It thus seems clear that the generating set 1 can effectively be adapted to the actual operating conditions, operating with a lower level of noise and with a more contained consumption of fuel, with respect to conventional solutions.

[0037] In particular, in the embodiment illustrated in the accompanying figures by way of non-limiting example of the application of the invention, the actuator 8 comprises a unit 10 for moving a screw 11, which is actuated by the movement unit 10 itself and can rotate about its own axis.

[0038] In the preferred embodiment, the movement unit 10 is constituted by a stepper motor, although different implementation choices are not ruled out, which in any case remain within the scope of protection claimed herein.

[0039] The screw 11 meshes with a female thread 12, which is connected to the regulator 9 and can translate along the axis of the screw 11, when the latter rotates.

[0040] With further reference to the accompanying figures (1, 2 and 3 in particular), in order to move the regulator 9 the female thread 12 is articulated to a linkage 13 that is pivoted at its opposite end to a crank 14, which is integral with the regulator 9.

[0041] In turn, in the preferred embodiment the regulator 9 is constituted by a rod 15 for controlling and adjusting (according to methods that are known per se) the amount of fuel that is introduced instant by instant into the primary engine 2, in order to vary the power supply

and the power supplied, and therefore the number of revolutions.

[0042] By virtue of the kinematic mechanism described in the previous paragraphs, the rod 15 can therefore be actuated (rotated) as a consequence of the translation of the female thread 12 along the axis, such translation being actuated by the movement unit 10 (and therefore by the electronic unit 7) by way of the screw 11, and causing the consequent rotation of the crank 14, which is pivoted to the linkage 13.

[0043] Conveniently, the electronic unit 7 comprises instructions for executing one mode chosen from among an automatic operating mode and/or a manual operating mode and/or a safety operating mode of the primary engine 2. The possibility is not ruled out of adopting or having further and different operating modes, in light of the specific application requirements and of the customer requirements.

[0044] Evidently, such different operating modes (of which further details will be given below, relating to a possible embodiment) ensure exceptional versatility of the invention, by enabling it to be best adjusted to the applicative needs and to the tastes/necessities of the user.

[0045] Precisely in order to allow a user to freely select the desired operating mode, the electronic unit 7 is preferably associated with a control interface. Such interface can likewise be used by the user to monitor the operation of the generating set 1 (to verify its status, view any alarms and the operating history, manage and run diagnostic tests etc.), start it up and/or shut it down.

[0046] For example therefore, such interface can comprise (or be constituted by) a control panel 16, in which there can be for example a screen 17 (or multiple screens 17), on which the user can view information messages about the operation of the generating set 1.

[0047] It should be noted that the possibility exists that the control panel 16 is affixed directly to the outer casing 18 of the generating set 1, just as the possibility is not ruled out of locating the panel 16 remotely with respect to the primary engine 2, the alternator 3 and the converter 4. For example, the panel 16 could be hung on a wall of the inhabitable compartment of the camper van, caravan, or other recreational vehicle in which the generating set 1 operates, thus simplifying interaction with the latter for the user.

[0048] The panel 16 can therefore be provided with means for selecting the operating mode, such as buttons 19 or switches 20, which can also be used to generally actuate and control all the activities of the various components of the generating set 1 according to the invention.

[0049] The panel 16 can likewise have a USB connection, optionally protected by a cover 20a, which can be used for software updates of the entire generating set 1, as well as of the panel 16 proper, and also for executing diagnostics (on site or remote).

[0050] Conveniently, the interface can comprise means for connection to an integrated management system 21, of the type of a home automation system and the like. Such connection means can therefore comprise data buses (in order to allow the exchange of data between the various devices and peripherals) according to the CAN bus standard.

[0051] In such embodiment therefore, the user will also be able to actuate the generating set 1 by way of the system 21 and the corresponding interface module (designed obviously to control the other connected devices), which can supplement or replace the panel 16. It should be noted that the interface module can be implemented on a smartphone, therefore offering the user a further (and extremely easy) method of controlling and actuating the generating set 1.

[0052] Advantageously, the generating set 1 comprises an auxiliary battery 22, which, as can also be seen from Figure 4, is associated with a charging device 23 arranged downstream of the alternator 3, for its indirect supply with power by the primary engine 2.

[0053] The charging device 23 therefore makes it possible to provide electric power also to the battery 22, which is thus a convenient and additional energy resource, for emergency conditions or even to power the electronic unit 7 and the other components of the generating set 1 according to the invention.

[0054] Operation of the electric power generating set according to the invention is the following.

[0055] According to methods that are known per se, the primary engine 2 delivers mechanical energy which, by virtue of the conversion into electric power done by the alternator 3 and by the converter 4, is supplied to the load 6 (or loads 6) with second values (typically fixed) of voltage and frequency.

[0056] The electronic unit 7 is capable of controlling automatically (based on the voltages entering and exiting the converter 4 and on the current required by the load 6) or on input of the user, the variation of the number of revolutions of the shaft 5 of the primary engine 2. This in fact makes it possible to deliver more or less power as a function of the specific load 6 applied each time and, especially, of its specific energy needs.

[0057] Conveniently, the electronic unit 7 enables the user to choose between various operating modes, according to his/her needs and specific types of loads 6.

[0058] More precisely, in manual mode the electric power generating set 1 can be started at the direct command of the user.

[0059] In the automatic operating mode on the other hand, preferably the generating set 1 starts up and shuts down, without the presence of the user, upon reaching a predefined voltage threshold on the auxiliary battery 22, which is pre-programmed at the factory or set by the user. For example, according to the programming, the generating set 1 can autonomously start up when the voltage value on the auxiliary battery 22 drops to below a threshold of 12 V, and shut down when the value rises above 14 V.

[0060] As mentioned above, the generating set 1 and the electronic unit 7 can also have a third safety operating mode (and indeed others), in which the rotation speed of the shaft 5 is in any case kept at an intermediate value between the lowest possible and the highest.

[0061] Such additional mode is extremely useful and can preserve the generating set 1 from hazardous problems, which can in fact could arise under particular conditions. If, in fact, while the primary engine 2 is operating at the lowest possible speed because no load 6 is applied, a load 6 equal to the maximum power that can be supplied by the generating set 1 is suddenly connected to the output, the converter 4 can find itself laboring for the time required by the primary engine 2 to reach the new power delivery speed.

[0062] At the cost of fuel consumption (and noise) slightly exceeding that of other operating modes, the safety mode (in which the shaft 5 in any case rotates at a higher number of revolutions than the lowest possible and one that is selected so as to be capable of responding readily to sudden and elevated demands for current) ensures the capacity to meet promptly and without damage sudden peaks of energy demand, which otherwise could excessively stress and damage the components.

[0063] Operationally, as has been seen the electronic unit 7 carries out the adjustment by actuating a stepper motor, or other unit 10 for moving a screw 11, which by rotating about its own axis produces the translation of a female thread 12, which thus moves a linkage 13 which is articulated to a crank 14, which is integral with the rod 15 for controlling and adjusting the amount of fuel introduced (or other regulator 9).

[0064] Differently therefore from conventional solutions, in the generating set 1 the primary engine 2 operates at the highest rotation speed (of the shaft 5) only when the specific load 6 requires the maximum amount of electric power for its operation. Conversely, when another load 6, associated with a reduced demand for electric power, is brought into operation, correspondingly the power delivered by the primary engine 2 will be lower (because the electronic unit 7 decreases the number of revolutions of the shaft 5). This evidently ensures great versatility of the electric power generating set 1 according to the invention, since it makes it possible to adjust to actual operating conditions by reducing the consumption of fuel and the level of noise (proportional obviously to the number of revolutions of the primary engine 2), in all situations in which a partial delivery of power is sufficient, and therefore operation at a reduced number of revolutions.

[0065] As previously noted, such peculiarities clearly distinguish the generating set 1 from conventional solutions, in which the engine responsible for delivering mechanical energy always operates at the highest number of revolutions, which is constant and chosen to be such as to meet the peaks of energy demand, associated evidently with only some of the user devices to be powered.

[0066] It should be noted moreover that by reducing the number of revolutions in most practical circumstances, the reliability of operation is certainly increased and is in general high: the generating set 1 is in fact less subject to malfunctions, wear and deterioration, with respect to conventional devices, which must always operate at the maximum number of revolutions (and therefore under constant conditions of maximum stresses underwent and greatest risk of wear).

[0067] In addition, it should be noted that the generating set 1, which comprises a high-frequency alternator 3 paired with a converter 4 (inverter), weighs less than conventional generating sets.

[0068] The possibility of connecting the generating set 1 to an integrated management system 21, of the type of a home automation system and the like, offers further practical modes of interaction, just as the panel 16 enables an easy monitoring of the operation of the generating set 1 according to the invention.

[0069] Finally, it should be noted that the charging device 23 makes it possible to supply power to a battery 22 (by way of the mechanical energy produced by the primary engine 2), which constitutes a convenient and additional energy resource.

[0070] In practice it has been found that the electric power generating set according to the invention fully achieves the set aim, in that the use of an electronic control and management unit, functionally associated with the converter and with an actuator for actuating a regulator of the number of revolutions of the primary engine, makes it possible to adjust the number of revolutions to the energy demands of the loads applied, and therefore it ensures maximal versatility to the electric power generating set.

[0071] 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.

[0072] It should be noted moreover that the use is also possible of two (or more) electric power generating sets 1 according to the invention, arranged side-by-side and operating in parallel, so as to ensure a double energy source (or in any case a multiple of that ensured by a single generating set 1).

[0073] In the embodiments illustrated, individual characteristics shown in relation to specific examples may in reality be substituted with other, different characteristics, existing in other embodiments.

[0074] In practice, the materials employed, as well as the dimensions, may be any according to requirements and to the state of the art.

[0075] The disclosures in Italian Patent Application No. 102015000087034 (UB2015A009186) from which this application claims priority are incorporated herein by reference.

[0076] Where technical features mentioned in any claim are followed by reference signs, those reference signs have been included for the sole purpose of increas-

ing 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 for means of transport, comprising in series a primary engine (2), for delivering mechanical energy, an alternator (3), for converting the mechanical energy delivered by said primary engine (2) into electric power, with first voltage and frequency values, and a converter (4), for varying said first values and transferring the energy to at least one electrical load (6) that can be installed on the means of transport, with second voltage and frequency values, **characterized in that** it comprises an electronic control and management unit (7), which is functionally associated with said converter (4) and with an actuator (8) for actuating a regulator (9) of the number of revolutions of said primary engine (2), in order to adapt said number of revolutions, by way of said regulator (9), to the energy demands of the at least one load (6).

2. The electric power generating set according to claim 1, **characterized in that** said primary engine (2) is a diesel engine.

3. The electric power generating set according to claim 1 or 2, **characterized in that** said actuator (8) comprises a unit (10) for moving a screw (11), which is actuated by said movement unit (10) and rotates about its own axis, said screw (11) meshing with a female thread (12) which is connected to said regulator (9) and translates along said axis, as a consequence of the rotation of said screw (11).

4. The electric power generating set according to claim 3, **characterized in that** said movement unit (10) is a stepper motor.

5. The electric power generating set according to one or more of the preceding claims, **characterized in that** said female thread (12) is articulated to a linkage (13) that is pivoted at its opposite end to a crank (14) that is integral with said regulator (9), constituted by a rod (15) for controlling and adjusting the amount of fuel that is introduced instant by instant into said primary engine (2), in order to vary the number of revolutions, said rod (15) being actuatable as a consequence of the translation of said female thread (12) along said axis, actuated by said movement unit (10) by way of said screw (11), and of the consequent rotation of said crank (14), which is pivoted to said linkage (13).

6. The electric power generating set according to one or more of the preceding claims, **characterized in that** said electronic unit (7) comprises instructions for executing one chosen from among an automatic operating mode and/or a manual operating mode and/or a safety operating mode of said primary engine (2).

7. The electric power generating set according to claim 6, **characterized in that** said electronic unit (7) is associated with a control interface, which can be used by a user to select said operating mode and/or to monitor the operation of said generating set (1), start it up and/or shut it down.

8. The electric power generating set according to claim 7, **characterized in that** said interface comprises a control panel (16), which can be arranged remotely with respect to said primary engine (2), said alternator (3) and said converter (4), and is provided with means for selecting said operating mode.

9. The electric power generating set according to claim 7, **characterized in that** said interface comprises means for connection to an integrated management system (21), such as a home automation system and the like.

10. The electric power generating set according to one or more of the preceding claims, **characterized in that** it comprises an auxiliary battery (22) associated with a charging device (23), arranged downstream of said alternator (3) for its indirect supply with power by said primary engine (2).

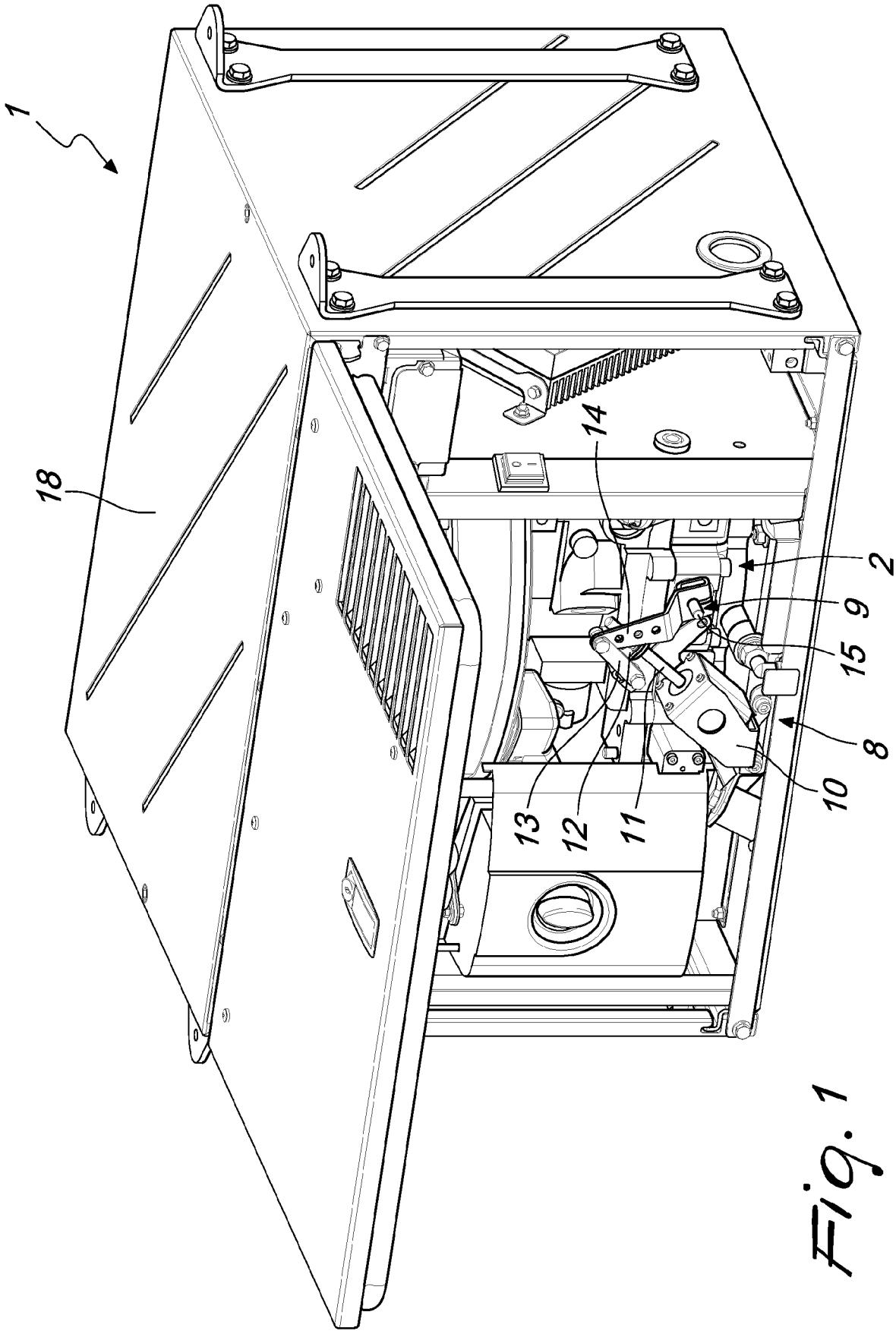

Fig. 1

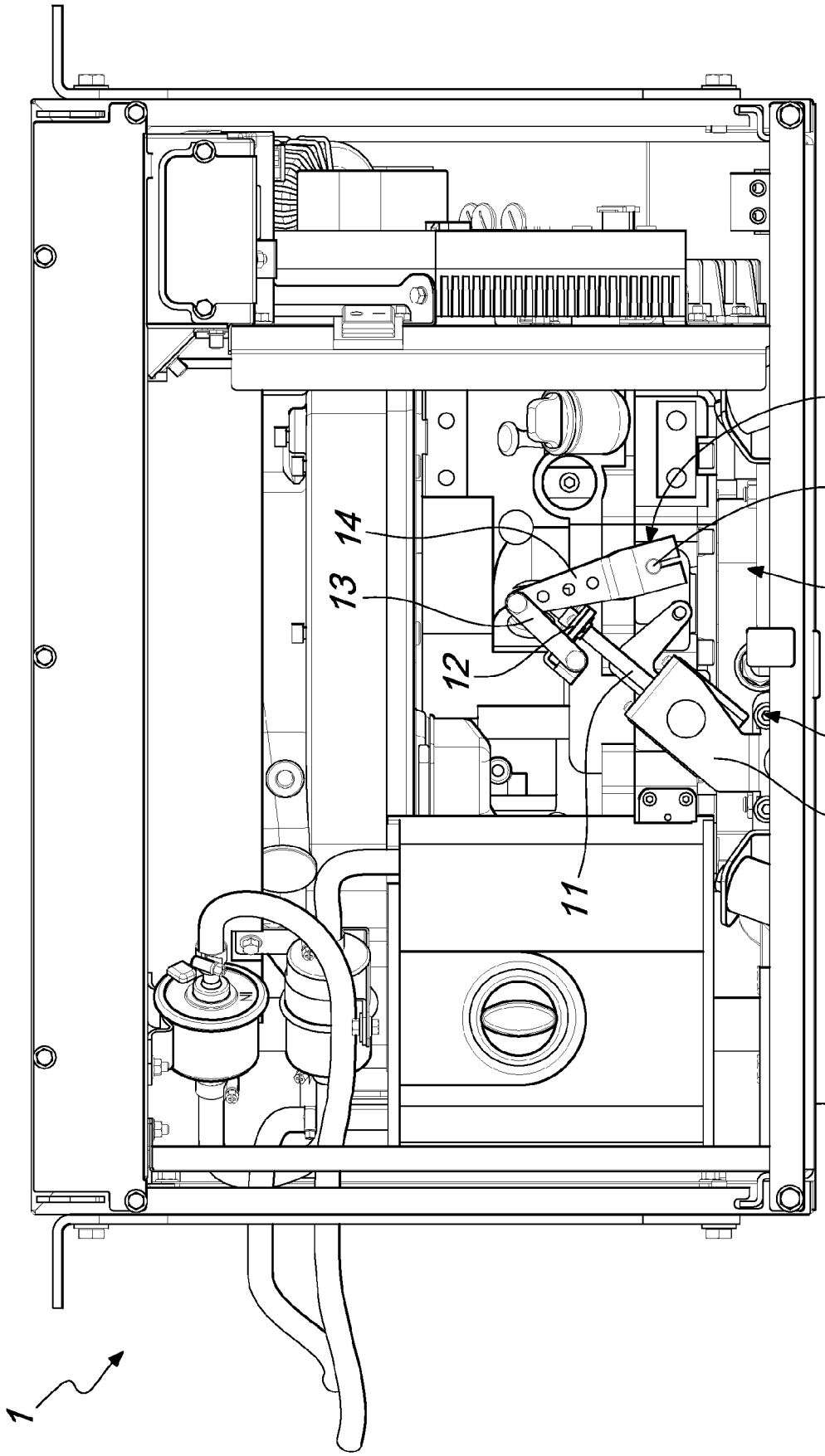

Fig. 2

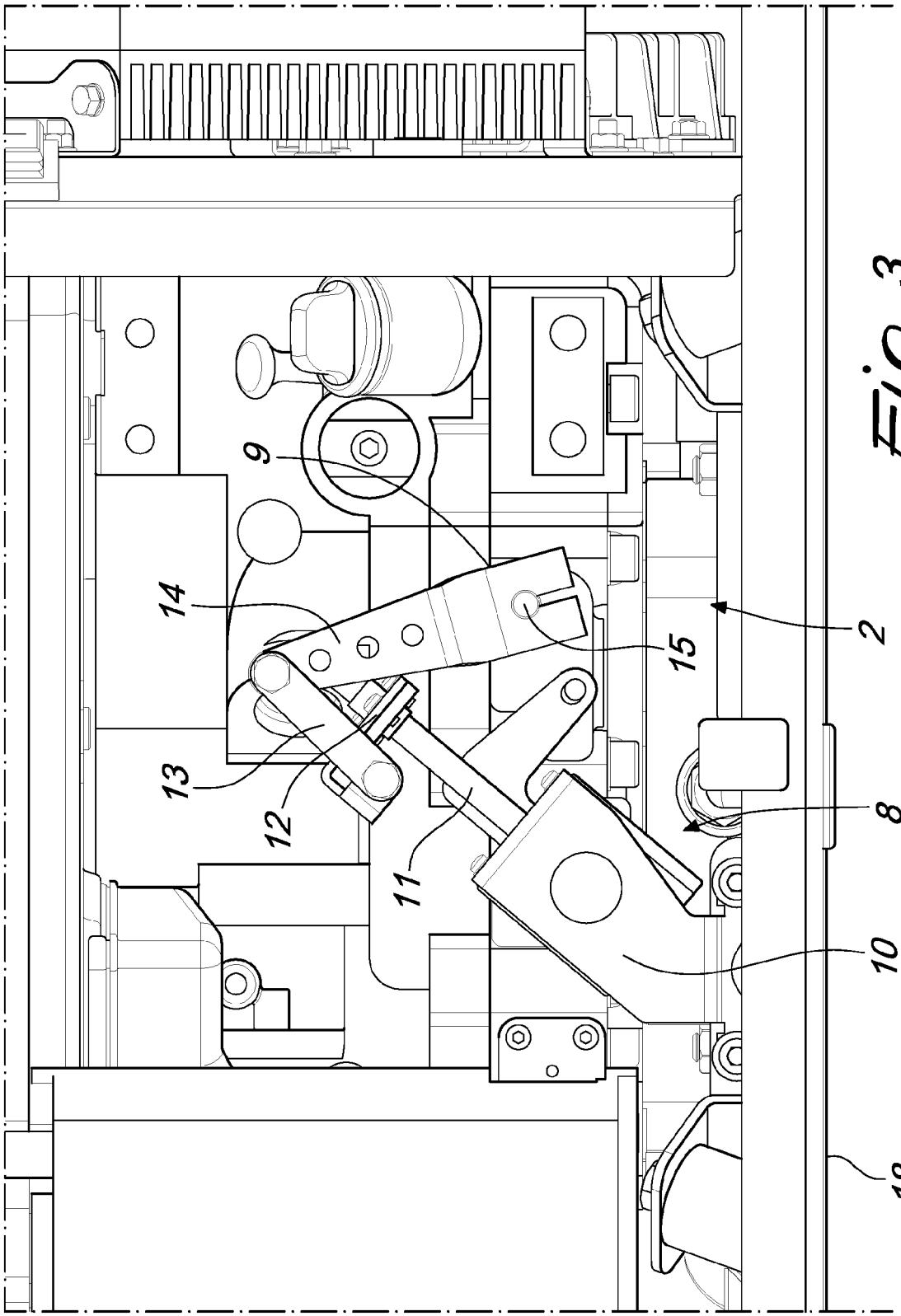

Fig. 3

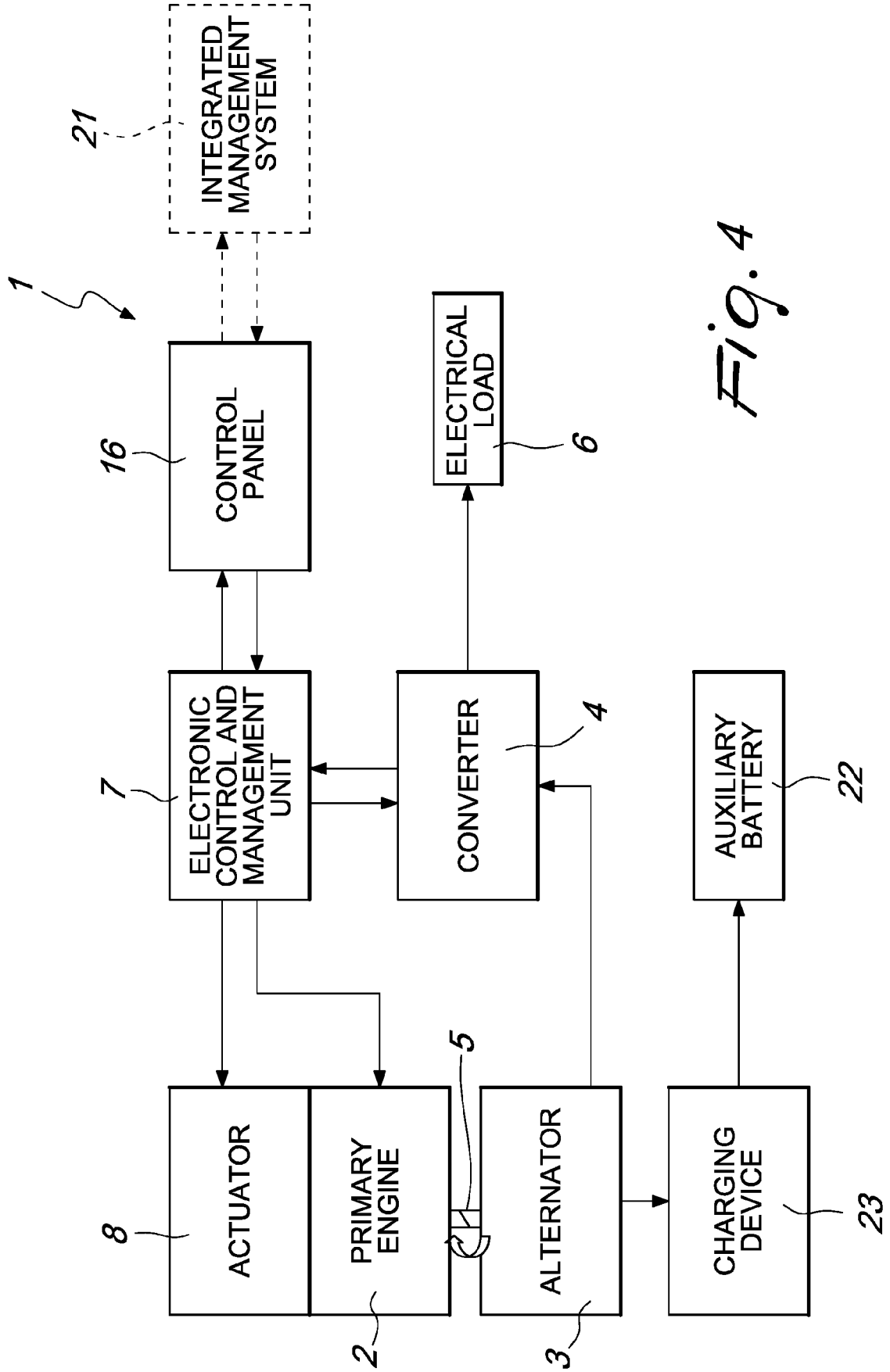
INTEGRATED MANAGEMENT SYSTEM
21
1
CONTROL PANEL
16
ELECTRICAL LOAD
6
ELECTRONIC CONTROL AND MANAGEMENT UNIT
7
CONVERTER
4
AUXILIARY BATTERY
22
5
ACTUATOR
8
PRIMARY ENGINE
2
ALTERNATOR
3
CHARGING DEVICE
23

Fig. 4

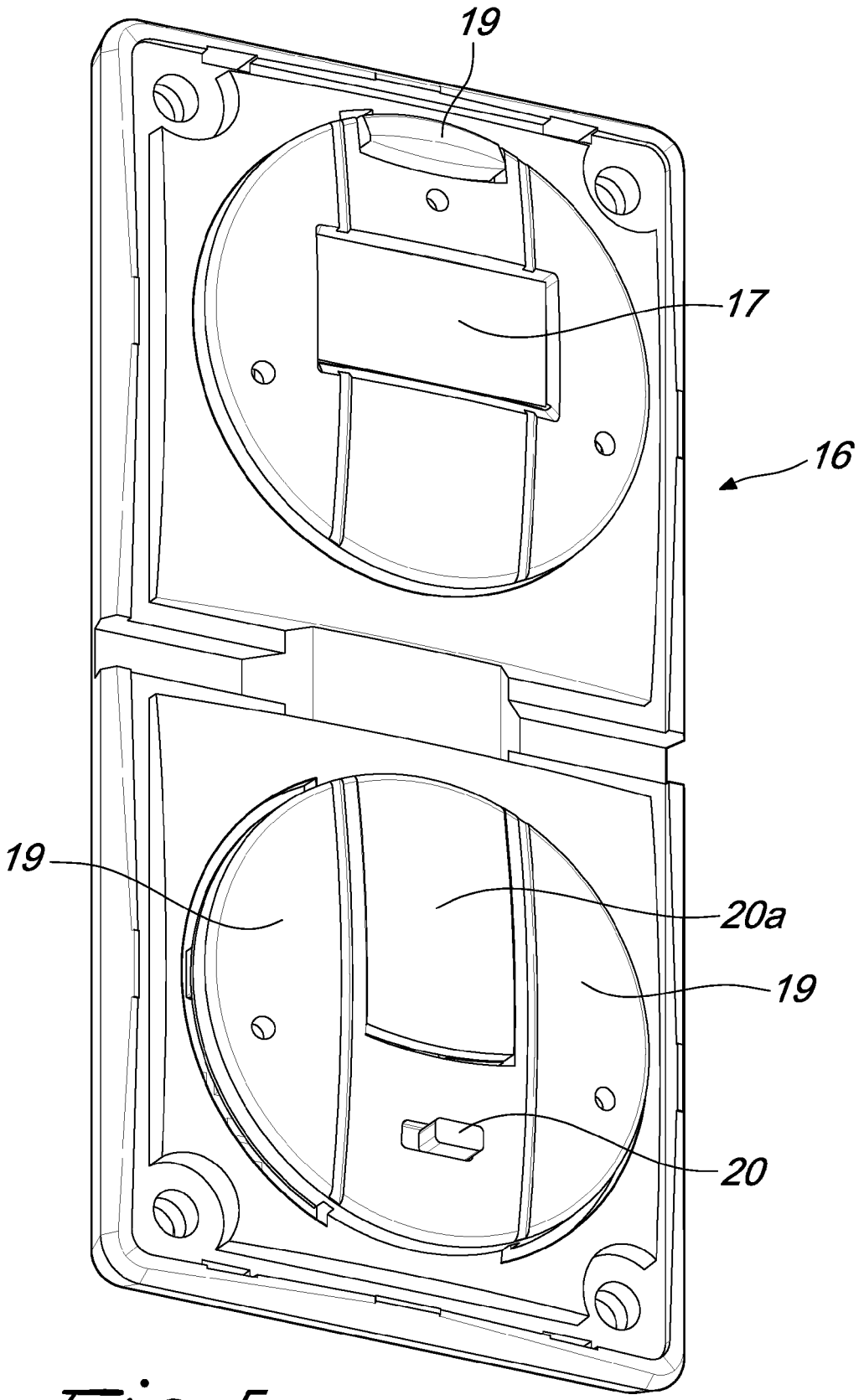

Fig. 5

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- IT 102015000087034 **[0075]**
- IT UB2015009186 A **[0075]**