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(56) Related Art
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Abstract

The invention is related to a control module for an alternator. The control module comprises an operating circuit and a bridge. The operating circuit comprises an output terminal, a first transistor, a first bridge terminal, a second bridge terminal, and a second transistor. The output terminal is electrically coupled to a first electrical element operable to be electrically connected to a battery and electrically coupled to a second electrical element. The first transistor is electrically coupled to the output terminal and a ground for controlling a current between the output terminal and the ground. The first bridge terminal is electrically coupled to the output terminal. The second transistor is electrically coupled to the battery and the second bridge terminal for controlling a current between the battery and the second bridge terminal. The bridge is operable to electrically connect the first bridge terminal with the second bridge terminal.

CONTROL MODULE FOR AN ALTERNATOR

Field of the Invention

[0001] The present invention is related to a control module, especially a control module for an alternator of a vehicle.

Background of the Invention

[0002] Conventional control modules for an alternator of a vehicle may be categorized as comprising an inactive operating circuit 11 or an active operating circuit 12 as shown in Figs. 1 and 2, respectively.

[0003] The inactive operating circuit 11 as shown in Fig. 1 only comprises an output terminal 1L electrically coupled to a first electrical element 91, such as a charge warning lamp on the dashboard of a vehicle, which is operable to be electrically connected to a battery BT, and a transistor 111 electrically coupled to the output terminal 1L and a ground GND for controlling a current between the output terminal 1L and the ground GND via a ground terminal 1E. Specifically, when the transistor 111 is on, the current flows from battery BT through the first electrical element 91, the output terminal 1L, the transistor 111, the ground terminal 1E to the ground GND. Thus, the inactive operating circuit 11 can only control whether the current is conducted through the first electrical element 91, such as a charge warning lamp on the dashboard of a vehicle.

[0004] The active operating circuit 12 as shown in Fig. 2 comprises an output terminal 1L electrically coupled to a first electrical element 91 operable to be electrically connected to a battery BT and electrically coupled to a second electrical element 92 (if any), a first transistor 121 electrically coupled to the output terminal 1L and a ground GND via a ground terminal 1E for controlling a current between the output terminal 1L and the ground GND, a second transistor 122 electrically coupled to the battery BT via a battery terminal 1B+ and the output

terminal 1L for controlling a current between the battery BT and the output terminal 1L. An example of the first electrical element 91 is a charge warning lamp on the dashboard of a vehicle. As shown in Fig. 2, the first transistor 121 controls the current to flow from the battery BT through the first electrical element 91, the output terminal 1L and the ground terminal 1E to the ground GND but not to the second electrical element 92, such as an Active Valve Control System (AVCS) of a vehicle because the resistance of the second electrical element 92 is much higher than that of the path from the output terminal 1L to the ground GND. It is the second transistor 122 that controls the current transmitted from the battery through the output terminal to the second electrical element 92. Specifically, when the first transistor 121 is on and the second transistor 122 is off, the current flows from battery BT through the first electrical element 91, the output terminal 1L, the first transistor 121, the ground terminal 1E to the ground GND. When the second transistor 122 is on and the first transistor 121 is off, the current flows from battery BT through the output terminal 1L to the second electrical element 92.

[0005] Please refer to Figs. 3A and 3B. The conventional control module for an alternator has a frame 15 the output terminal 1L, the battery terminal 1B+, the ground terminal 1E, a field terminal 1F electrically connected to the alternator to control the charge of the battery BT and a phase terminal 1P for receiving a phase signal detected from the alternator.

[0006] However, the conventional active operating circuit 12 may not be properly used in a vehicle system which does not have the second electrical element 92. This is because the redundant circuits of the second transistor 122 would cause error signals, which may disturb the operation of the vehicle system. In a system in which there is no such second electrical element 92, the conventional inactive operating circuit 11 should be used. That is, for different systems, different control modules should be used.

[0007] Thus, there is a need to design a control module which can be switched between the inactive operating circuit and the active operating circuit so that such control module can be used in two different systems. Such a design can avoid mistakenly using a control module for an incompatible system.

Summary of the Invention

[0008] A control module for an alternator is provided. The control module comprises an operating circuit and a bridge. The operating circuit comprises an output terminal, a first transistor, a first bridge terminal, a second bridge terminal, and a second transistor. The output terminal is electrically coupled to a first electrical element operable to be electrically connected to a battery and electrically coupled to a second electrical element. The first transistor is electrically coupled to the output terminal and a ground for controlling a current between the output terminal and the ground. The first bridge terminal is electrically coupled to the output terminal. The second transistor is electrically coupled to the battery and the second bridge terminal for controlling a current between the battery and the second bridge terminal. The bridge is operable to electrically connect the first bridge terminal with the second bridge terminal. When the bridge electrically connects the first bridge terminal with the second bridge terminal, the second transistor controls the current from the battery through the second bridge terminal, the first bridge terminal and the output terminal to the second electrical element.

Brief Description of the Drawings

[0009] FIG. 1 is a schematic view of a conventional inactive operating circuit for an alternator.

[0010] FIG. 2 is a schematic view of a conventional active operating circuit for an alternator.

[0011] Figs. 3A and 3B are a front schematic view and a perspective schematic view of the frame of a conventional control module.

[0012] FIG. 4 is a schematic view of the operating circuit of the control module for an alternator of one embodiment of the present invention.

[0013] Figs. 5A and 5B are a front schematic view and a perspective schematic view of the frame of the control module of the embodiment.

[0014] Fig. 6A is a schematic view showing another embodiment of the present invention in which a heat sink is mounted on a frame thereof.

[0015] Figs. 6B-6D are schematic views of a further embodiment of the present invention in which a shell covers the frame.

Detailed Description of the Invention

[0016] The characteristics, subject matter, advantages, and effects of the present invention are detailed hereinafter by reference to the embodiments of the present invention and the accompanying drawings. It is understood that the drawings referred to in the following description are intended only for purposes of illustration and do not necessarily show the actual proportion and precise arrangement of the embodiments. Therefore, the proportion and arrangement shown in the drawings should not be construed as limiting or restricting the scope of the present invention.

[0017] Please refer to Fig. 4. The control module 3 of this embodiment is used for an alternator (not shown), preferably an alternator of a vehicle. The control module 3 comprises an operating circuit 31 and a bridge 33. The operating circuit 31 comprises an output terminal 3L, a first transistor 311, a first bridge terminal 3A, a second bridge terminal 3B, and a second transistor 312. The output terminal 3L is electrically coupled to a first electrical element 91 operable to be electrically connected to a battery BT and electrically coupled to a second electrical element 92. The first transistor 311 is electrically coupled to the output

terminal 3L and a ground GND for controlling a current between the output terminal 3L and the ground GND. The first bridge terminal 3A is electrically coupled to the output terminal 3L. The second transistor 312 is electrically coupled to the battery BT and the second bridge terminal 3B for controlling a current between the battery BT and the second bridge terminal 3B. The bridge 33 is operable to electrically connect the first bridge terminal 3A with the second bridge terminal 3B.

[0018] When the bridge 33 electrically connects the first bridge terminal 3A with the second bridge terminal 3B, the operating circuit 31 is switched to an active operating circuit mode, and the second transistor 312 controls the current from the battery BT through the second bridge terminal 3B, the first bridge terminal 3A and the output terminal 3L to the second electrical element 92 and then to the ground GND. When the bridge 33 is not bridged over the first bridge terminal 3A and the second bridge terminal 3B, they are not electrically connected and thus the operating circuit 31 is switched to an inactive operating circuit mode.

[0019] As shown in Fig. 4, the first bridge terminal 3A is electrically coupled to and disposed between the output terminal 3L and the first transistor 311. The first transistor 311 can only control the current to flow from the battery BT through the first electrical element 91 and the output terminal 3L to the ground GND but not to the second electrical element 92 because the resistance of the second electrical element 92 is much higher than that of the path from the output terminal 3L to the ground GND. In a particular embodiment, the first electrical element 91 is a charge warning lamp on the dashboard of a vehicle.

[0020] As detailed below, there are three different stages in starting up a vehicle having the control module 3 in the active mode.

[0021] In a first stage, the bridge 33 electrically connects the first bridge terminal 3A with the second bridge terminal 3B, the first transistor 311 is on and the second transistor 312 is off. The current transmits from the battery BT through the first electrical element 91 and

the output terminal 3L to the ground GND, and the current does not transmit from the battery BT through the second bridge terminal 3B, the first bridge terminal 3A and the output terminal 3L to the second electrical element 92. In the first stage, the first electrical element 91, i.e. the charge warning lamp, is lit up but the second electrical element 92 is not operating.

[0022] In a second stage, the bridge 33 electrically connects the first bridge terminal 3A with the second bridge terminal 3B and the first and second transistors 311, 312 are both off. The current does not transmit from the battery BT through the first electrical element 91 and the output terminal 3L to the ground GND, and the current does not transmit from the battery BT through the second bridge terminal 3B, the first bridge terminal 3A and the output terminal 3L to the second electrical element 92. In the second stage, neither the first electrical element 91, i.e. the charge warning lamp, nor the second electrical element 92 is operating, so as to prevent an instant short before switching to a third stage.

[0023] In the third stage, the bridge 33 electrically connects the first bridge terminal 3B with the second bridge terminal 3A, the first transistor 311 is off and the second transistor 312 is on. The current does not transmit from the battery BT through the first electrical element 91 and the output terminal 3L to the ground GND, and the current transmits from the battery BT through the second bridge terminal 3B, the first bridge terminal 3A and the output terminal 3L to the second electrical element 92. In the third stage, the first electrical element 91, i.e. the charge warning lamp, is off but the second electrical element 92 such as an Active Valve Control System (AVCS) is on.

[0024] When the bridge 33 does not bridge the first bridge terminal 3B and the second bridge terminal 3A, i.e. the control module 3 is the inactive mode, the current does not transmit from the battery BT through the second bridge terminal 3B, the first bridge terminal 3A and the output terminal 3L to the second electrical element 92 in any of the stages.

[0025] Please refer to Figs. 4, 5A and 5B. The operating circuit further comprises a battery terminal 3B+ to electrically connect the second transistor 312 to the battery BT, a ground terminal 3E to electrically connect the first transistor 311 to the ground GND. Referring to Figs. 5A and 5B, the operating circuit 31 further comprises a field terminal 3F electrically connected to the alternator to control the charge of the battery BT and a phase terminal 3P for receiving a phase signal detected from the alternator. As shown in Figs. 5A and 5B, the control module 3 comprises a frame 35, which accommodates the operating circuit 31. The output terminal 3L, the first bridge terminal 3A, the second bridge terminal 3B, the battery terminal 3B+, the ground terminal 3E, the field terminal 3F and the phase terminal 3P protrude from the frame 35 for wiring to components of the vehicle.

[0026] In a preferred embodiment, the first transistor 311 is an NMOS and the second transistor 312 is a PMOS. The first transistor 311 has a source electrode S, a drain electrode D and a gate electrode G. The source electrode S of the first transistor 311 is electrically connected to the ground terminal 3E, the drain electrode D of the first transistor 311 is electrically connected to the output terminal 3L and the gate electrode G of the first transistor 311 is electrically connected to a source of a first control signal. The second transistor 312 also has a source electrode S, a drain electrode D and a gate electrode G, the source electrode S of the second transistor 312 is electrically connected to the battery terminal 3B+, the drain electrode D of the second transistor 312 is electrically connected to the second bridge terminal 3B and the gate electrode G of the second transistor 312 is electrically connected to a source of a second control signal. In a preferred embodiment, the control module comprises a heat sink 34 with fins mounted on the frame 35 as shown in Fig. 6A for dispensing heat.

[0027] The bridge 33 may be a screw, pin, switch, wire, connector or any other element which can bridge two terminals. In a preferred embodiment, the bridge 33 is a screw 331 as

shown in Figs. 6B-6D. In this preferred embodiment, the frame 35 has a threaded hole 351 disposed between the first bridge terminal 3A and the second bridge terminal 3B as can be seen from Fig. 5B. When the screw 331 is screwed into the threaded hole 351 as shown in Fig. 6C, the first bridge terminal 3A is electrically connected with the second bridge terminal 3B through the screw 331.

[0028] Please refer to Fig. 6B. When the frame 35 of the control module 3 is fixed to the alternator with a shaft (not shown), an axis (L1) of the threaded hole 351 is preferably substantially perpendicular to an axis of the shaft of the alternator. The screw 331 can be easily screwed into the threaded hole 351 from the lateral side of the control module 3.

[0029] In one embodiment of the present invention, the control module 3 has a shell 93 which is usually used as the ground GND and electrically connected to the ground terminal 3E. In a preferred embodiment, the shell 93 has a through hole 931 to expose the threaded hole 351of the frame 35 for the convenience of insertion of the screw 331 as shown in Fig. 6B.

[0030] Please refer to Figs. 6C and 6D. The control module 3 preferably comprises an insulator cap 37. After the screw 331 is screwed into the threaded hole 351 of the frame 35 as shown in Fig. 6C, the insulator cap 37 is inserted into the through hole 931 of the shell 93 to prevent shortage between the screw 331 and the shell 93 as shown in Fig. 6D.

With the screw 331, the threaded hole 351 and the insulator cap 37, the control module 3 of this embodiment can tightly connect the first bridge terminal 3A with the second bridge terminal 3B and can sustain the vibration of the vehicle, which can prevent the control module from unpredictable shortage.

[0031] The foregoing embodiments are illustrative of the technical concepts and characteristics of the present invention so as to enable a person skilled in the art to gain insight into the contents disclosed herein and to implement the present invention accordingly.

However, it is understood that the embodiments are not intended to restrict the scope of the present invention. Hence, all equivalent modifications to and variations of the disclosed embodiments made without departing from the spirit and principle of the present invention should fall within the scope of the appended claims.

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1. A control module for an alternator, comprising:

an operating circuit comprising:

an output terminal, electrically coupled to a first electrical element operable to be electrically connected to a battery and electrically coupled to a second electrical element;

a first transistor, electrically coupled to the output terminal and a ground for controlling a current between the output terminal and the ground;

a first bridge terminal, electrically coupled to the output terminal;

a second bridge terminal; and

a second transistor, electrically coupled to the battery and the second bridge terminal for controlling a current between the battery and the second bridge terminal; and

a bridge, operable to electrically connect the first bridge terminal with the second bridge terminal;

wherein when the bridge electrically connects the first bridge terminal with the second bridge terminal, the second transistor controls the current from the battery through the second bridge terminal, the first bridge terminal and the output terminal to the second electrical element;

wherein the first bridge terminal is electrically coupled to and disposed between the output terminal and the first transistor;

wherein the bridge is a screw and the control module comprises a frame accommodating the operating circuit, the frame has a threaded hole disposed between the first bridge terminal and the second bridge terminal, and when the screw is screwed into the threaded hole, the first bridge terminal is electrically connected with the second bridge terminal through the screw.

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2. The control module according to claim 1, wherein the frame is fixed to the alternator with a shaft, an axis of the threaded hole being substantially perpendicular to an axis of the shaft.

3. The control module according to claim 2, wherein the control module further comprises a shell for covering the frame, the shell having a through hole therein to expose the threaded hole of the frame, wherein the shell comprises an insulator cap, and the insulator cap is inserted into the through hole to prevent shortage between the screw and the shell.

4. The control module according to claim 3, wherein the operating circuit comprises a battery terminal to electrically connect the second transistor to the battery.

5. The control module according to claim 4, wherein the operating circuit comprises a ground terminal to electrically connect the first transistor to the ground.

6. The control module according to claim 5, wherein the first transistor is an NMOS and has a source electrode, a drain electrode and a gate electrode, the source electrode is electrically connected to the ground terminal, the drain electrode is electrically connected to the output terminal and the gate electrode is electrically connected to a source of a first control signal.

7. The control module according to claim 6, wherein the second transistor is a PMOS and has a source electrode, a drain electrode and a gate electrode, the source electrode is electrically connected to the battery terminal, the drain electrode is electrically connected to the second bridge terminal and the gate electrode is electrically connected to a source of a second control signal.

8. The control module according to claim 7, wherein the first electrical element is a charge warning lamp.

9. The control module according to claim 8, wherein the operating circuit further comprises a field terminal electrically connecting to the alternator to control the charge of the battery.

10. The control module according to claim 7, wherein the operating circuit further comprises a phase terminal for receiving a phase signal detected from the alternator.

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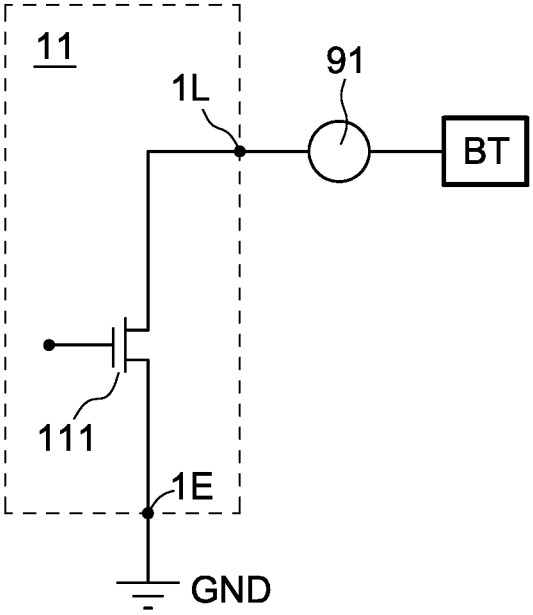

FIG. 1

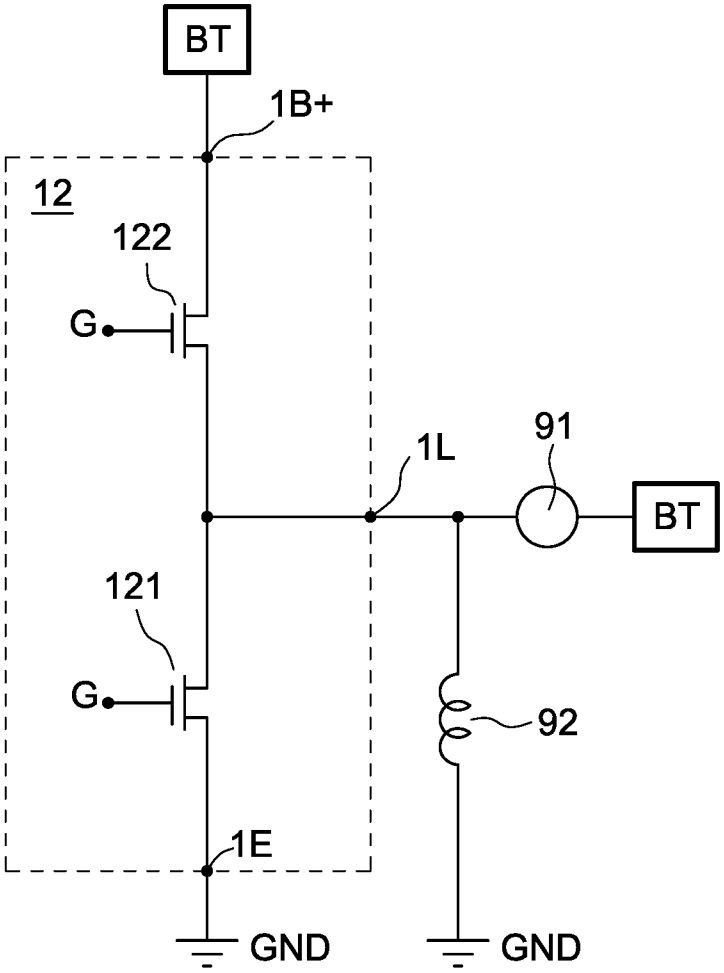

FIG. 2

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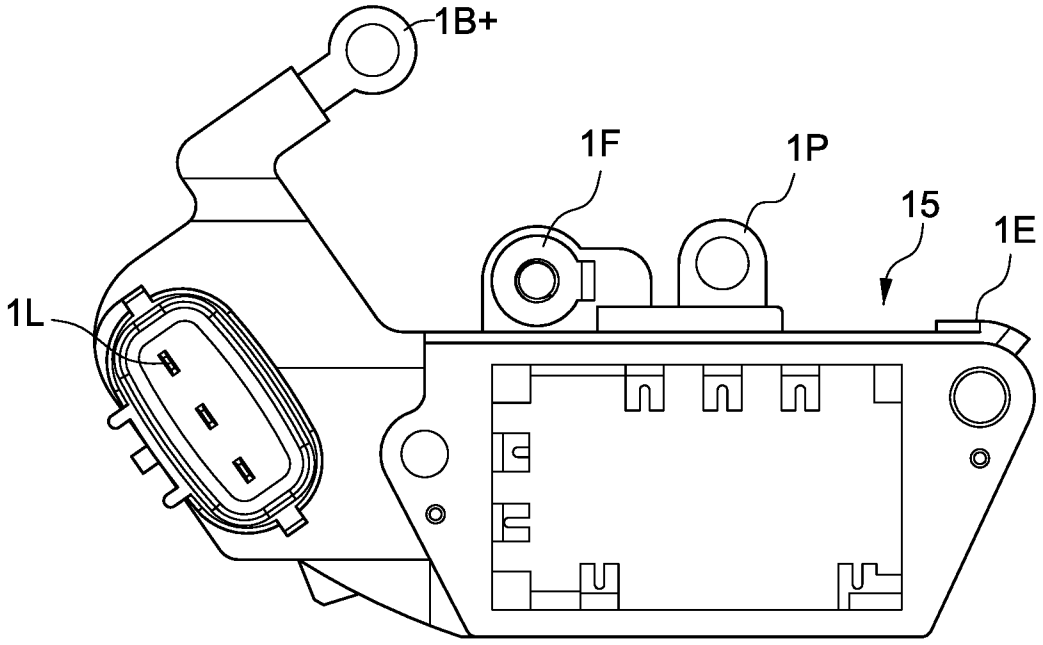

FIG. 3A

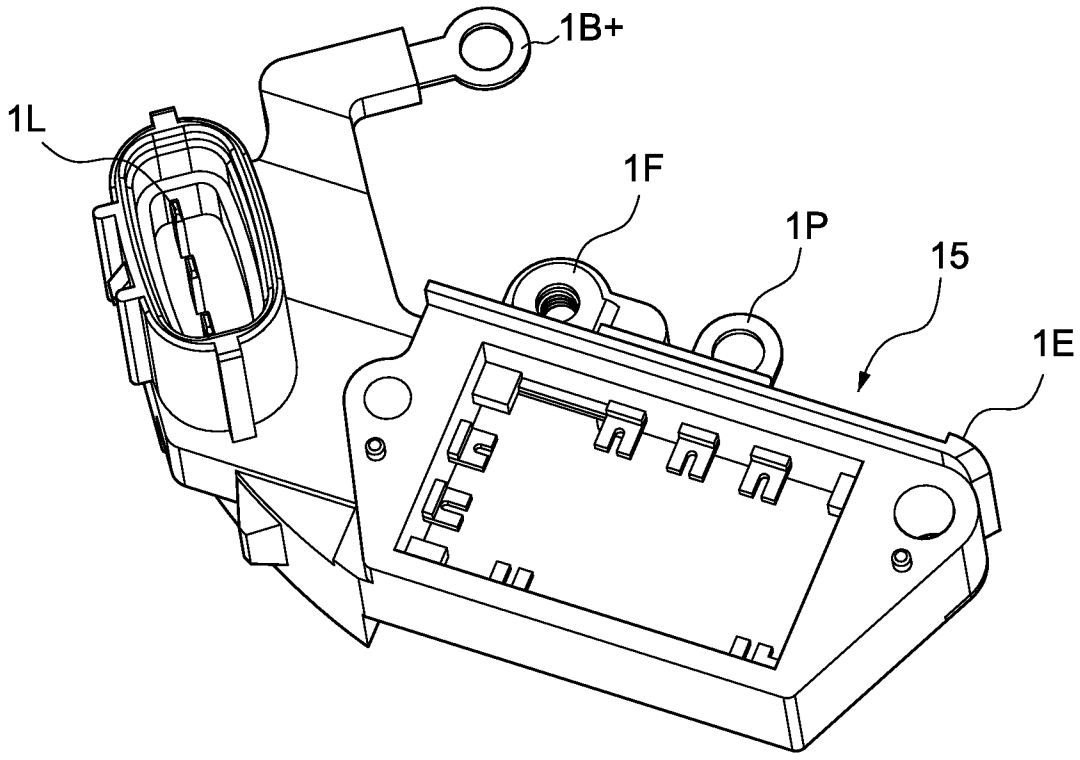

FIG. 3B

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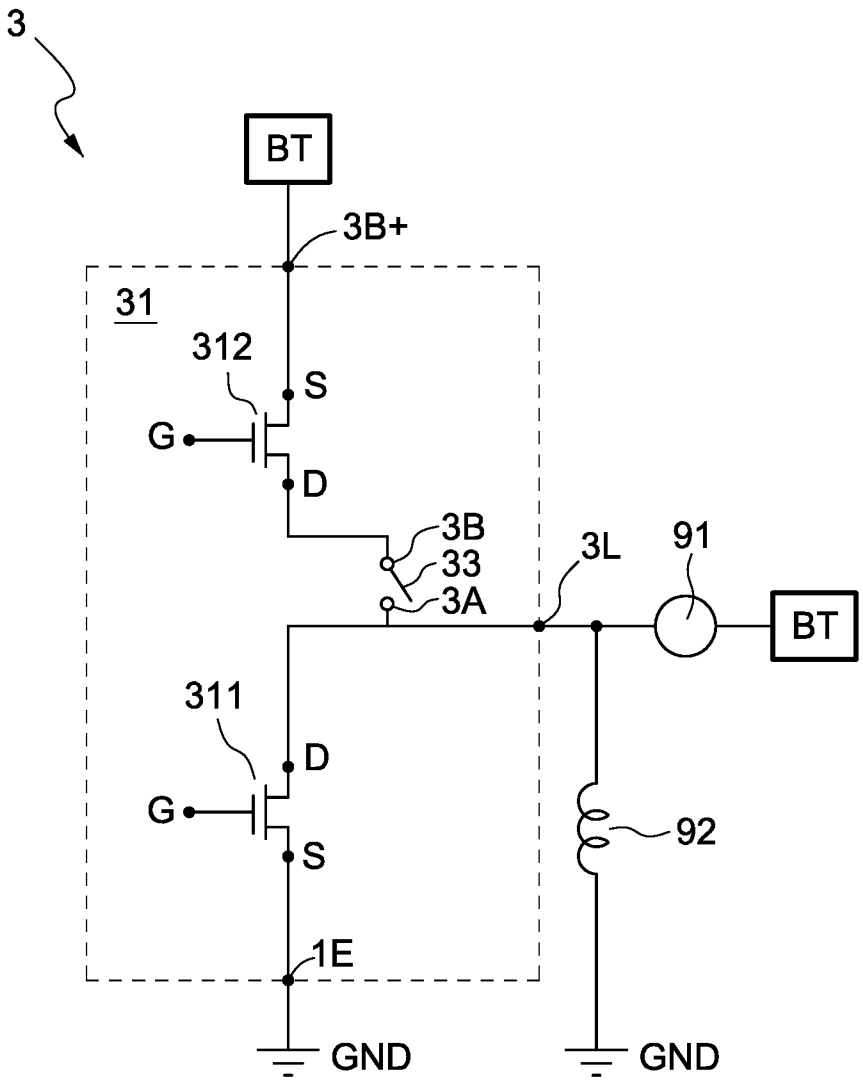

FIG. 4

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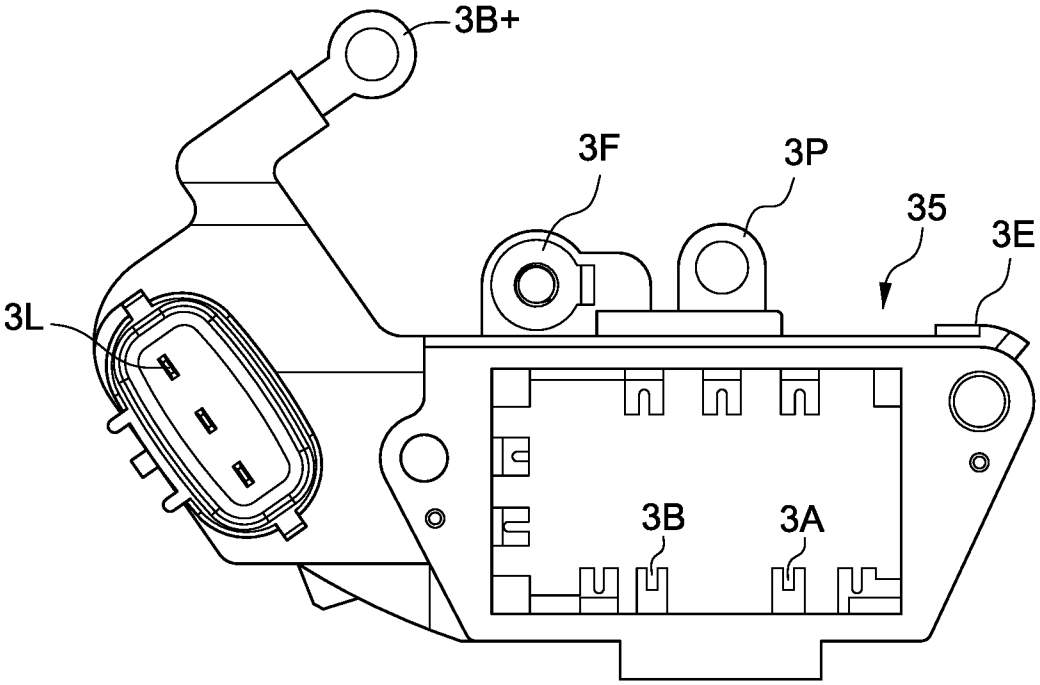

FIG. 5A

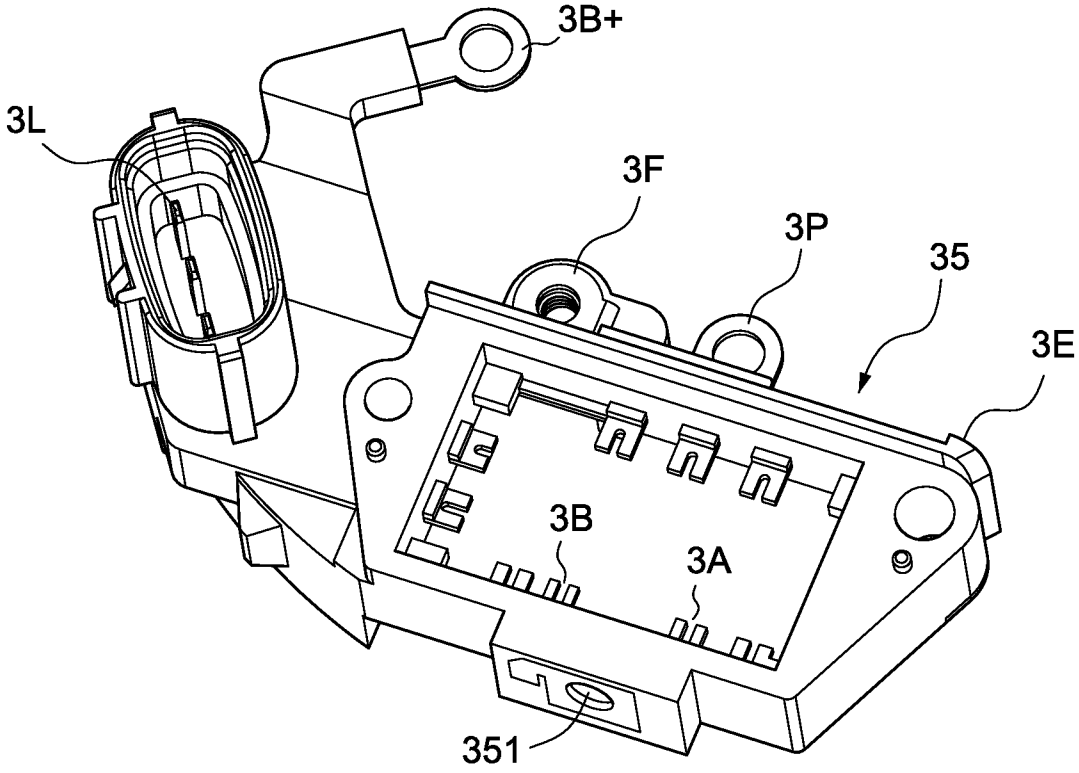

FIG. 5B

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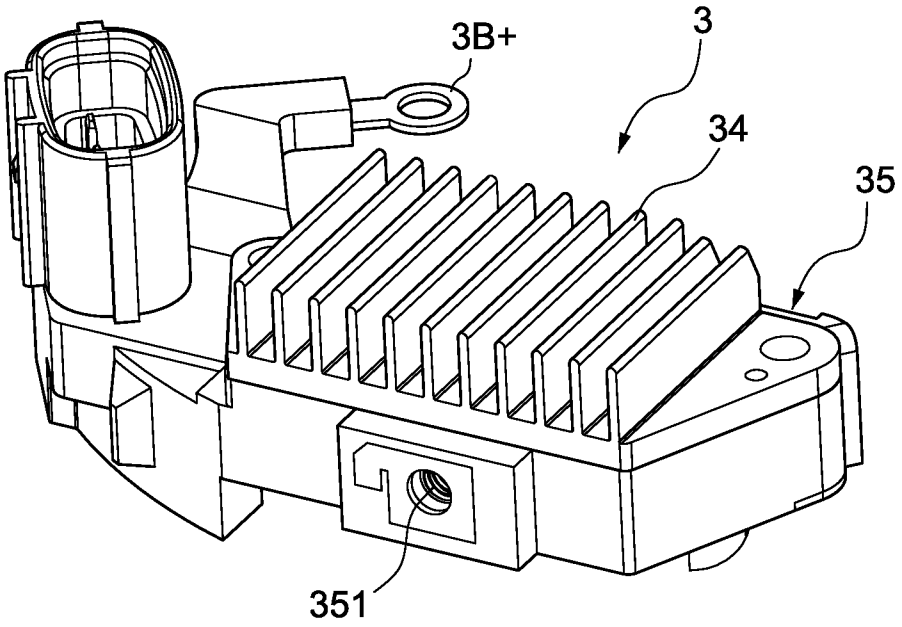

FIG. 6A

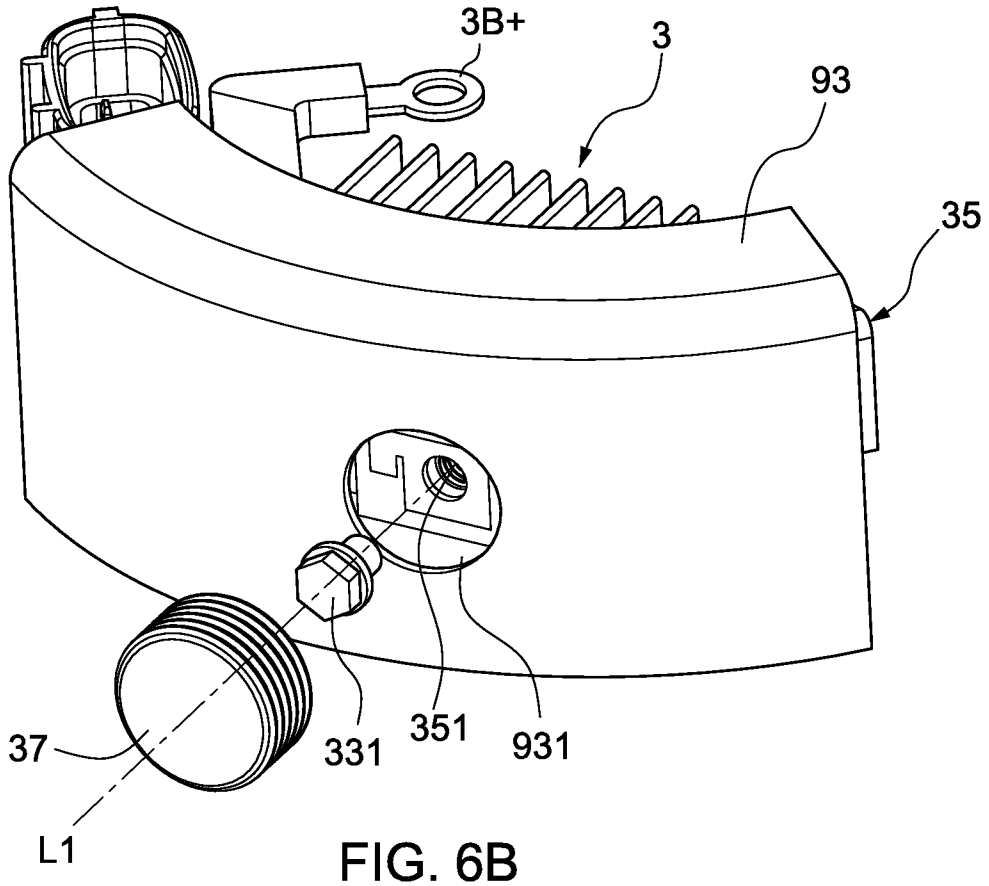

FIG. 6B

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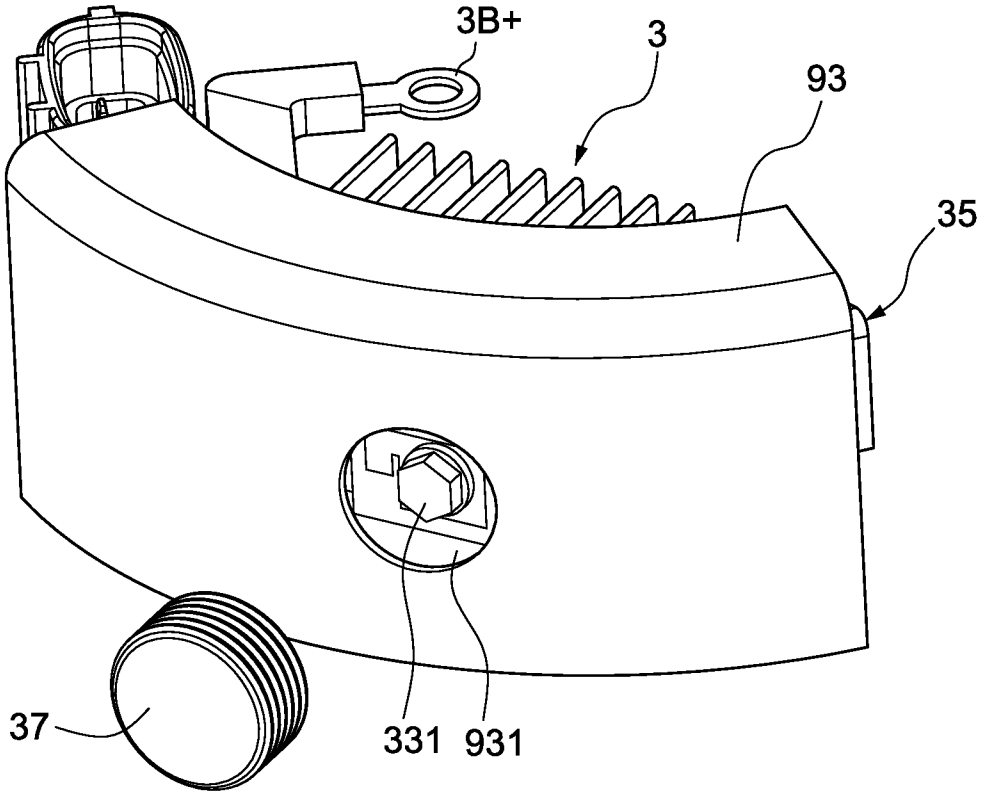

FIG. 6C

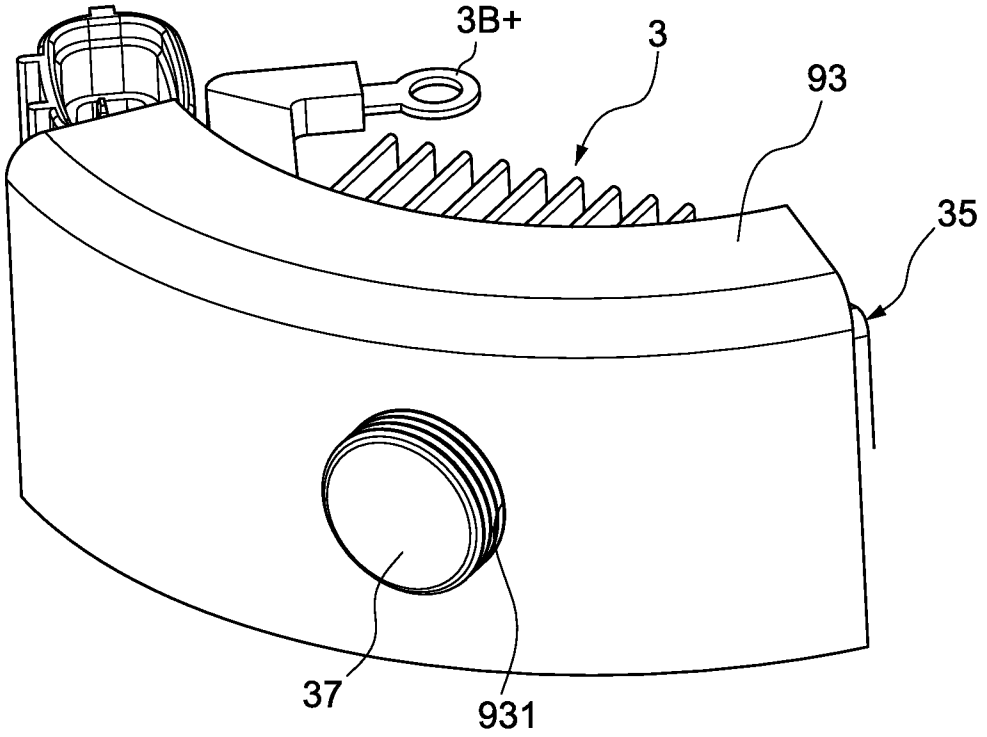

FIG. 6D