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(54) Exhaust brake with electromagnetic control

(57) Art exhaust brake with electromagnetic control for diesel engine vehicles comprises an electric contact (77) mechanically coupled to the vehicle brake pedal, a butterfly valve (4) for closing the engine exhaust gases actuated by an electromagnetic device (9) and an electronic control unit (60) that senses the status of the electric contact (77) and the engine speed and closes the butterfly valve (4) if the pedal is pressed and the engine speed is over a predetermined minimum threshold.

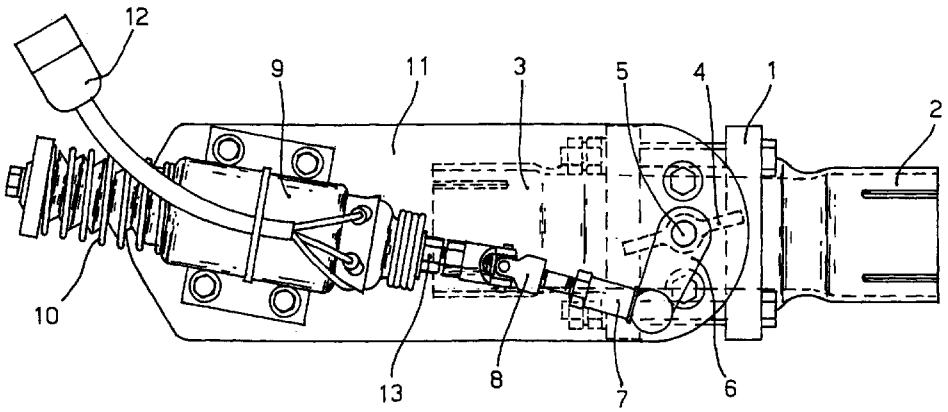

FIG. 1

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Description

[0001] The present invention refers to an exhaust brake for small size trucks.

[0002] More particularly the invention refers to a mechanic exhaust brake with an exhaust butterfly valve driven by an electromagnetic cylinder coupled to a control unit, for commercial or industrial small or medium diesel trucks, which normally lack such equipment.

[0003] The same electronic control unit, alternatively, can be used for driving a solenoid valve, for controlling therefore a pneumatic exhaust brake, normally used on heavy trucks, which used the compressed air system present on such vehicles.

[0004] The energy of the compressed air is used for closing the engine exhaust pipe, increasing the internal compression, and facilitating the stopping of the vehicle when it is in deceleration.

[0005] Nevertheless smaller vehicles must often renounce to economic and safety benefits proper of this kind of braking, because of the high costs and dimensions of a compressed air system.

[0006] Other exhaust brake systems use an electric circuit acting on an electromagnetic actuator coupled to one or more stop valves placed in the engine exhaust pipes.

[0007] An exhaust brake electrically driven is disclosed for example in the French "certificat d'utilitè" FR 2 629 411 filed on 28.03.1989 in the name of STEYR DAIMPLER PUCH Aktiengesellschaft.

[0008] In the aforesaid document is disclosed an exhaust brake for an agricultural vehicle or for a tracked building vehicle. Such vehicles are provided with two brake pedals, one acting on left wheels and another acting on right wheels. This expedient, which allows the vehicle to perform sharp turns, does not allow however the use of a traditional exhaust brake, in that the operation of one of the brake pedals would cause an engine stop and not the desired braking action.

[0009] The electric exhaust brake disclosed in the French document is therefore provided with a switch that is closed only when both brake pedals are pressed and that operates an electromagnetic actuator for closing the engine exhaust pipe. A second switch, coupled to the vehicle clutch pedal, opens the electric circuit when the clutch pedal is pressed, avoiding an engine stop.

[0010] Such device has however the risk of an unexpected engine stop, in that, even when the vehicle is not moving and the speed gear is in a neutral position, it is always necessary to press the clutch pedal before pressing the brake pedal.

[0011] A first object of the present invention it is therefore to provide an electric exhaust brake with an electronic control, cheap and easy to install as an accessory on small trucks or on heavy trucks already provided with a pneumatic exhaust brake.

[0012] Moreover, thanks to the electronic control, the operation of the brake does never interfere with the engine operation and, especially, can never stop the engine accidentally.

[0013] These objects of the present invention are reached by an exhaust brake realised according to the invention, as defined in the enclosed claims.

[0014] The exhaust brake realised according to the invention can be advantageously mounted on every kind of motor vehicle, preferably a diesel vehicle, allowing to perform a better braking, to reduce the braking distance, to lower the temperature and consumption of the brake elements and to lower fuel consumption.

[0015] The aforesaid objects of the invention will become more evident from the detailed description of a preferred embodiment with particular reference to the attached drawings wherein:

Figure 1 is a lateral view of a butterfly valve - electromagnetic actuator system of an exhaust brake realised according to the present invention;
figure 2 is a top view of the butterfly valve - electromagnetic actuator system of figure 1;
figure 3 shows, in an electronic block diagram, an electronic control unit for an exhaust brake realised according to the present invention; and
figure 4 shows a connection electric diagram, in a vehicle electric equipment, of the electronic control unit for an exhaust brake realised according to the present invention.

[0016] With reference to the enclosed figures now will be described an exhaust brake with an electromagnetic control for an internal-combustion engine vehicle according to an embodiment of the present invention.

[0017] The vehicle to which is applied the exhaust brake is provided with a traditional braking system operated by a pedal; an electric contact is coupled to the pedal for the switching on the vehicle rear stoplights.

[0018] In figures 1 and 2 is shown a mechanical stop valve for the engine exhaust gases coupled to an electromagnetic cylinder actuator 9, in a front view, and in a top view in figure 2.

[0019] The stop valve comprises a main hollow body 1 having inside a shutter element, or butterfly 4, substantially circular and pivoted on a rotating shaft 5. The rotation of the butterfly 4 on its axis of rotation 5, about 90°, causes the closing of the inner passage into the main hollow body.

[0020] Two flanges 2 and 3 are fixed to the main body 1 for the fitting with pipes of the vehicle exhaust system. The stop valve can therefore be easily installed between the exhaust pipe coming from the engine and a first expansion chamber so that the exhaust pipe is closed as close as possible to the engine.

[0021] Advantageously the stop valve can be inserted in whichever point of the vehicle exhaust system; nevertheless better results are obtained if the valve is placed near the engine.

[0022] A supporting plate 11, firmly fixed to the main body 1 of the stop valve, supports the electromagnetic cylinder actuator 9, so that the actuator-valve assembly becomes a compact element easy and quick to install.

[0023] The piston 13 of the actuator 9, actuated by at least a solenoid, is coupled to the shaft 5 of the butterfly 4 by means of an articulated joint 8, a junction arm 7 and a lever 6.

[0024] The linear movement of the piston 13 is therefore converted in a rotation movement of the butterfly 4 around its axis 5, allowing to close and open the exhaust duct by means of electric signals sent to the electromagnetic actuator 9 through its electric connection plug 12.

[0025] A helical spring 10 facilitates the reverse motion of the piston 13, withdrawing it when the solenoid is not energised.

[0026] Preferably the electromagnetic actuator 9 is provided with two solenoids, a first power solenoid is initially used for closing the butterfly valve 4 and a second solenoid, draining a low current, is used for maintaining the valve in closed position.

[0027] This expedient allows reducing to the minimum the current drawn from the electric equipment of the vehicle.

[0028] Figure 3 shows an electronic block diagram of an electronic control unit 60 for the exhaust brake with electromagnetic control.

[0029] The control unit 60 is powered by a ground terminal 68, connected to the negative terminal of the vehicle battery, and by a power supply terminal 75, connected to the positive terminal of the battery.

[0030] Two input terminals 66 and 67 receive, from an inductive sensor placed near the vehicle alternator, an electric signal which varies proportionally to the number of revolutions of the alternator and, consequently, to the number of revolutions of the engine.

[0031] A third input terminal 69 is connected to an electric contact or switch, coupled to the brake pedal, for the vehicle stoplights.

[0032] A first interface circuit 61 converts the signal coming from the inductive sensor into a voltage proportional to the engine revolutions, compares that voltage with a predetermined threshold voltage and generates a logic positive signal if that voltage is higher then the predetermined threshold voltage.

[0033] An enabling circuit 63 receives the logic signal coming from the circuit 61 and the signal coming from the stoplights switch and enables an output enable signal when both the input signals are active, i.e. when the engine revolutions are over the predetermined threshold and the brake pedal is pressed.

[0034] The enable signal reaches the output power interface circuit 64 and a switch circuit 65.

[0035] The output power interface circuit 64 drives, through the output terminals 72, 73 and 74, the electromagnetic piston actuator 9.

[0036] In particular the terminal 72 is a ground terminal, the terminal 73 supplies, for a limited initial time, the current needed by the power solenoid for closing the butterfly valve 4, and the terminal 74 supplies the second solenoid which maintains the valve in the closed position.

[0037] The interface circuit 64 includes therefore a timer which allows the power solenoid to be energised for a predetermined initial limited time.

[0038] Same electromagnetic piston actuators have a fourth connection terminal, used for forcing back the piston to the stand-by position; in this case the interface circuit 64 will power that terminal after having switched off the second solenoid.

[0039] The switch circuit 65 opens, through the terminals 70 and 71, the contact of a solenoid valve present in the fuel supply circuit of the vehicle engine.

[0040] In this way, when the exhaust brake is active, the engine is not fuel supplied, increasing the braking action and introducing a saving in fuel consumption.

[0041] A power supply circuit 62 reduces the battery voltage to a lower regulated voltage suitable for supplying safely all the control unit circuits, in particular circuit 61 and circuit 63.

[0042] In figure 4 is shown the wiring electric diagram of the control unit 60 in the electric equipment of a diesel vehicle not provided with an exhaust brake.

[0043] The short dashes lines represents the wires of the vehicle electric equipment while the continuous lines are the new wires which must be connected for installing the system.

[0044] An ignition lock key 78 of the vehicle supplies current to the brake pedal switch 77 and to the solenoid valve 79 of the diesel fuel system.

[0045] The switch 77 switches on the stoplights, shown in figure as a lamp symbol 76 connected between the switch 77 and ground.

[0046] A first wire connects the common node between the switch 77 and the lamp 76 with the input terminal 69 of the control unit.

[0047] The terminals 70 and 71 break, in the point 83, the wire that supplies the diesel fuel solenoid valve 79 and allow the control unit to open and close the valve.

[0048] The input terminals 66 and 67 are connected to the inductive sensor 81 that is physically coupled to the vehicle alternator 80.

[0049] The terminals 75 and 68 are connected to the battery 82, respectively to the positive and negative poles.

[0050] The exhaust brake device previously described can be used preferably on vehicles provided with a direct injection diesel engine, in that this kind of engine allows to interrupt easily the diesel fuel to the engine.

[0051] Thanks to the compactness of the butterfly valve - electromagnetic actuator assembly and thanks to the easy integration of the control unit in the vehicle electric equipment, the above illustrated exhaust brake is easily installable on all vehicles that are not provided with, without the necessity of modifying the vehicle

brake system and therefore without the necessity of a new vehicle approval or homologation.

[0052] In fact, as the system uses the same pedal of the hydraulic vehicle brake, in case of a failure in the exhaust system, the traditional hydraulic brake always guarantees the braking.

[0053] Moreover, since a slight pedal pressure normally switches on the stoplights, when the traditional brake in not yet activated, the exhaust brake is always activated earlier then the traditional brake.

[0054] This allows the driver to slow down or to maintain constant downhill the vehicle speed without activating the traditional brake system.

[0055] Therefore a potentially dangerous heating and wear of the brakes is avoided, obtaining a big saving in maintenance costs and in replacement parts of the traditional braking system.

[0056] Moreover if, as a consequence of the action of the exhaust brake, the engine speed goes under a predetermined minimum value, the control unit immediately re-opens the gas exhaust valve and the fuel solenoid valve, avoiding a sudden engine stop.

[0057] The aforesaid control unit is likewise easily utilisable for better managing a pneumatic exhaust braking system already installed on a heavy truck.

[0058] The electromagnetic actuator 9 is in this case an electrically controlled valve, or solenoid valve, replacing a mechanical valve in the compressed air circuit used for controlling a pneumatic actuator that closes the exhaust pipes of the vehicle.

[0059] The electronic control of the pneumatic exhaust brake allows obtaining all the advantages of the above-described system allowing, at a limited cost, to improve the management of the existing exhaust braking system.

Claims

1. Exhaust brake with electromagnetic control for an internal combustion engine vehicle comprising:

   an electric contact (77) indicative of the pressure status of a pedal of a vehicle braking system;
   an electromagnetic device (9) for controlling a mechanical valve (4) for closing the engine exhaust gases,
   characterised in that it comprises an electronic control unit (60) that senses the status of said electric contact (77) and the engine speed and enables said electromagnetic device (9) if the braking circuit pedal is pressed and the engine speed is over a predetermined minimum threshold.

2. Exhaust brake according to claim 1, wherein the electric contact (77), normally open when the pedal is in a rest position, is already closed in a first travel portion in which the vehicle braking system is not yet active.

3. Exhaust brake according to claim 2, wherein said electric contact (77) is the switch that switches on the vehicle rear stoplights (76).

4. Exhaust brake according to claim 1, wherein said minimum threshold is equal to or higher then the minimum allowed engine speed.

5. Exhaust brake according to claim 1, wherein said electronic control unit (60) senses the engine speed by means of an inductive sensor (81) coupled to the vehicle alternator (80).

6. Exhaust brake according to claim 1, wherein said mechanical valve (4) is a butterfly valve.

7. Exhaust brake according to claim 6, wherein said butterfly valve (4) and the electromagnetic device (9) are joined in order to set up a single element which can be coupled to the vehicle exhaust duct.

8. Exhaust brake according to claim 7, wherein said electromagnetic device (9) comprises a first power solenoid for closing the butterfly valve (4) and a second solenoid, draining a low current, for maintaining the butterfly valve (4) in closed position.

9. Exhaust brake according to claim 1, wherein the fuel supply to the engine is interrupted when the electromagnetic device (9) is active and the butterfly valve (4) is closed.

10. Exhaust brake according to claim 1, wherein said electromagnetic device (9) is a solenoid valve inserted in a compressed air circuit of a pneumatic exhaust brake which, when actuated, allows the passage of compressed air closing said mechanical valve for closing the engine exhaust gases.

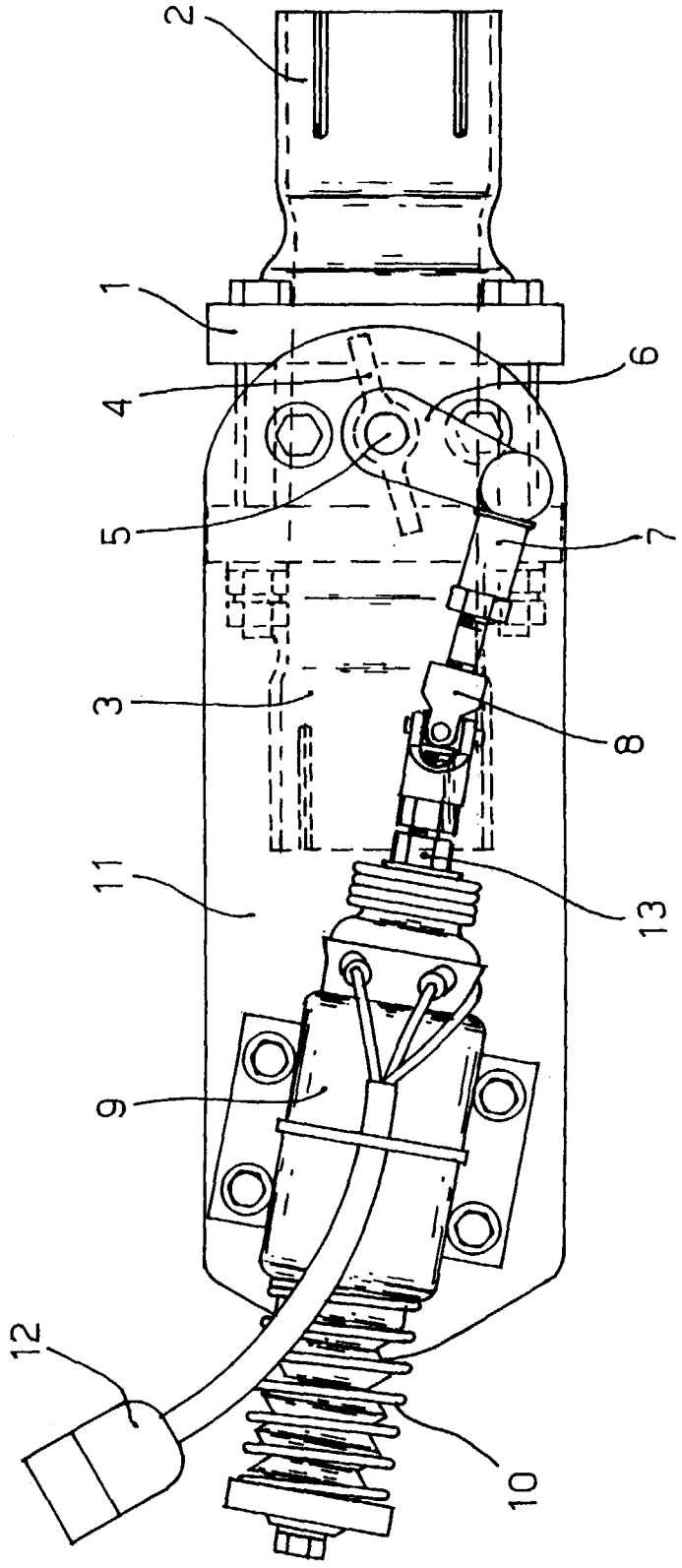

FIG. 1

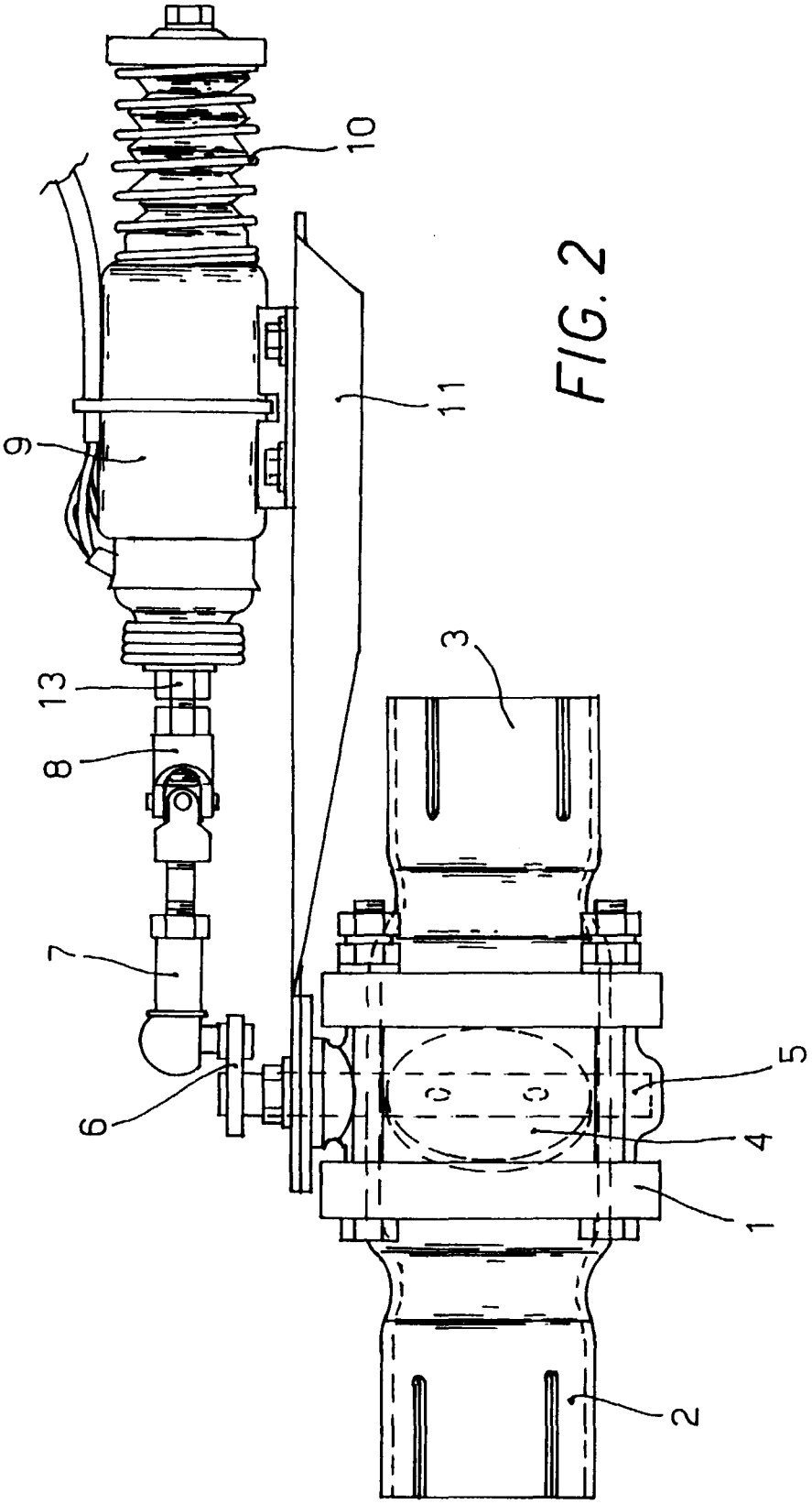

FIG. 2

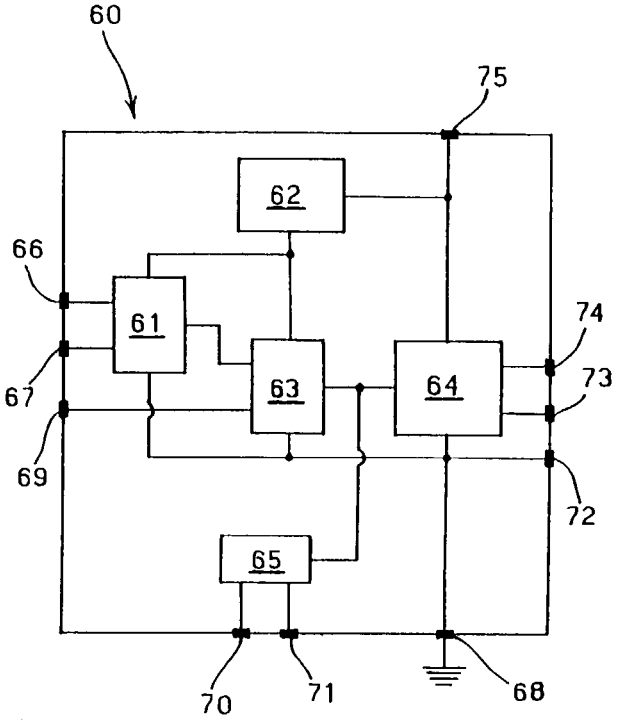
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FIG. 3

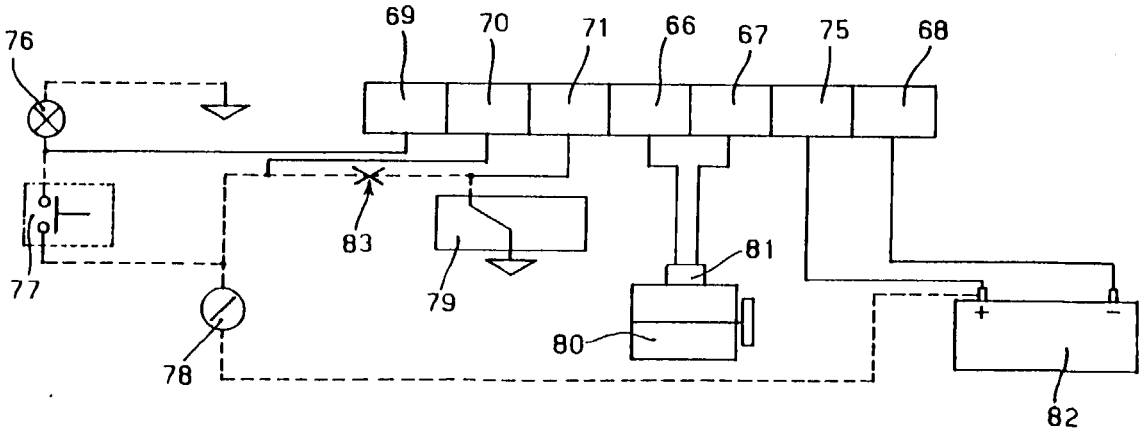
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FIG. 4