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(54) **System for starting an internal combustion engine, in particular of a vehicle and a vehicle equipped with said system**

(57) System for starting an internal combustion engine, in particular the engine of a vehicle, comprising:
a starting motor (4) able to start said engine;
a first electric circuit (2) able to supply power to said starting motor;
a control relay (7) that, when powered by a second electric circuit, is able to close said first circuit or, when not powered, to open said first circuit;
a second electric circuit (8) able to supply power to said control relay only when the engine is not running.

Vehicle equipped with said system.

EP 1 947 326 A1

Description

SCOPE OF THE INVENTION

[0001] The present invention relates to a system for starting an internal combustion engine, in particular of a vehicle.

PRIOR ART

[0002] In vehicles equipped with an internal combustion engine, in particular reciprocating engines, such as ordinary Otto or Diesel engines, a starting motor is used to start the engine. When the ignition key is turned to the start position the starting motor is connected to a power source (usually the vehicle's battery). What generally happens is that a coil is energized and operates a toothed pinion set in motion by the starting motor so as to mesh with a part capable of driving the crankshaft of the vehicle's engine, usually the ring gear on the flywheel. At the same time the starting motor becomes operational, cranking the engine to make it start. At this stage the starting motor must be disconnected from the power source, and its mechanical connection with the engine must also be disengaged. This is done by turning the key from the start position to the running position. When running, the minimum engine rotation speed is much faster than that generated by the starting motor. It must not be possible for the engine to drive the starting motor. This would cause the starting motor to overheat and break. It could also start a fire, which would be particularly serious in the presence of residual oil or fuel. If the starting motor breaks, and particularly if parts such as the carbon brushes break, they can also cause a short circuit in the whole electrical system on-board the vehicle.

[0003] Devices that prevent start procedures from being repeated are frequently used in vehicles. When a start procedure has been performed, these devices prevent another start procedure from being performed until the ignition key has been turned to the stop position, to turn the engine off, if it was running, so as to reduce the risk of damaging the starting motor by performing an incorrect procedure.

[0004] However, due to the fault of the driver, or if the contacts do not re-open (sticking), it is not infrequent for the starting motor to continue to run for too long once the engine is running, even if a single start procedure is performed. In that case the anti-repeat protections known in the prior art are ineffective, and it is possible for the engine to drive the starting motor, with all the consequences listed above.

SUMMARY

[0005] The problems described above have now been solved according to the present invention with a system for starting an internal combustion engine comprising:

a starting motor able to start said engine;

a first electric circuit able to supply power to said starting motor;

a control relay that, when powered by a second electric circuit, is able to close said first circuit or, when not powered, to open said first circuit;

a second electric circuit able to supply power to said control relay only when the engine is not running.

[0006] The term "engine running" refers to the condition wherein a minimum engine rotation speed has been exceeded, preferably for a predefined period of time.

[0007] According to a preferred embodiment of the invention, the starting motor is mechanically connected to the engine when powered, and disengaged from the engine when it is not powered.

[0008] According to another preferred embodiment of the invention, the system comprises a control device able to assume a start position wherein it closes said first circuit and other positions in wherein it opens it. Preferably said device is also able to open or close said second circuit simultaneously with the first.

[0009] According to another embodiment, the system also comprises a safety relay, that, when powered by a third electric circuit, is able to close said second circuit and open it if it is not powered.

[0010] According to a further embodiment of the invention said control device closes said third circuit when it is in the start position. Optionally, said device can also close said third circuit in other positions.

[0011] The invention also relates to a vehicle equipped with the system as described above.

[0012] The invention relates in particular to what set forth in the appended claims.

LIST OF DRAWINGS

[0013] The present invention will now be illustrated through the following detailed description of preferred but not exclusive embodiments, provided merely by way of example, with the help of the drawings attached hereto of which:

figure 1 is the diagram of a system for starting the engine of a vehicle according to the present invention;

figures 2 and 3 represent, respectively, the voltage at an output terminal from a control device and at a point of the second circuit during the phases of a normal start procedure and at a point with an excessively prolonged action on the control device.

DETAILED DESCRIPTION OF A PREFERRED EMBODIMENT

[0014] With reference to figure 1, a system for starting an engine of a vehicle, according to the present invention, is schematically illustrated. There is an electric power

source 1, for instance the battery of the vehicle, connected in the usual way at one pole to the ground 3 of the vehicle, and at the other to the various users to be powered, which are connected in turn to the ground to create the electric circuits, which can have parts in common, as is frequently the case and also as described below, in addition to the ground. The purpose of the first circuit 2 is to supply power to the starting motor 4, to enable it to crank the engine of the vehicle to start it. The starting motor can be of a known type, in particular it is preferably of the type that can be mechanically disengaged from the engine when not powered, so that it cannot be driven by said engine. This can be achieved in the way described above with reference to the prior art or in any other known way, not described in detail here. The circuit 2 can comprise a control device 5, which can be the ordinary vehicle ignition key, able to assume a number of positions. The position indicated in the drawing is the stop position, with the circuits generally disconnected. There may be a running position and a start position; the latter, as is normally the case, is not stable like the others and is maintained by means of a continuous action, for example by the driver on the key, and when released from said position it returns to the normal running position. The connections and terminals illustrated in the drawing are merely included as indications, and all variants are possible. In the start position the device makes a connection to close the circuit 2 in order to allow power to be supplied to the starting motor. The circuit 2 comprises the openable contact 6 of the control relay 7. The starting motor 4 can only be activated by closing the contact, which is possible by powering the relay 7. The relay can be monostable, so that when the power supply is interrupted it re-opens the contact 6 to prevent starting and, in the case described above, disengages the mechanical connection between the engine and the starting motor. For example the coil 9 of the relay can be able to activate the contact 7 and be part of the second circuit 8. The latter comprises an apparatus 10 capable of powering it only if the engine is not running. In that way, with the engine running the first circuit 2 is opened by the relay 7 and the starting motor 4 cannot be activated even by turning the device 5 to the start position. For example, said apparatus can be such as to provide, at a point in the circuit, one voltage with the engine running and another when the engine is not running. In the case in the example said apparatus is capable of supplying at the point 11 of the circuit, connected to the relay 9, the ground voltage 3 with the engine not running and the voltage available at the other pole of the battery with the engine running. Thus with the engine running the potential difference is not sufficient to power the relay 9 even if connected via the control device to the pole of the battery. To "power" means to supply sufficient electric power to activate the relay. Devices of this type are known in the prior art. For example they may be connected to the generator, more commonly an alternator, of the vehicle and are used, for example, to allow an indicator lamp or LED to light up if the generator is unable to supply energy (for example if the engine is not running) and to switch off when the alternator is working. Alternators equipped with a terminal or socket capable of providing the voltage as described above are usually provided. Said apparatus are incorporated in the alternator. Similar devices can comprise a circuit of the alternator capable of generating voltage, or a simple contact that opens at a certain engine rotation speed. The suitable voltage at the terminal can be achieved when the engine reaches a minimum speed of rotation or when it maintains that speed for a suitable length of time. Apparatus of this kind require no further description. Any suitable apparatus can be used.

[0015] The second circuit 8 can, if desired, be closed by the control device 5 in the start position, as in the case in figure 1, where it has a part in common with the first circuit 2, which is a simple solution that avoids keeping the relay 9 energized unless necessary. Alternatively, it could be permanently connected to one pole of the battery, or connected by the device in the running position instead of in the stop position.

[0016] According to a preferred embodiment of the invention, there may be an additional safety relay 12, able to open or close the second circuit 8. It can be similar to the control relay 9 and powered by a third circuit 13 that is opened by the control device when this is in the stop position. The arrangement in figure 1 is advantageous because it enables the third circuit to be connected in parallel to all the circuits closed by the control device in both the running and in the start positions. Thus the device 1 can be entirely similar to those known in the prior art, with the need for no additional openable contacts. The safety relay is useful in the event of the start position contact sticking or another fault that could cause an undesirable activation of the starting motor 4 as soon as the engine is turned off when the device 5 is moved to the stop position. In the drawing the curve D+ represents the voltage at the point indicated by 11 in a test performed using a system like that in figure 1 and +50 represents the voltage downstream of the contact 6 of the control relay 7. The voltages range from a minimum of 0 V (ground potential 3) to a maximum of around 12 V (supplied by the battery). The voltage +50 rises when the control device is activated to start the engine, said device then being correctly released after a sufficient time, before the voltage D+ rises to 12 V (which happens after the engine has exceeded 1450 rpm for 0.4 ms). In the case in figure 3 the control device is not released: however it can be observed that as the voltage D+ rises to the maximum value, the voltage +50 returns to zero, when the control relay is opened, disconnecting the starting motor and avoiding any damage.

[0017] The diagram in figure 1 is provided purely by way of example and the expert in the field will be able to implement all the appropriate variations in accordance with specific requirements.

[0018] With the system according to the present invention there is no need for a device to prevent any repetition

of the start procedure. The start procedure can only be performed a second time if the engine is not running, otherwise the control relay, which is not powered, does not allow any power to be supplied to the starting motor. However, an anti-repeat protection may be included, if desired.

[0019] With the vehicles known in the prior art it is generally possible (when compatible with the type of power transmission and gear system, manual or automatic), with the engine not running, even in case it cannot be started due to a failure, lack of fuel or for other reasons, to drive the entire vehicle at least for short distances using the starting motor, keeping the clutch and gear engaged and making use of the control device. This is also possible with the system according to the present invention. Although this operation should normally be avoided, it may, at times, represent the only option if the vehicle has to be moved to avoid a hazardous situation.

Claims

1. System for starting an internal combustion engine comprising:

   a starting motor (4) able to start said engine;
   a first electric circuit (2) able to supply power to said starting motor;
   a control relay (7) that, when powered by a second electric circuit, is able to close said first circuit or, when not powered, to open said first circuit;
   a second electric circuit (8) able to supply power to said control relay only when the engine is not running.

2. System according to claim 1, wherein said starting motor is such as to enable a mechanical connection with the engine, when powered, and to disengage said connection when not powered.

3. System according to any of the previous claims, comprising a control device (5) able to assume a start position wherein it closes said first circuit and other positions wherein it opens it.

4. System according to claim 3, wherein said device is also able to open or close said second circuit simultaneously with the first.

5. System according to any of the previous claims, also comprising a safety relay (12) that, if powered by a third electric circuit (13), is able to close said second circuit and open it if it is not powered.

6. System according to claims 3 and 5 wherein said third circuit is opened or closed by said control device.

7. System according to any of the previous claims for starting the engine of a vehicle.

8. System according to claim 7, comprising an apparatus 10 having a contact able to provide the vehicle ground voltage when the engine is not running, and the voltage at the other pole of the battery (1) of the vehicle with the engine running.

9. Vehicle equipped with the system according to claim 7 or 8.

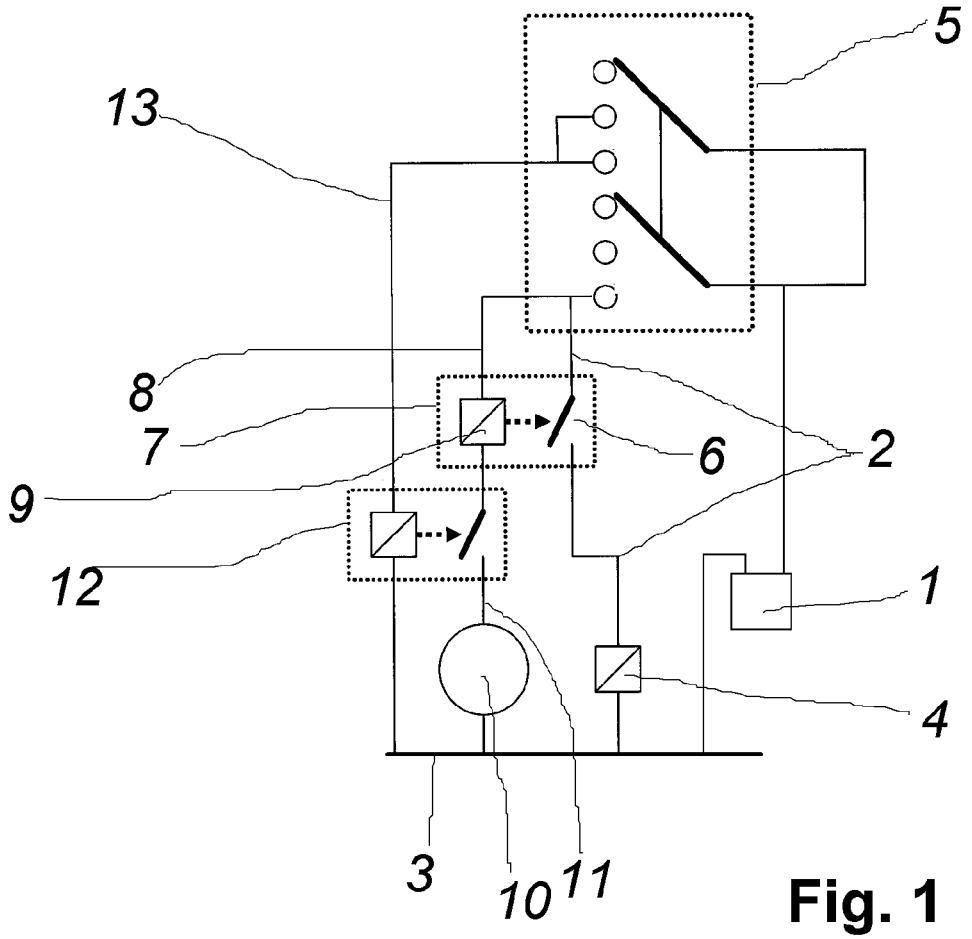

Fig. 1

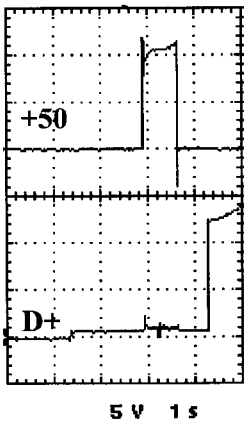

Fig. 2

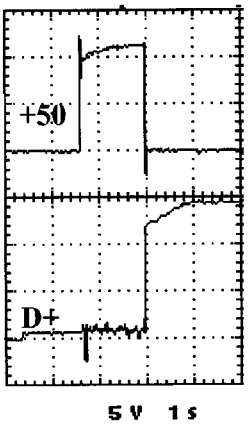

Fig. 3

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EUROPEAN SEARCH REPORT

Application Number
EP 08 10 0622

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	US 5 936 316 A (JURKIEWICZ JAMES S [US] ET AL) 10 August 1999 (1999-08-10) * figures 1,2 * * abstract * * column 1, line 50 - column 2, line 64 * * column 3, lines 25-43 * * column 3, line 58 - column 4, line 24 *	1-9	INV. F02N11/08 F02N11/10
X	US 2002/185098 A1 (PERRY BRIAN JAMES [US] ET AL) 12 December 2002 (2002-12-12) * figures 1,2 * * paragraph [0010] * * paragraphs [0026], [0027] *	1-4,7-9	
X	US 2003/051691 A1 (SAITO MIKIO [JP]) 20 March 2003 (2003-03-20) * abstract * * figures 1,4 * * paragraphs [0007] - [0010] * * paragraphs [0013], [0014] * * paragraph [0020] * * paragraphs [0030] - [0034] * * paragraphs [0038], [0039] *	1-4,7,9	TECHNICAL FIELDS SEARCHED (IPC) F02N

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	4 April 2008	Parmentier, Hélène

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 08 10 0622

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
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04-04-2008

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 5936316 A	10-08-1999	NONE	
US 2002185098 A1	12-12-2002	NONE	
US 2003051691 A1	20-03-2003	JP 2003083213 A	19-03-2003

EPO FORM P0459

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