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Renner

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(54) **FUEL CUTOFF SYSTEM FOR ENGINE-DRIVEN GENERATOR**

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(52) **U.S. Cl.** .... **290/41**; 290/40 C; 219/133; 123/406.14; 322/90

(58) **Field of Search** .... 290/41, 40 C; 219/133; 123/406.14; 322/90

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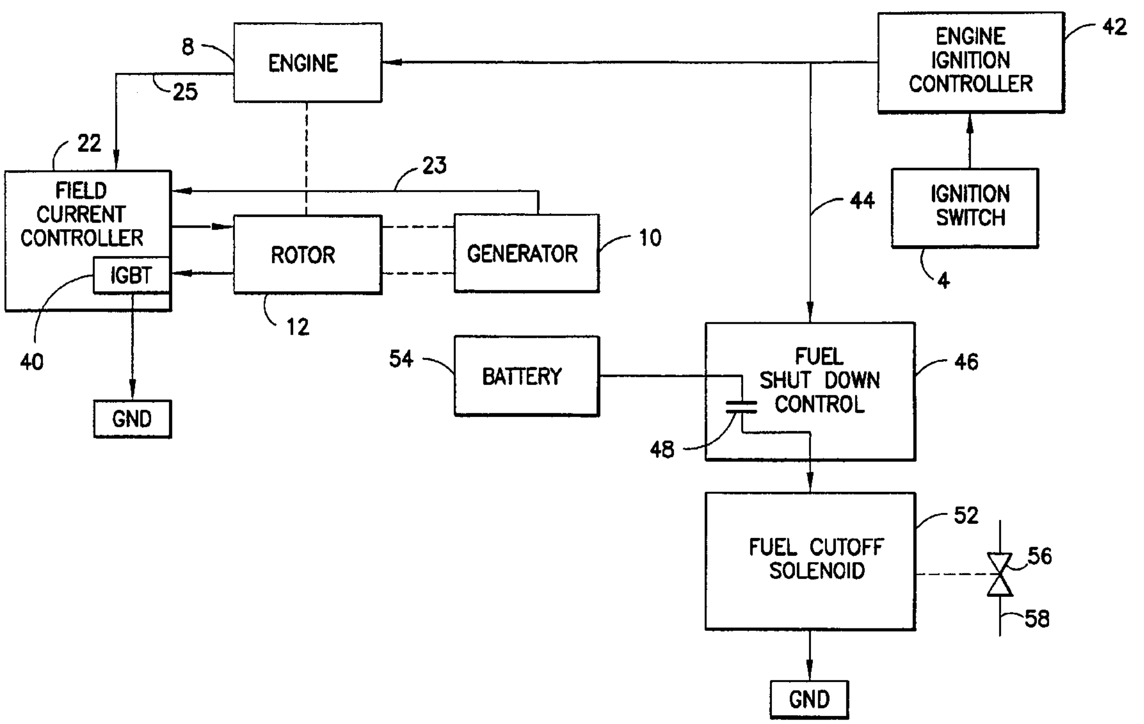
(57) **ABSTRACT**

Methods and systems for cutting off the supply of fuel to an engine in response to engine turn-off. A fuel cutoff solenoid or functionally equivalent device is connected to a source of electrical power in response to detection of conditions representing engine turn-off. One method for cutting off the supply of fuel to the engine comprises the following steps: detecting whether ignition pulses are present; and then activating a device for cutting off the supply of fuel to the engine in response to detecting the cessation of ignition pulses. The fuel cutoff device is activated by connecting it to either a battery or an output of a generator being driven by the engine. In the latter case, the rotor is grounded and a bipolar transistor is bypassed in response to detection of conditions representing engine turn-off.

24 Claims, 5 Drawing Sheets



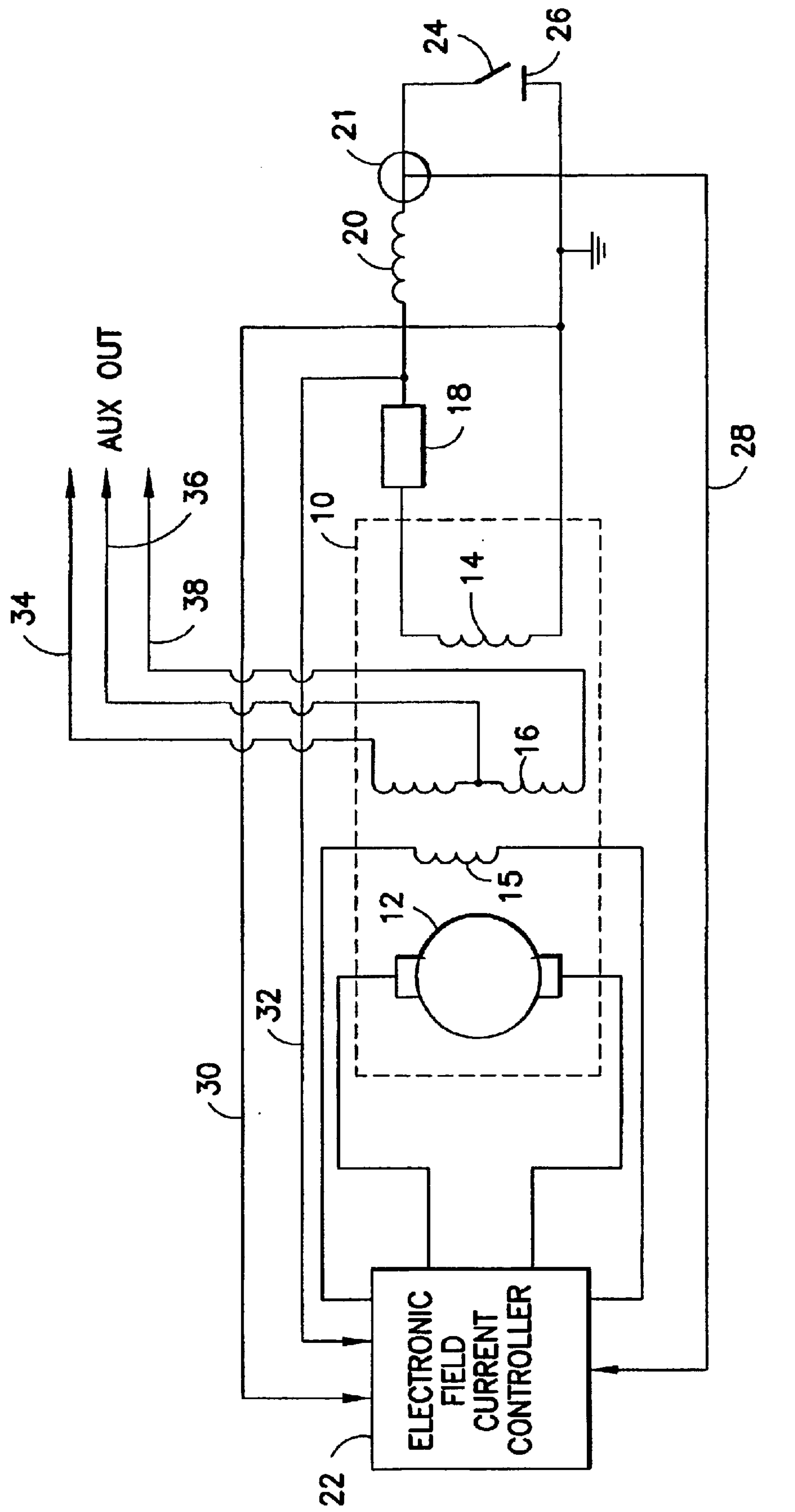


FIG. 1
PRIOR ART

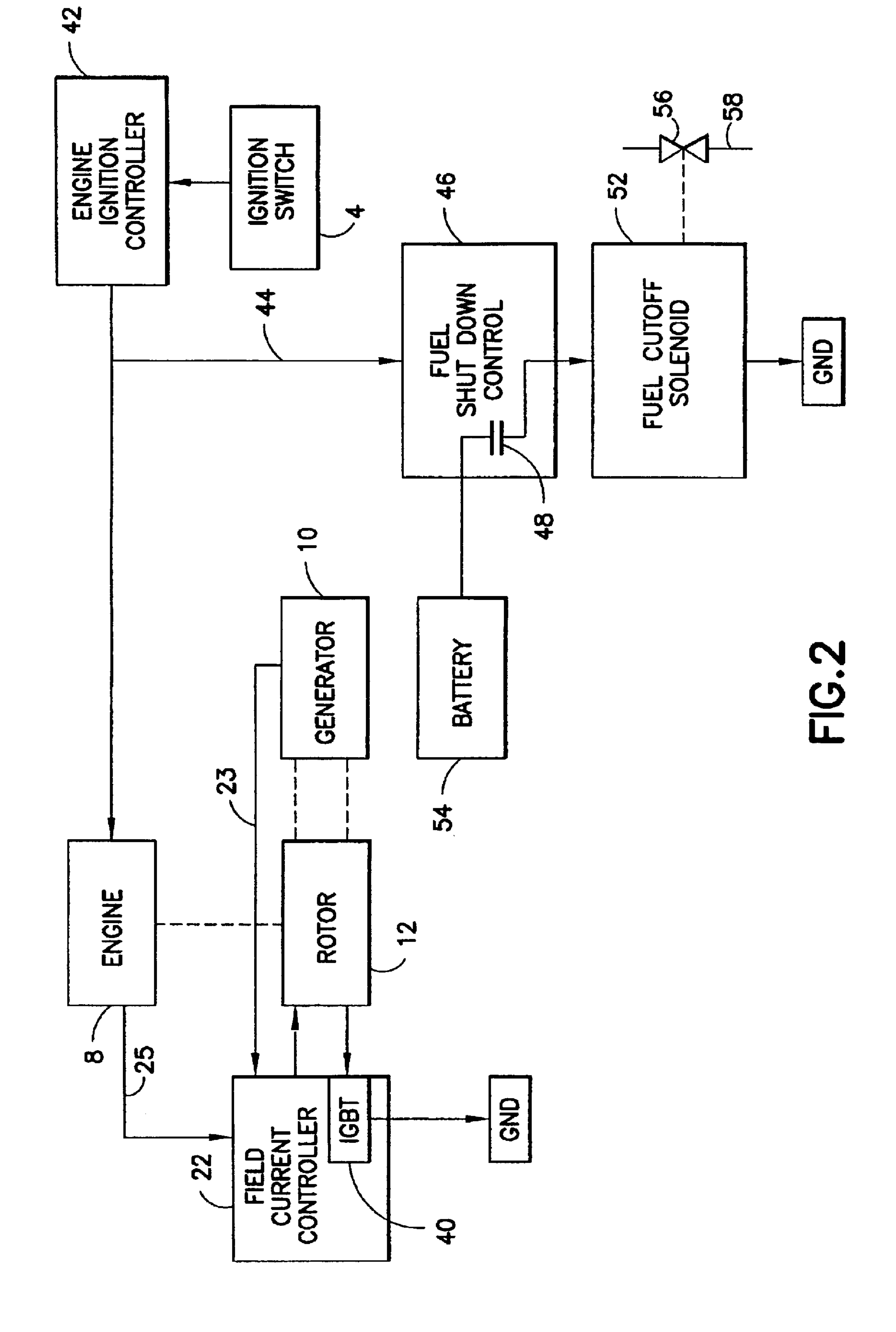

42
ENGINE IGNITION CONTROLLER
IGNITION SWITCH
4
44
46
FUEL SHUT DOWN CONTROL
48
52
FUEL CUTOFF SOLENOID
56
58
GND
10
GENERATOR
BATTERY
54
23
ENGINE
ROTOR
12
8
25
22
FIELD CURRENT CONTROLLER
IGBT
40
GND

FIG.2

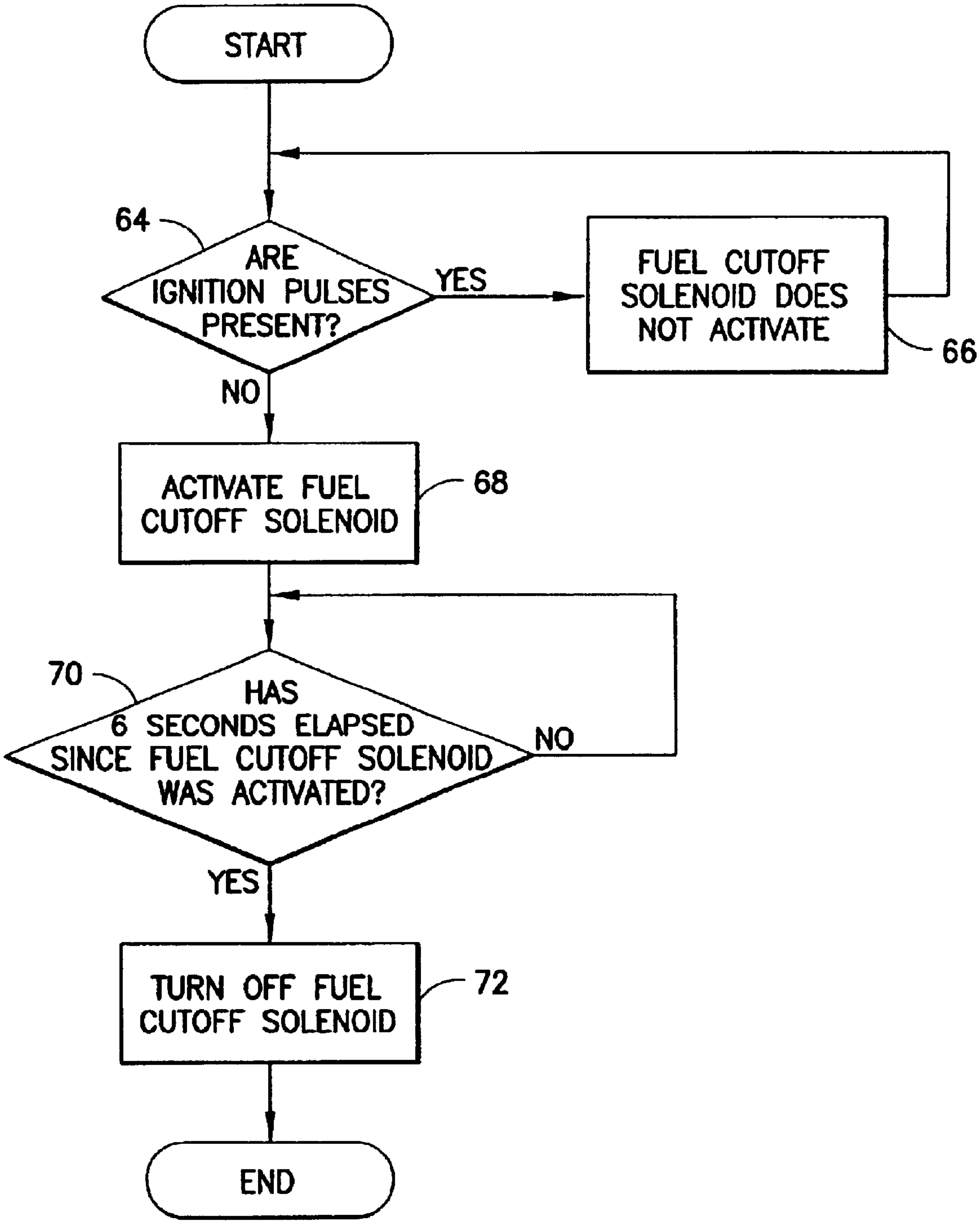

START
64
ARE IGNITION PULSES PRESENT?
YES
FUEL CUTOFF SOLENOID DOES NOT ACTIVATE
66
NO
ACTIVATE FUEL CUTOFF SOLENOID
68
70
HAS 6 SECONDS ELAPSED SINCE FUEL CUTOFF SOLENOID WAS ACTIVATED?
NO
YES
TURN OFF FUEL CUTOFF SOLENOID
72
END

FIG.3

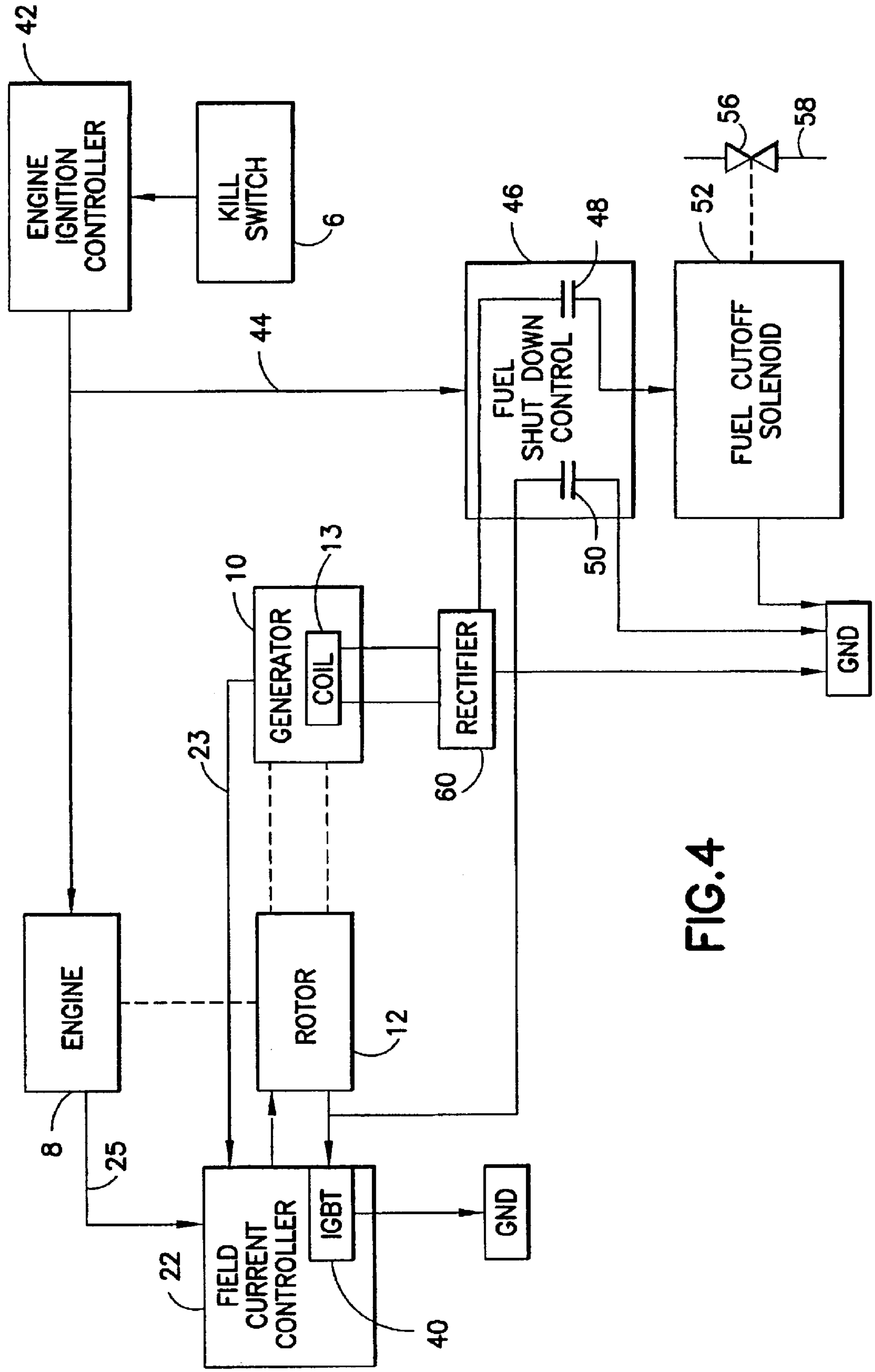

ENGINE IGNITION CONTROLLER
42
KILL SWITCH
6
44
FUEL SHUT DOWN CONTROL
46
48
50
FUEL CUTOFF SOLENOID
52
56
58
GENERATOR
10
COIL
13
RECTIFIER
60
GND
GND
23
ENGINE
8
ROTOR
12
25
FIELD CURRENT CONTROLLER
22
IGBT
40

FIG.4

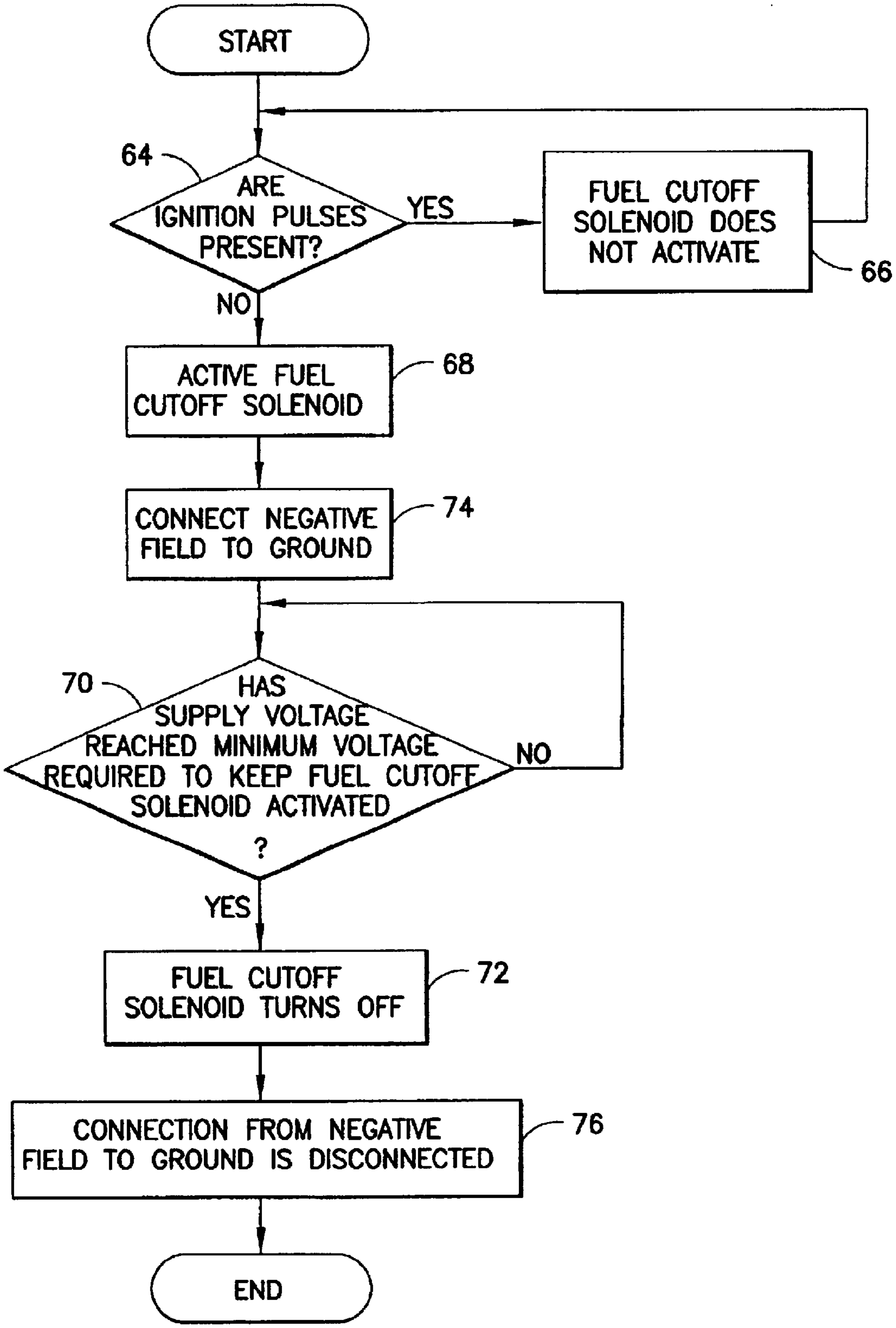

START
64
ARE IGNITION PULSES PRESENT?
YES
FUEL CUTOFF SOLENOID DOES NOT ACTIVATE
66
NO
ACTIVE FUEL CUTOFF SOLENOID
68
CONNECT NEGATIVE FIELD TO GROUND
74
70
HAS SUPPLY VOLTAGE REACHED MINIMUM VOLTAGE REQUIRED TO KEEP FUEL CUTOFF SOLENOID ACTIVATED ?
NO
YES
FUEL CUTOFF SOLENOID TURNS OFF
72
CONNECTION FROM NEGATIVE FIELD TO GROUND IS DISCONNECTED
76
END

FIG.5

FUEL CUTOFF SYSTEM FOR ENGINE-DRIVEN GENERATOR

BACKGROUND OF THE INVENTION

This invention generally relates to engine-driven power supplies. More specifically, the invention relates to systems for controlling the supply of fuel to engines that drive power supplies.

Engine driven welding power supplies are well known, and may be driven either by a DC generator or an AC generator (also called an alternator-rectifier). An AC generator generally includes, in addition to an alternator, a reactor followed by rectifiers to provide a DC output. Electrical power produced by the generator as the engine drives rotation of the rotor is converted by known electrical components into useable welding power available at terminals.

Often, the output is controlled in welding power supplies using feedback. For example, a known field current control algorithm includes the steps of comparing field current to a set point and then adjusting the field current in response to deviations therefrom. Another prior art design receives welding current and/or welding voltage feedback, and controls the field current to produce a desired output. U.S. Pat. No. 5,734,147, issued Mar. 31, 1998 to the assignee of the present invention, and entitled Method and Apparatus for Electronically Controlling the Output of a Generator Driven Welding Power Supply, describes such a field current control. Another example of a known engine driven welding power supply with field current control can be operated to provide a constant current or constant voltage output.

Engine-driven welding power supplies of the foregoing type comprise a generator driven by an engine. Typically the engine is an internal combustion engine that burns gasoline. The engine is started either electrically (using a battery) or manually (by pulling a pull-start cable). Initially the engine may run at an idle speed, with the speed being increased to a running speed when a load is applied to the generator. For example, in one known system, the position of the governor arm of the engine can be changed by energizing a so-called "idle solenoid", which is mechanically linked to the engine governor arm. The state of the idle solenoid is in turn controlled by a suitable idle control circuit that is part of the control system. The idle control circuit, in conjunction with other electrical components, senses the demand for welding power at the welding terminals and actuates the idle solenoid accordingly. During times when welding is taking place, the idle solenoid is de-energized. In the de-energized state, the plunger of the solenoid is free to float, and it does so as the governor arm changes its position to maintain a constant engine operating speed (e.g., 3,700 rpm). When the idle control circuit senses no demand for welding power at the terminals, it starts a delay routine. If after a predetermined period of time, no welding demand has been made, the idle control circuit actuates the solenoid, causing its plunger to retract. When the actuated solenoid clamps the governor arm, the engine speed drops to an idle speed (e.g., 2,200 rpm). However, the engine speed may be controlled in accordance with other control algorithms.

To turn off the welding machine, the engine must be turned off. In the case of an electric-start engine, the engine can be turned off by returning a start or ignition switch to its OFF position. In the case of a pull-start engine, the engine can be turned off by pressing a kill switch. In either case, it is desirable to cut off the supply of fuel in order to decrease fuel consumption and also to avoid after-bang in the muffler, caused when fuel passes through the engine cylinder(s) without being combusted and instead is combusted in the muffler. This circumstance arises when the engine receives fuel but does not receive ignition pulses.

A known device for cutting off the supply of fuel to a turned-off engine is a so-called "fuel cutoff solenoid". U.S. Pat. No. 4,633,831 discloses a fuel cutoff system for a motor vehicle in which a control circuit activates a fuel cutoff solenoid in response to detection of a set of predetermined conditions. The fuel cutoff solenoid is adapted to operate a fuel cutoff valve placed in the fuel line that runs from the fuel tank to the engine. U.S. Pat. No. 6,166,525 discloses an automatic electric power generator control wherein the engine driving the generator stops at a predetermined time after the power demand is removed. In addition, a kill switch is provided to stop the engine. The '525 Patent states that in the simplest case, the kill switch can be a switch or relay connected across the coil primary of the engine, thereby shorting the coil and eliminating the ignition spark; and further states that engines may also be stopped by a fuel shutoff solenoid valve, or a combination of the two methods.

There is a need for fuel shutdown systems and methods that cut off the supply of fuel when the engine of an engine-driven electric generator is turned off. Such systems are needed for both electric-start and pull-start internal combustion engines.

BRIEF DESCRIPTION OF THE INVENTION

The invention is directed to methods and systems for cutting off the supply of fuel to an engine in response to engine turn-off. The invention is particularly directed to methods and systems wherein a fuel cutoff solenoid or functionally equivalent device is connected to a source of electrical power in response to detection of conditions representing engine turn-off.

One aspect of the invention is a method for cutting off the supply of fuel to an engine, comprising the steps of detecting whether ignition pulses are present; and activating a device for cutting off the supply of fuel to the engine in response to detection of a change from a first state in which ignition pulses are present to a second state in which ignition pulses are absent. The device may be activated by drawing electrical power from a battery or from a stator winding in an electric generator being driven by the engine.

Another aspect of the invention is a system for cutting off the supply of fuel to an engine, comprising: a battery power supply; a first device that cuts off the supply of fuel to the engine when energized by the battery power supply and does not cut off the supply of fuel to the engine when not energized by the battery power supply; a second device for connecting the first device to the battery power supply in a first state and disconnecting the first device from the battery power supply in a second state; and a control circuit that causes a change of state of the second device from the second state to the first state in response to a change from ignition pulses being present to ignition pulses being absent. In one disclosed embodiment, the first device is a solenoid and the second device is a relay.

A further aspect of the invention is a method for cutting off the supply of fuel to an engine being used to drive an electric generator, comprising the following steps: detecting whether ignition pulses are present; and coupling a rotor winding of the generator to ground and a stator winding of the generator to a fuel cutoff device in response to detection of cessation of ignition pulses.

Another aspect of the invention is a power generation system comprising: an engine, an engine ignition controller for providing ignition pulses to the engine, a stator winding or coil for providing a generator output, a rotor winding driven to rotate by the engine, and a fuel shutdown system for cutting off the supply of fuel to the engine. The fuel shutdown system comprises: a first device that cuts off the supply of fuel to the engine when energized by the battery power supply and does not cut off the supply of fuel to the engine when not energized by the battery power supply; a second device having first and second states, the rotor winding being connected to ground when the second device is in its first state and not connected to ground when the second device is in its second state; a third device having first and second states, the stator winding or coil being connected to the first device when the third device is in its first state and not connected to the first device when the third device is in its second state; and a control circuit that causes a first change of state of the second device from its second state to its first state and a second change of state of the third device from its second state to its first state in response to cessation of ignition pulses. In one disclosed embodiment, the first device is a solenoid and the second and third devices are relays.

Yet another aspect of the invention is a method for cutting off the supply of fuel to an engine being used to drive an electric generator, comprising the following steps: detecting whether the engine has been turned off; and connecting an input of fuel cutoff device to an output of a stator winding of the generator in response to detection of engine turn-off, the fuel cutoff device being energized by the generator output.

Other aspects of the invention are disclosed and claimed below.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a diagram of a known engine-driven welding power supply.

FIG. **2** is a block diagram showing portions of an electric-start engine-driven generator system having a fuel shutdown control system in accordance with one embodiment of the present invention.

FIG. **3** is a flowchart showing steps of an algorithm performed by the fuel shutdown control system incorporated in the embodiment depicted in FIG. **2**

FIG. **4** is a block diagram showing portions of a pull-start (no battery) engine-driven generator system having a fuel shutdown control system in accordance with another embodiment of the present invention.

FIG. **5** is a flowchart showing steps of an algorithm performed by the fuel shutdown control system incorporated in the embodiment depicted in FIG. **4**

Reference will now be made to the drawings in which similar elements in different drawings bear the same reference numerals.

DETAILED DESCRIPTION OF THE INVENTION

While the present invention will be illustrated with reference to a particular engine/generator-driven welding power supply, it should be understood at the outset that the invention in its broadest scope may be applied to any engine, including engines that drive other types of electrical generators, e.g., generators not used in conjunction with or incorporated in a welding machine.

The present invention is described with respect to an engine-driven generator welding power supply having an electronic field current controller. The details of the electronic field current controller, as it relates to the welding output (current, voltage and/or power), will not be described herein, but are described in detail in U.S. Pat. No. 5,734,147. (As used herein, the term "electronic controller" refers to a controller using digital, analog, or a combination of digital and analog components.)

Referring to FIG. **1**, the operation of an AC generator-driven power supply having an electronic field current controller will be generally described. The system comprises a generator **10**, an electronic field current controller board **22** for regulating the welding and auxiliary outputs of the generator **10**, an output rectifier **18**, an output inductor or filter **20**, weld feedback lines **30** and **32**, and auxiliary output lines **34**, **36** and **38**. The generator comprises a rotor **12** and a stator. The rotor **12** comprises a rotor winding (not shown in FIG. **1**) The stator comprises various windings depicted in FIG. **1**, including welding power output winding **14**, exciter winding **15** and auxiliary power output windings **16**. The welding power output winding provides current to one electrode **24** (typically located at the tip of a welding gun). Another electrode **26** is clamped to the workpiece. The electrode **26** is typically connected to machine ground. The winding **14** produces a desired voltage potential difference across the electrodes **24** and **26**.

The generator **10** may be either a three-phase or a single-phase generator. In response to current from the field current controller board **22**, the rotor winding creates electromagnetic fields that induce current in the various stator windings. The voltage and current derived by welding power output winding **14** is responsive to the magnitude of the field current provided to the rotor **12**. The output of welding power output winding **14** is provided to a rectifier **18** and an output inductor **20**, which provides the welding power supply to the electrode **24**. The magnitude of the field current in the rotor winding is responsive to the electronic field current controller on board **22**. Thus, the electronic field current controller indirectly controls the output of welding power supply.

Typically, feedback from the welding output is provided on lines **28**, **30** and **32**. Voltage feedback is obtained from the output of rectifier **18** and is fed back to the electronic field current controller board **22** via lines **30** and **32**. Current feedback is obtained by a current sense device **21** and is fed back to the electronic field current controller board **22** via line **28**. The electronic field current controller board **22** uses the current and voltage feedback to control the field current in such a manner as to provide a desired output current and voltage. The exciter winding **15** provides an output to the field current controller, which in turn provides field current to the rotor winding.

The electronic field current controller comprises a frequency-to-voltage converter, a welding voltage regulator, a welding current regulator, a curve shaping circuit, a set point adjust, a welding decoupling circuit, and a pulse width modulator circuit (individually and collectively a welding regulator). The welding voltage regulator receives inputs indicative of welding current and voltage. (Welding current, welding output, welding power and welding voltage refer to the main output of the power supply, which is used for welding in the preferred embodiment. However, in other embodiments the main output of the power supply is used for other purposes, such as plasma cutting, or other high power loads.) Using these inputs, the welding voltage regulator controls the field current and sets the open circuit output voltage of the power supply to a preselected value.

Generally, the auxiliary output windings **16** are used to provide an auxiliary power output (current, voltage and/or power). The auxiliary output is often used to power tools, lights, etc., that require 110 VAC. Thus, the auxiliary output is typically 110 VAC, but may be 240 or 480 VAC. The output may be single phase or three phase. The frequency of the auxiliary output may be made dependent upon the presence or absence a welding output. For example, when a welding output is being provided, the generator runs at a higher rpm, and the auxiliary output will be at approximately 100 Hz. However, when only an auxiliary output is being provided, the generator runs at an idle rpm, and the auxiliary output will be at approximately 60 Hz.

In accordance with the embodiments disclosed herein, the electronic field current controller board comprises a power switch that is turned on and off, as desired, to respectively provide or not provide field current to the rotor. In the respective embodiments shown in FIGS. **2** and **4**, the power switch takes the form of an insulated gate bipolar transistor (IGBT) **40**. The control board **22** actively controls the output of the generator **10** by switching the IGBT **40** on and off to control the current in the winding of rotor **12**. The field current control board **22** regulates the amount of current supplied to the rotor **12**. During normal operation, when the IGBT **40** (power switch) turns on, current flows from the field current control board **22** to the rotor **12**, and then back to the control board **22** to machine ground via the IGBT **40**. The field current control board **22** supplies the current to the rotor **12** from on-board capacitors. These capacitors in turn store electrical energy received via lines connected to the terminals of the exciter winding (item **15** in FIG. **1**) in the generator **10**. The supply of power to the control board from the exciter winding is generally indicated by the line **23** in FIGS. **2** and **4**. The electronics on the control board **22** are powered by electrical energy received via lines connected to the terminals of a lamp coil (not shown) inside the engine **8**. The supply of power to the control board from the lamp coil in the engine **8** is generally indicated by the line **23** in FIG. **4**,

As previously noted, the control board **22** actively controls the output of the generator **10** by switching the IGBT **40** on and off to control the current in the rotor **12**. When the power supply to the field current control board **22** is turned off, e.g., by moving an ignition switch to the OFF position when an electric-start engine drives the generator or by pressing a kill switch when a pull-start engine drives the generator, the IGBT (power switch) **40** is also turned off, which turns off the output of the generator **10** as well (by cutting off current to the rotor winding). When the ignition switch is turned off, the engine coasts down and the voltage output by the lamp coil in the engine decreases. The lamp coil output voltage supplies the field current control board with power, which in turn provides the regulated voltage that is applied to the gate of the IGBT **40**. The regulated voltage drops as the lamp coil voltage decays. The control board **22** needs to turn the IGBT **40** off when the voltage on the gate of the IGBT is less than 12 volts. This is needed to protect the IGBT from damage.

When the generator is turned off, the fuel to the engine must be cut off to prevent raw gas from entering the muffler, which if it does, will ignite and send a flame out of the muffler accompanied by a substantial after-bang. Different fuel shutdown systems are disclosed herein for respective use with an electric-start engine and a pull-start engine. The former has a battery that can provide the needed power for actuating a fuel cutoff solenoid; the latter does not have a battery, so that the power for actuating the fuel cutoff solenoid is derived from the generator. The first embodiment (electric start) will be described with reference to FIGS. **2** and **3**; the second embodiment (pull start) will be described with reference to FIGS. **4** and **5**.

In the electric start embodiment depicted in FIG. **2**, the battery **54** is used to energize the fuel cutoff solenoid **52**, which in turn closes a fuel cutoff valve **56** placed along the fuel line **58** that supplies fuel from a fuel tank (not shown) to the engine **8**. Actuation of the solenoid **52** is controlled by a fuel shutdown control board **46** having a relay **48**. One side of the relay **48** is connected to the battery **54**, while the other side of the relay **48** is connected to the solenoid **52**. The fuel shutdown control circuit on board **46** closes the relay **48** in response to the detection of conditions representing engine turn-off. When the ignition switch **4** is in its ON position, the engine ignition controller **42** provides ignition pulses to the engine **8**. Ignition pulse signals are also received by the fuel shutdown control board **46** on line **44**. In response to detecting that ignition pulses are not present; the fuel shutdown control board **46** activates the fuel cutoff solenoid **52**, thereby cutting off the supply of fuel to the engine **8**.

The circuitry for performing the fuel shutdown control function may be analog or digital. In one example of an analog circuit, comparators are used to control the ON state of a fuel cutoff transistor as a function of the incoming pulses on line **44**. As long as ignition pulses are present, the fuel cutoff transistor is maintained in the ON state. The state of the relay **48** is a function of the state of the fuel cutoff transistor. When the fuel cutoff transistor is ON, the relay is held open. When ignition pulses are no longer present, the transistor turns OFF, causing the relay **48** to close, thereby energizing the fuel cutoff solenoid **52**. Alternatively, the fuel shutdown control board could be provided with a microprocessor or a microcontroller that is programmed to issue a command that causes the relay **48** to be closed in response to detection of the above-described condition on line **44**.

The details of the algorithm performed by the fuel shutdown controller are presented in FIG. **3**. After the engine has been started, the fuel shutdown controller monitors line **44** (see FIG. **2**) for the presence of ignition pulses (step **64**). If ignition pulses are present, then the fuel cutoff solenoid is not activated (block **66**). If ignition pulses are absent, then the fuel cutoff solenoid is activated (step **68**) by closing the relay **48** (see FIG. **2**) to provide battery power to the solenoid. The fuel shutdown controller then monitors the time elapsed since the activation of the solenoid (step **70**). The time elapsed is monitored continuously until 6 seconds have elapsed, at which point the fuel shutdown controller times out and releases the relay **48** to prevent discharge of the battery **54**. As a result, the fuel cutoff solenoid is de-energized or turned off (step **72**). The time interval of 6 seconds is adopted herein merely as an example. However, the time during which the fuel cutoff solenoid is energized must have a duration adequate to prevent muffler after-bang as the turned-off engine coasts to a halt. The IGBT **40** does not need to be bypassed for the electric-start embodiment.

In contrast to the electric-start embodiment, the pull-start embodiment depicted in FIG. **4** has no battery to power the fuel cutoff solenoid **52**. Instead the power to drive the fuel cutoff solenoid is derived from a stator winding or coil **13** in the generator **10**. The coil **13**, depicted in FIG. **4**, is in addition to the stator windings **14**, **15** and **16** (not shown in FIG. **4**) previously described with reference to FIG. **1**. The voltage from coil **13** is output to a rectifier **60**, which converts the AC voltage to rectified DC that is sent to the fuel shutdown control block **46**. In one embodiment, the rectifier **60** is a 15,000 i F capacitor.

As previously explained, the field current controller of the prior art is designed to turn off the generator **10** when the engine **8** is turned off, i.e., when the supply of power on line **25** from the lamp coil in the engine **8** is turned off. The field current controller **22** needs to turn off IGBT **40**, which controls the current in the rotor winding, when the voltage on the gate of the IGBT falls below about 12 volts. This protects the IGBT from damage. However, when the generator turns off too quickly, there is not enough power to keep the fuel cutoff solenoid **52** energized. When the generator **10** shuts down to early, fuel is allowed back into the engine, which causes an after-bang in the muffler (not shown).

To overcome the foregoing shortage of power from the generator **10**, in the embodiment depicted in FIG. **4** the fuel shutdown controller **46** senses when the kill switch **6** has been pressed (or when a start switch has been turned to the OFF position). This condition is detected in the same manner as previously described with reference to the embodiment shown in FIG. **2**, namely, the fuel shutdown control circuit on board **46** monitors line **44** and detects when the output of ignition pulses ceases. When this state is detected, the fuel shutdown control circuit turns on, i.e., closes, a pair of relays **48** and **50** on board **46**. The relay **48** connects the DC voltage output by the rectifier **60** to the fuel cutoff solenoid **52**, while the other relay **50** connects the rotor winding to machine ground, which effectively bypasses the IGBT **40**, letting the field in the rotor decay through its own resistance in the field. More precisely, when the IGBT is bypassed, the current to the rotor is not turned off and the full current from the exciter winding (item **15** in FIG. **1**) is provided to the rotor, which in turn induces more current in the exciter winding. This decay process keeps the output from winding or coil **13** high as long as needed, which in turn keeps the fuel cutoff solenoid **52** engaged. Because the fuel cutoff valve **56** is held closed, fuel does not enter the muffler and the after-bang is eliminated. (The voltage applied to the fuel cutoff solenoid decays with the speed of the engine and only keeps the fuel cutoff valve closed above a certain minimum voltage.)

The algorithm performed by the fuel shutdown control circuit for the embodiment depicted in FIG. **4** is shown in FIG. **5**. After the engine has been started, the fuel shutdown controller **46** monitors line **44** for the presence of ignition pulses. If ignition pulses are present, then the fuel cutoff solenoid is not activated (block **66**). If ignition pulses are not present, then the fuel cutoff solenoid is activated (step **68**) by closing the relay **48** to provide power from the generator coil **13** (see FIG. **4**). In addition, the negative field terminal of the rotor winding is connected to ground (step **74** in FIG. **5**) by closure of relay **50** (see FIG. **4**). Steps **68** and **74** can be performed either concurrently or in sequence. The fuel shutdown controller then monitors whether the supply voltage from the generator has yet decayed to the minimum voltage required to keep the fuel cutoff solenoid activated (step **70**). After a period of time (in one case, approximately 6 seconds) that is a function of the voltage decay rate, the fuel shutdown controller times out and releases the relays **48** and **50**, causing the fuel cutoff solenoid to turn off (step **72**) and also causing the connection from the negative field terminal of the rotor winding to machine ground to be disconnected (step **76**). These steps may be performed concurrently or in sequence. The actual time that the solenoid stays active depends on the decay time of the voltage from coil **13** supplied to it, which is dependent upon the rpm of the engine.

While the invention has been described with reference to preferred embodiments, it will be understood by those skilled in the art that various changes may be made and equivalents may be substituted for members thereof without departing from the scope of the invention. In addition, many modifications may be made to adapt a particular situation to the teachings of the invention without departing from the essential scope thereof. Therefore it is intended that the invention not be limited to the particular embodiment disclosed as the best mode contemplated for carrying out this invention, but that the invention will include all embodiments falling within the scope of the appended claims.

As used in the specification and claims, the term "winding" means one or more turns of wire forming a continuous coil or a fraction of a turn.

What is claimed is:

1. A method for cutting off the supply of fuel to an engine, comprising the following steps:

detecting whether ignition pulses are present; and

activating a device for cutting off the supply of fuel to the engine in response to detection of a change from a first state in which ignition pulses are present to a second state in which ignition pulses are absent.

2. The method as recited in claim **1**, further comprising the step of deactivating said device at a predetermined time subsequent to said activating step.

3. The method as recited in claim **1**, wherein said activating step comprises the step of energizing a solenoid.

4. The method as recited in claim **3**, wherein said step of energizing the solenoid comprises electrically connecting the solenoid to a battery power supply.

5. The method as recited in claim **3**, wherein said step of energizing the solenoid comprises electrically connecting the solenoid to an output of a winding in a generator driven by the engine.

6. The method as recited in claim **5**, further comprising the step of connecting a rotor winding of the generator to ground in response to detection that ignition pulses are not present, said winding connected to said solenoid being electromagnetically coupled to said rotor winding.

7. A system for cutting off the supply of fuel to an engine, comprising:

a battery power supply;

a first device that cuts off the supply of fuel to the engine when energized by said battery power supply and does not cut off the supply of fuel to the engine when not energized by said battery power supply;

a second device for connecting said first device to said battery power supply in a first state and disconnecting said first device from said battery power supply in a second state; and

a control circuit that causes a change of state of said second device from said second state to said first state in response to a change from ignition pulses being present to ignition pulses being absent.

8. The system as recited in claim **7**, wherein said first device comprises a solenoid.

9. The system as recited in claim **7**, wherein said second device comprises a relay.

10. The system as recited in claim **7**, wherein said control circuit has an input for receiving signals representing ignition pulses being sent to said engine.

11. A method for cutting off the supply of fuel to an engine being used to drive an electric generator, comprising the following steps:

detecting whether ignition pulses are present; and

coupling a rotor winding of the generator to ground and a stator winding or coil of the generator to a fuel cutoff device in response to detection of cessation of ignition pulses.

12. The method as recited in claim **11**, wherein said step of coupling the rotor winding to ground has the effect of shorting a power switch.

13. The method as recited in claim **11**, further comprising the steps of opening said connections at a predetermined time subsequent to said coupling step.

14. The method as recited in claim **11**, further comprising the step of rectifying said generator output, wherein said fuel cutoff device comprises a solenoid that is energized by the rectified generator output.

15. A power generation system comprising: an engine, an engine ignition controller for providing ignition pulses to said engine, a stator winding or coil for providing a generator output, a rotor winding driven to rotate by said engine, and a fuel shutdown system for cutting off the supply of fuel to said engine, wherein said fuel shutdown system comprises:

a first device that cuts off the supply of fuel to the engine when energized by said battery power supply and does not cut off the supply of fuel to the engine when not energized by said battery power supply;

a second device having first and second states, said rotor winding being connected to ground when said second device is in its first state and not connected to ground when said second device is in its second state;

a third device having first and second states, said stator winding or coil being coupled to said first device when said third device is in its first state and not coupled to said first device when said third device is in its second state; and

a control circuit that causes a first change of state of said second device from its second state to its first state and a second change of state of said third device from its second state to its first state in response to cessation of ignition pulses.

16. The system as recited in claim **15**, wherein said first device comprises a solenoid.

17. The system as recited in claim **15**, wherein said second device comprises a first relay and said third device comprises a second relay.

18. The system as recited in claim **15**, wherein said control circuit has an input for receiving signals representing ignition pulses being sent to said engine.

19. The system as recited in claim **15**, further comprising a field current controller for supplying current to said rotor winding, said field current controller comprising a power switch that is shorted when said rotor winding is connected to ground.

20. The system as recited in claim **15**, further comprising a rectifier for rectifying the output of said stator winding or coil.

21. A method for cutting off the supply of fuel to an engine being used to drive an electric generator, comprising the following steps:

detecting whether the engine has been turned off; and

connecting an input of a fuel cutoff device to an output of a stator winding or coil of the generator in response to detection of engine turn-off, said fuel cutoff device being energized by said generator output.

22. The method as recited in claim **21**, further comprising the step of connecting a rotor winding of the generator to ground in response to detection of engine turn-off.

23. The method as recited in claim **21**, wherein a bipolar transistor is bypassed by grounding of the rotor winding.

24. The method as recited in claim **21**, wherein said detecting step comprises the step of detecting whether ignition pulses are present.

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