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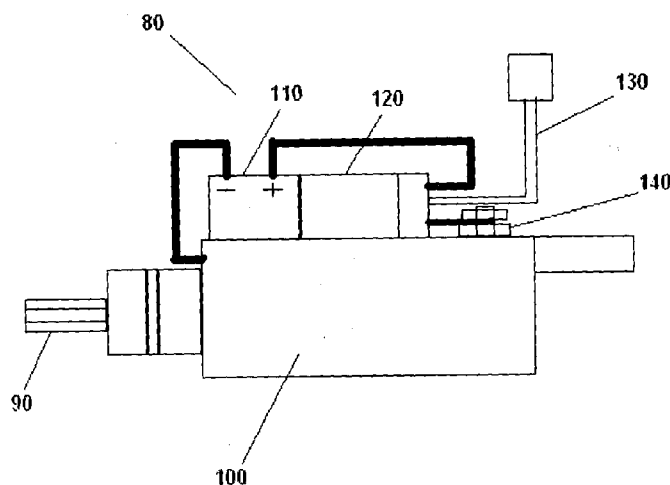
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(54) Title: ELECTRIC START SYSTEM FOR A VEHICLE WITH INTERNAL COMBUSTION ENGINE



(57) Abstract: The present invention describes an improved Electric Start System for a vehicle comprising of a Starter Motor 100, Starter Relay 120 and Battery 110 in a single assembly 73. The high current connections 70 between the starter motor 100, starter relay 120 and battery 110 are provided within the housing and only the actuating signals from the switches or sensors are obtained from outside the housing. The system has a housing cover 150 made of a plastic material like PBT (Poly Butylene Terephthalate) or an alloy. The battery pack 110 is the electrical power source capable of withstanding engine vibrations and the associated high temperatures. As the Starter Motor 100, battery pack 110 and Starter Relay 120 are close to each other, voltage drop in the high current path is minimized. Thereby Electric Start System 80 efficiency improves and high current wire cost is reduced.



ELECTRIC START SYSTEM FOR A VEHICLE WITH INTERNAL COMBUSTION ENGINE

BACKGROUND

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FIELD OF THE INVENTION

The present invention relates to an Electric Start System for a vehicle with Internal Combustion Engine.

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DISCUSSION OF PRIOR ART

Internal Combustion Engines cannot self start unlike steam engines. The crankshaft assembly of the internal combustion engine has to be accelerated to a predetermined speed in order to sustain the combustion process. In vehicles with internal combustion engine either the crankshaft has to be rotated manually (kick starting or hand starting) or an Electric Start is used. Electric Start is an easier way of starting the Internal Combustion Engine (IC Engine) wherein a Starter Motor is energized to drive the crankshaft assembly to the required angular speed.

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In an Electric Start System, a battery provides electrical energy required for Starter Motor operation. A Starter Relay connects the battery to the Starter Motor when a predetermined set of conditions are satisfied. For example, in a two-wheeler Electric Start system, the Starter Relay will connect Starter Motor to battery when the ignition switch is ON and engine transmission is in neutral condition. The battery is also responsible for supplying electrical energy to other DC loads. Conventionally, the battery Starter Relay and Starter Motor are mounted in different locations in the vehicle. Although the mounting locations are different, they are located as close as possible in order to reduce the voltage drop in connecting wires. The Starter Motor is

mounted in the engine in order to interface with gear train assembly for driving the crankshaft assembly. The Starter Relay and Battery are located in the vehicle chassis close to the engine.

- 5 The Starter Motor could be either pre-engaged with the gear train assembly or could have Bendix drive connecting the motor to the gear train upon energizing the Starter Motor. With a Bendix drive, the pinion comprising weights move axially along the motor shaft to engage with a mating gear coupled to the crankshaft assembly when motor speed exceeds a predetermined value. The Bendix drive permits one way
10 transmission of power as the pinion would retract back along the motor shaft if the mating gear speed is greater than motor shaft speed. With pre-engaged Starter Motor systems, a one-way clutch ensures one way transmission of power from motor to crankshaft assembly. Some Starter Motors have a solenoid moving the pinion to mesh with the mating gear when Starter Motor is energized.

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JP2009030450A titled "*Starter Starting Circuit*" discloses a Starter Starting circuit in which a Starter Relay is mounted on the Starter Motor and it also performs the solenoid function for axially moving the pinion. But the battery is externally connected in the circuit.

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US8035259 titled "*Electric motor starting device*" describes a method of starting an electric motor having a rotor. The device incorporates air, gas, liquid or electrically actuated engine starter to initiate rotation of an electric motor and its associated driven components. Therefore it provides a method for starting an electric motor
25 whether or not being used to drive any type of mechanical or electrical device.

US7594491 titled "*Internal combustion engine start controller*" describes an IC engine start controller in a vehicle provided with an internal combustion engine that is started by using the electric power supplied from a power source. It has a first motor

and an electric power converter constructed to perform electric power conversion between the power source and the first motor by switching control of power semiconductor elements. The start controller has a start detecting device for detecting whether the engine is in a starting operation and a first frequency setting device.

- 5 When the engine is in a starting operation, the first frequency setting device sets a switching frequency of the first electric power converter to a frequency lower than that used when the engine is not in a starting operation.

The Electric Start System disclosed according to the present invention comprises a Starter Motor, Starter Relay and Battery housed within a single assembly. Electrical connections between the Battery, Starter Motor and Starter Relay are provided within the housing and only actuating signals from switches or sensors are obtained from outside the Electric Start System housing. The Electric Start System is mounted on the engine.

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SUMMARY OF THE INVENTION

The present invention describes an improved electric start system which comprises of a Starter motor, Starter relay and battery within a single housing and as these are close to each other, voltage drop in the high current path is minimized, thereby improving the efficiency of the Electric Start System and reducing the cost of high current wire. The high current connections between the Starter motor, Starter relay and battery are provided within the housing only. The embodiment comprises of a starter motor fitted with a battery pack and starter relay and the actuation signals for the system is provided to the starter relay through the connecting wires. This starter relay connects battery's positive terminal with starter motor positive terminal when a signal is received through a starter relay. Also the housing cover is made of a plastic material like PBT (Poly Butylene Terephthalate) or an alloy which protects the battery and starter relay from being exposed to rain and dust. The battery in the

system is a second power source which provides signal to starter relay. It is capable of withstanding engine vibrations and the associated high temperatures.

5 BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 illustrates the conventional Electric Start System showing the side view of a two wheeler chassis;

Figure 2 illustrates an improved Electric Start system, according to the present invention;

Figure 3 illustrates the first embodiment of the Electric Start System;

Figure 4 illustrates the first embodiment with a cover;

Figure 5 illustrates the second embodiment of the electric circuit in the vehicle wherein a second battery is used to provide signal to Starter Relay according to the present invention; and

Figure 6 illustrates the second embodiment of electric circuit in the vehicle wherein the battery within the Electric Start System housing provides signal to Starter Relay.

DETAILED DESCRIPTION OF THE ACCOMPANYING EMBODIMENTS

Figure 1 shows the conventional Electric Start System explained using a side view of a two-wheeler chassis **10**. An Internal Combustion Engine **30** is mounted on frame **20**. The internal combustion engine **30** comprises a Starter Motor **60** for accelerating the crankshaft assembly while starting. A Battery **40** is fitted on the vehicle frame **20** to provide electrical energy to DC loads including Starter Motor **60**. A Starter Relay **50** connects the Battery **40** to the Starter Motor **60** when a set of predefined conditions are satisfied. A high current cable **70** connects the Starter Relay **50** to the Starter Motor **60**.

Figure 2 discloses according to the present invention, an Electric Start System **80** which comprises a Starter Motor **100**, a Starter Relay **120** and a Battery **110** within a single housing **73**. The high current connections **70** between the Starter Motor **100**, the Starter Relay **120** and the Battery **110** are provided within the housing **73**. The low current connection is indicated as **76**. A switch and sensor output **72** required for energizing the Starter Relay **120** are obtained from outside the housing **73**. Based on the sensor outputs **72**, the Starter Relay **120** connects the Battery **110** to the Starter Motor **100** which in turn drives a crankshaft assembly **71**.

Figure 3 show a preferred first embodiment of the present invention wherein the Electric Start System **80** comprises a Starter Motor **100** fitted with a battery **110** and a Starter Relay **120**. The actuation signal for the Electric Start System **80** is provided to the Starter Relay **120** through connecting wires **130**. A Starter Motor pinion **90** will mesh with a mating gear for driving the crankshaft assembly **71**. The Starter Relay **120** connects the Battery **110** positive terminal with the Starter Motor **100** positive terminal **140** when appropriate signal is received through the Starter Relay **120** connecting wires **130**.

The battery **110**, capable of providing sufficient electrical energy for cranking internal combustion engine is connected within the housing **73**. The Starter Relay **120** is mounted on the Starter Motor **100** for connecting the positive terminal **140** of the battery **110** to the Starter Motor **100** positive terminal **140** when appropriate signal is provided through the connecting wires **130**.

Figure 4 shows the preferred embodiment of the present invention along with a cover **150** which protects the battery **110** and Starter Relay **120** from being exposed to rain and dust. For a vehicle with a geared transmission system, it should be possible to crank the engine by electric start when the rider presses the Electric Start (ES switch) button with ignition in ON condition and transmission is in neutral. For a vehicle with

Continuously Variable Transmission (CVT) system, it should be possible to crank the engine by electric start when the rider presses the Electric Start button with ignition in ON condition and with either of the brakes applied. Based on these predetermined conditions, an electric circuit will provide signal to connecting wires **130** when
5 Electric Start is required. The electric circuit can either use a second power source (**Figure 5**) other than the battery **110** or it could use the battery **110** itself (**Figure 6**).

Figure 5 and **Figure 6** represent the electric circuit for vehicle with a geared transmission system. In case of a vehicle with Continuously Variable Transmission
10 (CVT), brake switch will replace the neutral switch. The invention disclosed is for an Electric Start System **80** of a Vehicle with an Internal Combustion Engine. The Electric Start System **80** comprises a Starter Motor **100**, Starter Relay **120** and Battery **110** within a single housing.

15 **Figure 5** shows an electric circuit in vehicle, wherein a second power source in the form of a battery **Vb2** is used to provide signal to the Starter Relay **120** by means of a connector **160**. The connector **160** is connected with the Electric Start System **80** by means of connecting wires **130**. When the ignition switch (**Ig Sw**) is in ON condition and when ES switch is pressed with transmission in neutral condition then the
20 Ignition switch (**Ig Sw**), **ES** switch and Neutral switch are closed. The voltage across battery **Vb2** terminals are then applied to the Starter Relay **120** along connector **160** and then wires **130**. The Starter Relay **120** then connects the Battery **110** positive terminal **140** to Starter Motor **100** positive terminal **140**. The Starter Motor **100** negative terminal is always connected to the Battery **110** negative terminal and hence
25 Starter motor **100** activates to crank the engine.

Figure 6 shows an electric circuit in vehicle wherein the battery **110** within the Electric Start System **80** is used to provide signal to Starter Relay **120**. When ignition switch, neutral switch and **ES** switch are all closed then the battery **110** voltage is

applied to Starter Relay **120** which again connects the positive terminal **140** of Starter Motor **100** to positive terminal **140** of Battery **110**. The Starter Motor **100** is activated to crank the engine. The Starter Relay **120** and Battery **110** are mounted on the Starter Motor **100** and a cover **150** prevents water and dust from entering into the assembly.

- 5 The housing cover **150** could be made of a plastic material like PBT (Poly Butylene Terephthalate) or an alloy. The battery **110** is capable of withstanding engine vibrations and the associated high temperatures.

Since the Electric Start System **80** comprises of Starter Motor **100**, battery **110** and Starter Relay **120** in a single assembly, vehicle assembly is more convenient. Also as
10 the Starter Motor **100**, battery **110** and Starter Relay **120** are close to each other, voltage drop in the high current path is minimized. Thereby Electric Start System **80** efficiency improves and high current wire cost is reduced.

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CLAIMS

1. An improved electric start system for a two-wheeler comprising:
 - a. an internal combustion engine **30** to propel the vehicle;
 - b. a starter motor **100** having a starter relay **120** to crank the engine **30**;
5 and
 - c. atleast a battery **110** to provide electrical energy to the starter motor **100** and other DC loads;wherein the said electric start system secures the Starter motor **100**, the Starter relay **120** and the battery **110** within a single housing **73**, mounted close to
10 each other, thereby minimizing voltage drop in high current path.
2. The improved electric start system for a two wheeler as claimed in Claim 1, wherein a second battery **Vb2** is also provided along with the battery **110**, such that the starter motor **100** can take power either from the battery **110** or second battery **Vb2**.
- 15 3. The improved electric start system for a two-wheeler as claimed in Claim 1 and Claim 2, wherein the second battery **Vb2** is used to provide signal to the Starter Relay **120** by means of a connector **160** such that the connector **160** is connected with the Electric Start System through connecting wires **130**, further the Starter Relay **120** is connected to the battery **110** positive terminal
20 **140** and to the Starter Motor **100** positive terminal **140** such that the Starter Motor **100** negative terminal is always connected to the battery **110** negative terminal, thereby enabling Starter motor **100** to crank the engine **30**.
4. The improved electric start system for a two wheeler as claimed in Claim 1, wherein a high current cable **70** is provided to connect the Starter Relay **120**,
25 the Battery **110** and the Starter Motor **100** inside the housing **73**.
5. The improved electric start system for a two-wheeler as claimed in Claim 1, wherein an actuation signal for the said electric start system is provided to the Starter Relay **120** through a connecting wires **130** including a Starter Motor pinion **90** for driving a crankshaft assembly **71** such that the Starter Relay **120**

connects the Battery **110** positive terminal with the Starter Motor **100** positive terminal **140** when appropriate signal is received through the Starter Relay **120** connecting wires **130**.

- 5 6. The improved electric start system for a two wheeler as claimed in claim 1, wherein the said housing **73** is provided with a cover **150**, made of plastic material like PBT (Poly Butylene Terephthalate) or alloy for protecting the Battery **110** and the Starter Relay **120** from being exposed to rain or dust.
- 10 7. The improved electric start system for a two-wheeler as claimed in Claim 1, wherein the battery **110** within the Electric Start System is used to provide signal to Starter Relay **120**, thereby ensuring the battery **110** being capable of withstanding engine **30** vibrations and the associated high temperatures.
- 15 8. The improved electric start system for a two-wheeler as claimed in Claim 1, wherein if the vehicle is provided with geared transmission system, then the engine **30** is cranked by the electric start system when the rider presses an electric start switch **Es Sw** with an ignition switch **Ig Sw** in ON position along with a neutral switch **neutral Sw** in ON condition to keep transmission in neutral.
- 20 9. The improved electric start system for a two-wheeler as claimed in Claim 1, wherein if the vehicle is provided with Continuously Variable Transmission (CVT) system, then the engine **30** is cranked by the electric start system, when the rider presses the electric start switch **Es Sw** with the ignition switch **Ig Sw** in ON position along with either of the brakes applied.
- 25 10. The improved electric start system for a two-wheeler as claimed in Claim 1, wherein the said electric start system is mounted on the engine **30**.

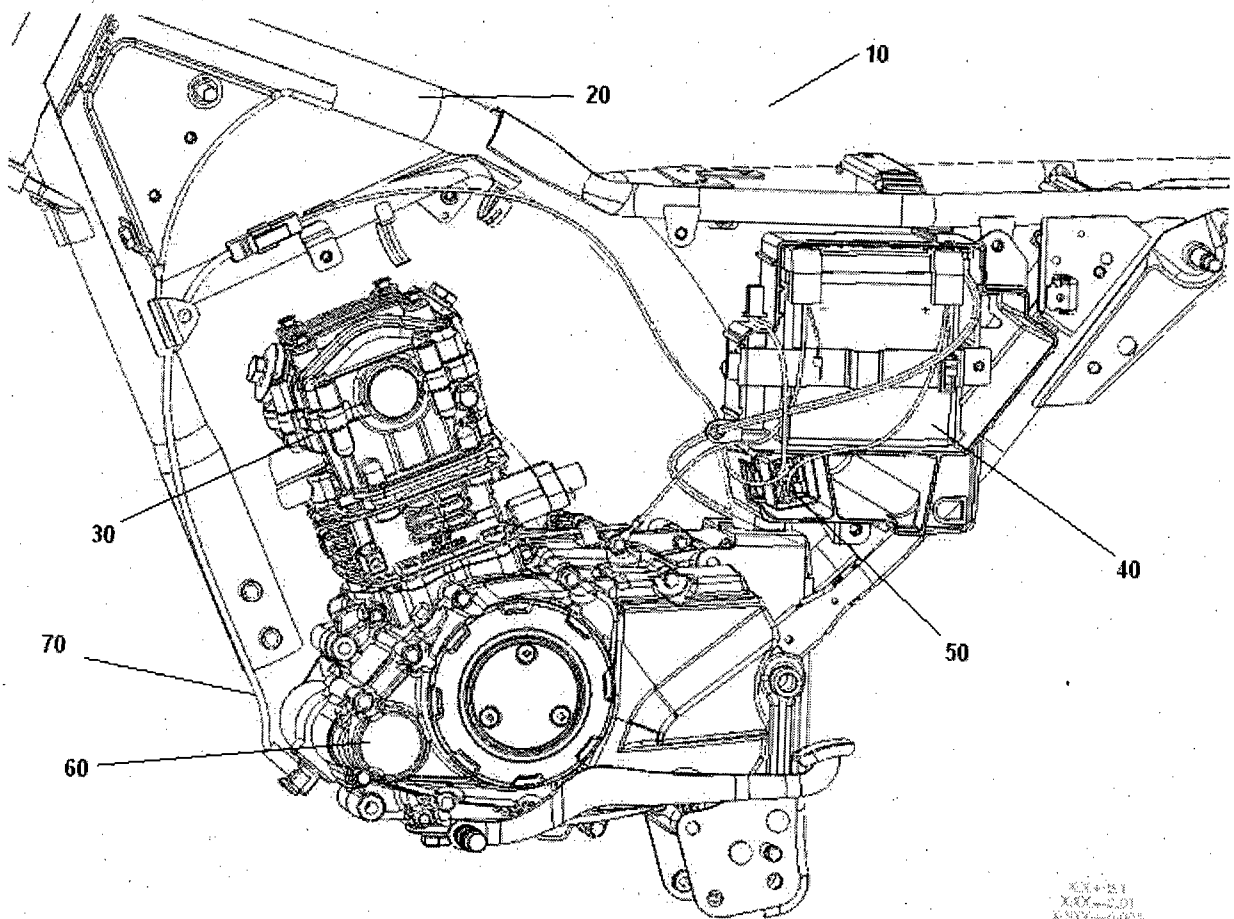


Figure 1

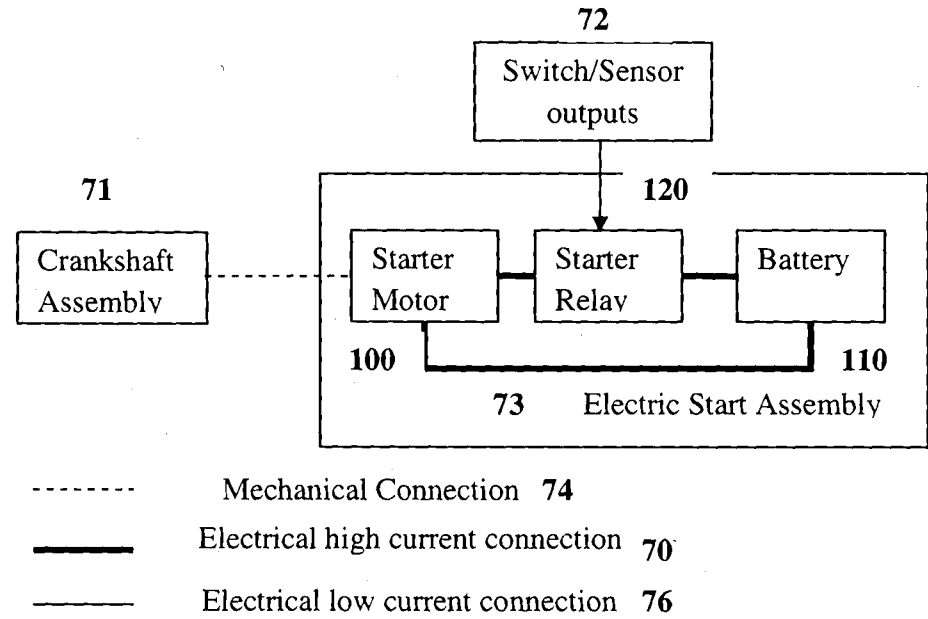


Figure 2

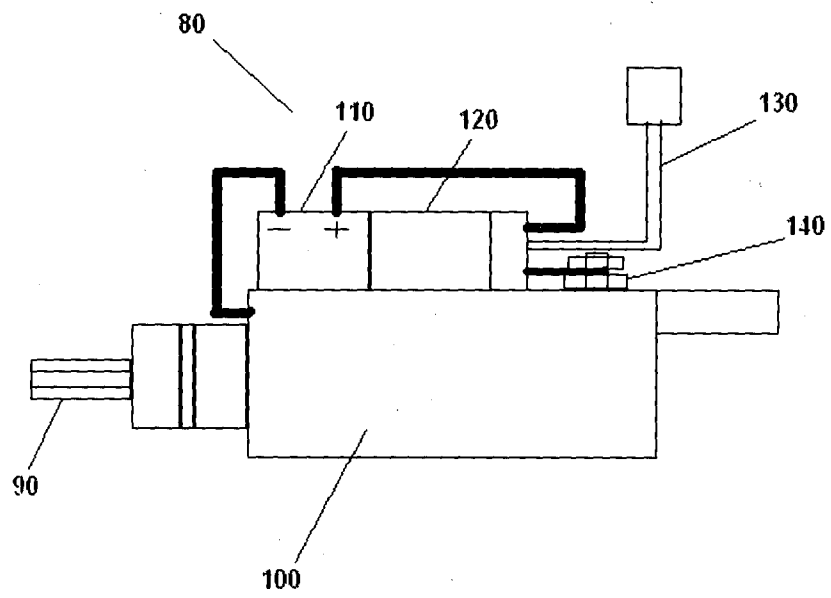


Figure 3

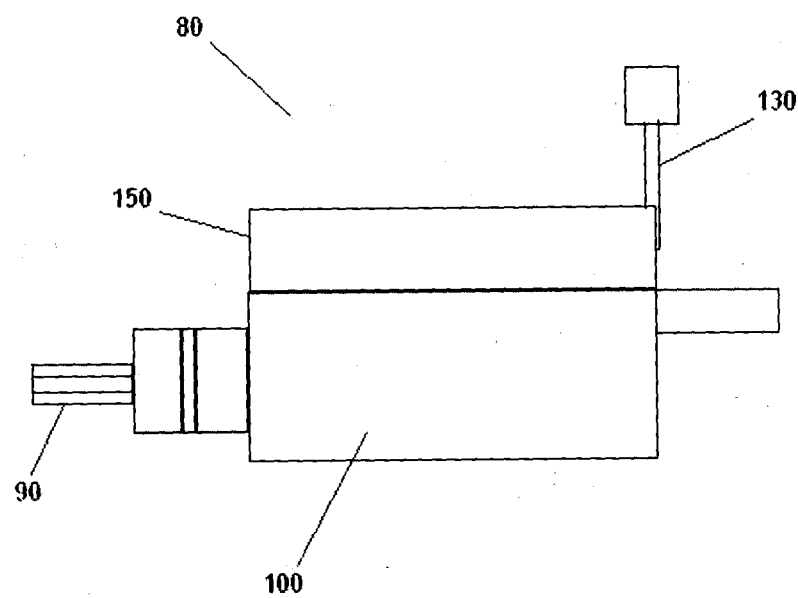


Figure 4

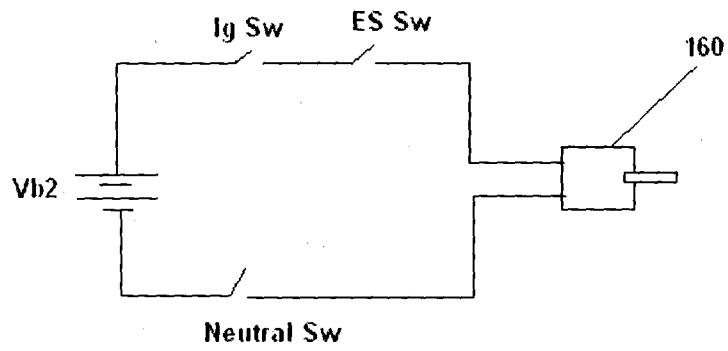


Figure 5

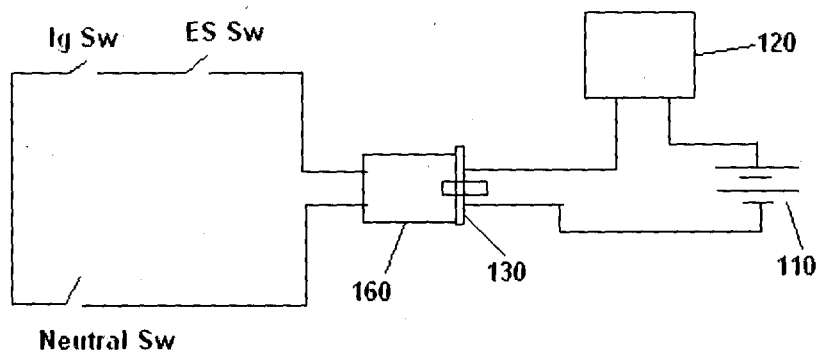


Figure 6