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Brungsberg

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[54] **AUTOMATIC TURN-OFF FOR TRANSISTORIZED IGNITION SYSTEMS FOR INTERNAL COMBUSTION ENGINES**

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[51] **Int. Cl.²** **F02P 1/00;** H05B 37/02

[58] **Field of Search** ..... 163/148 E; 315/209 T

[56] **References Cited**

UNITED STATES PATENTS

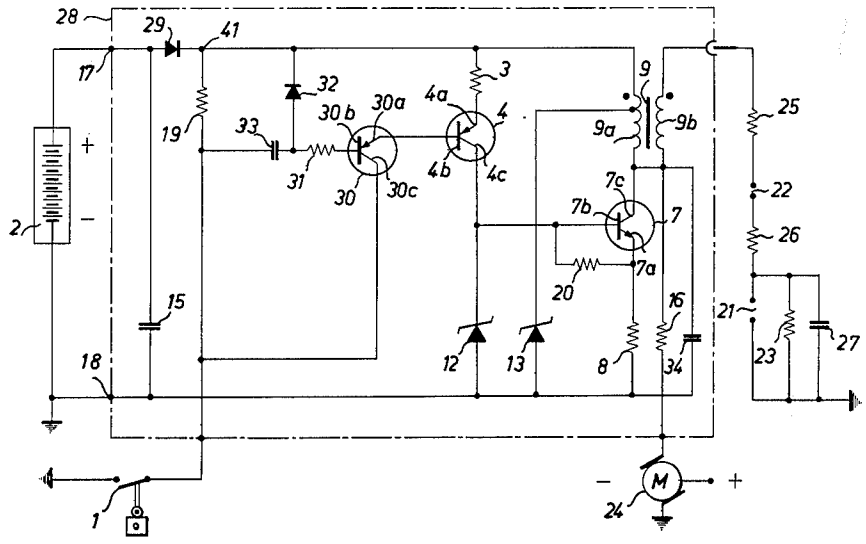
3,087,090	4/1963	Konopa	123/148 E
3,219,876	11/1965	Bays	123/148 E
3,249,808	5/1966	Sifort	123/148 E
3,841,288	10/1974	Korteling	123/148 E
3,854,466	12/1974	Steinberg	123/148 E

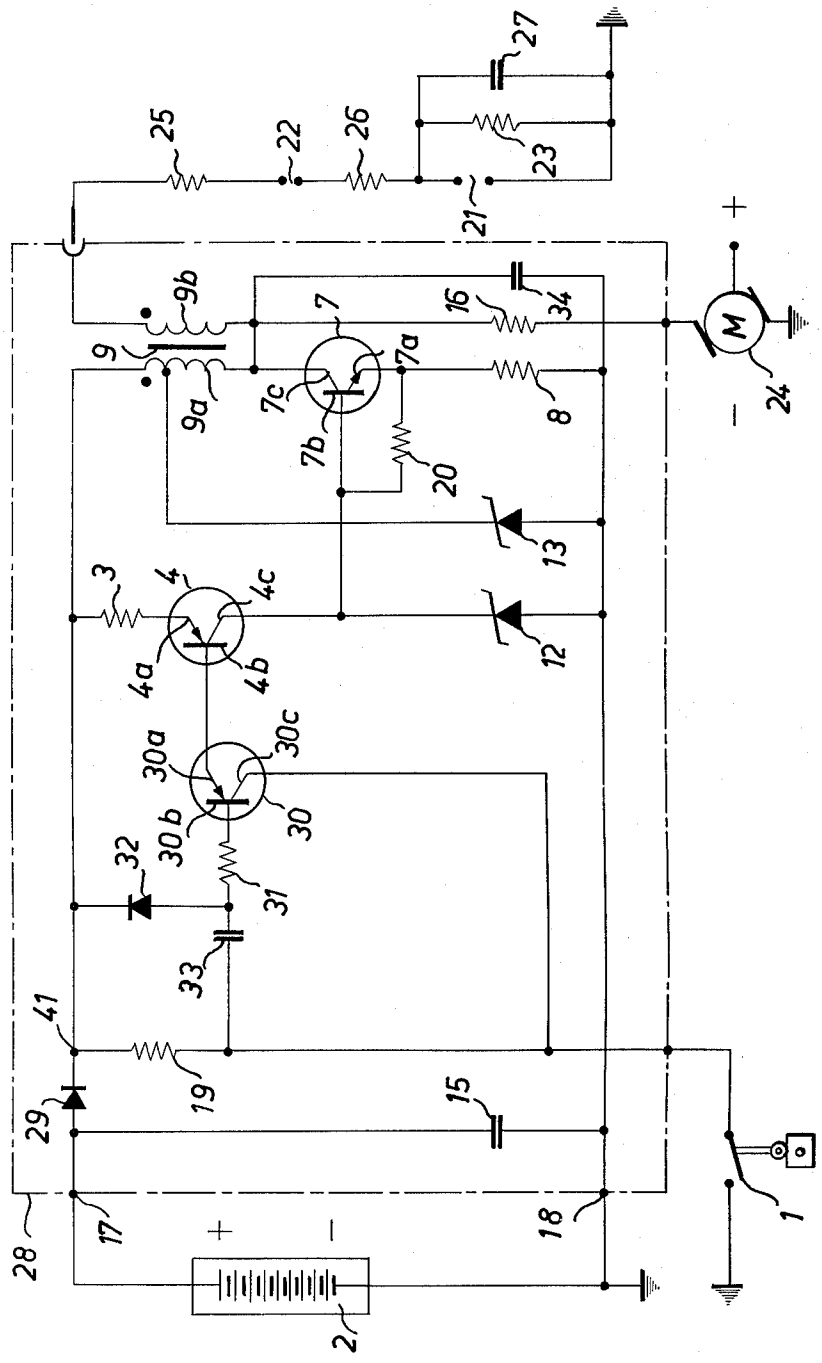
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[57] **ABSTRACT**

A d-c energized ignition system for internal combustion engines is first provided with negative feedback means for stabilizing the energizing current flowing through the primary winding of the ignition coil, and is secondly provided with means for automatically interrupting the current flow through the primary winding of the ignition coil in case that the operation of the internal combustion engine is interrupted at a point of time when the cooperating contacts of the interrupter are in engagement.

2 Claims, 1 Drawing Figure




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AUTOMATIC TURN-OFF FOR TRANSISTORIZED IGNITION SYSTEMS FOR INTERNAL COMBUSTION ENGINES

BACKGROUND OF THE INVENTION

My co-pending patent application Ser. No. 431,832 filed Jan. 9, 1974 for IGNITION SYSTEM FOR INTERNAL COMBUSTION ENGINES discloses a transistorized ignition system having negative feedback means for stabilizing the current flow in the primary winding of the ignition coil. The system disclosed in the above patent application makes it possible to stabilize, or to maintain at a substantially constant level, the energy available for ignition purposes as well as the ignition voltage in case that the terminal voltage of the d-c power supply or battery should decline, or drop. This constancy of ignition energy and ignition voltage can be maintained over the entire range of rpm at which the internal combustion engine is capable of operating. The circuitry disclosed in the above patent application includes a main or power transistor arranged in series with the primary winding of the ignition coil and with a negative feedback resistor. One end of the primary winding of the ignition coil is connected to one terminal of a d-c power supply, and the other end of the primary winding of the ignition coil is connected to the collector of the above referred-to power transistor, and the emitter of the latter is connected to the above referred-to negative feedback resistor. The base of the power transistor is connected to the collector of a control or auxiliary transistor which controls the current flow through the power transistor.

One object of this invention consists in supplementing the above circuitry with means for turning the ignition system off automatically when the operation of the internal combustion engine is interrupted.

Another object of the present invention consists in supplementing the above circuitry with means precluding to apply the wrong polarity to its semiconductor elements which are sensitive to the polarity of the power supply.

SUMMARY OF THE INVENTION

An ignition system embodying this invention includes an ignition coil having a primary winding and a secondary winding. A power transistor having a current path in series with said primary winding controls the current flow through said primary winding. A first auxiliary transistor controls the current flow through said power transistor. The system further includes an interrupter having relatively movable contacts, and a second auxiliary transistor. Said first and said second auxiliary transistor are cascade connected, and the second auxiliary transistor has a current path which includes a capacitor and said interrupter both arranged in series relation, whereby the current flow through said second auxiliary transistor is interrupted when said interrupter is in the closed position thereof and said capacitor is charged. The system further includes a discharge circuit for said capacitor for discharging the same in response to reopening of said interrupter, i.e. separating the contacts thereof.

BRIEF DESCRIPTION OF THE DRAWING

The drawing is a circuit diagram of an ignition system embodying the present invention.

DESCRIPTION OF PREFERRED EMBODIMENT

Referring to the drawing, reference character **2** has been applied to indicate a d-c power supply, or battery. The upper end of the battery is of positive polarity and is connected to the terminal **17** of the ignition system proper. The lower end of battery **2** is of negative polarity and is connected to the terminal **18** of the ignition system proper. The ignition coil **9** includes the primary winding **9***a* and the secondary winding **9***b*. One end of the primary winding **9***a* is connected to the terminal **17.** Reference numeral **7** has been applied to indicate a main transistor, or power transistor, including the emitter **7***a*, the base **7***b* and the collector **7***c*. One end of winding **9***a* is connected to collector **7***c* and the emitter **7***a* is connected to the negative feedback resistor **8** which, in turn, is connected to the terminal **18.** Base **7***b* and emitter **7***a* are interconnected by resistor **20.** Zener diode **13** interconnects a tap on winding **9***a* and the lead from resistor **8** to terminal **18.** Reference numeral **4** has been applied to indicate a control or auxiliary transistor including emitter **4***a*, base **4***b* and collector **4***c*. The latter is connected to base **7***b*. Emitter **4***a* is connected by means of resistor **3** to terminal **17.** Reference numeral **30** has been applied to indicate a third transistor, or auxiliary transistor, having an emitter **30***a*, a base **30***b* and a collector **30***c*. Emitter **30***a* is connected to base **4***b*. Any current path from the positive pole of battery **2** to ground includes diode **29,** junction point **41** and interrupter **1.** The charging current path of capacitor **33** includes diodes **4** and **30,** resistor **31,** the contacts of interrupter **1** when the latter is in the closed position thereof. When the contacts of interrupter **1** are separated, capacitor **33** is discharged through a current path including diode **32,** junction point **41** and resistor **19.** Reference character **12** has been applied to indicate a Zener diode interposed between ground and electrodes **4***c*. **7***b*. Capacitor **15** is shunted across terminals **17,18** and capacitor **34** is shunted across transistor **7** and resistor **8.** The circuit of coil **9** includes a resistor **16** of which one end is connected to revolution counter **24.**

Reference numeral **22** has been applied to indicate a spark plug whose circuit is energized by winding **9***b* of ignition coil **9.** The circuit of spark plug **22** includes resistors **25** and **26.** Reference character **21** has been applied to indicate a distributer having an arc gap. Resistor **23** is shunted across the latter. Reference character **27** has been applied to indicate the capacitance of the line. The dash-and-dot line **28** indicates a housing for the constituent parts of the system.

In operation, when the contacts of interrupter **1** are in engagement, a current flows from the positive pole of battery **2** by way of terminal **17,** diode **29,** junction point **41,** resistor **3,** emitter **4***a*, base **4***b* of transistor **4** and emitter **30***a* and base **30***b* of transistor **30,** resistor **31,** capacitor **33** and interrupter **1** to ground, or the negative pole of battery **2,** respectively. By virtue of this current flow transistors **4,30** and **7** are turned on. Consequently there is current flow in the primary winding **9***a* of ignition coil **9.** When the contacts of interrupter **1** part, the above current path is interrupted. Since no current flow can then occur through the bases of the transistors **4,30** and **7,** these transistors are turned off. Interrupting the currents in primary winding **9***a* causes generation of a high voltage spike in the secondary winding **9***b* of induction coil **9.** This voltage

spike is used to break down the gap in the spark plug **22.**

When the internal combustion engine is at a standstill and the contacts of interrupter **1** are in engagement, a current is allowed to flow from the positive terminal of battery **2** to resistor **3,** the emitter **4***a* and the base **4***b* of transistor **4,** the emitter **30***a* and the base **30***b* of transistor **30,** resistor **31** and capacitor **33.** This charging current of capacitor **33** decreases as time progresses. As a result of the charging of capacitor **33,** the potential of the base **30***b* of transistor **30** increases progressively. Finally the charging current of capacitor **33** becomes zero. As a result, all transistors are turned off, including control transistor **4** and power transistor **7.** Hence the current flow through the primary winding **9***a* of ignition coil **9** is interrupted. This interrupting process involves a relatively long period of time, as a result of which no high voltage spike is generated in the secondary winding **9***b* of ignition coil **9.**

When the contacts of the interrupter **1** part again from each other, capacitor **33** is discharged through diode **32** and resistor **19.** The discharge of capacitor **33** is a rapid discharge. The time constants of the circuitry are selected in such a fashion that the automatic energizing-current-interrupting means which have been described above remain inoperative if the number of rpm of the internal combustion engine is small, e.g. 60 rpm, encountered during the starting period of the motor or the internal combustion engine.

It will be apparent from the above that the circuitry embodying this invention effectively precludes inadmissible generation of heat in the ignition system and discharge of the battery on account of a failure of the contacts of the interrupter to part when the internal combustion engine is not operating.

The provision of the diode **29** between terminal **17** and junction point **41** precludes reversal of polarity and consequent damage to the semiconductor elements of the system. Such reversal of polarity occurs frequently during mainenance and repair operations, and results in serious damage. The diode or rectifier **29** is arranged in such a fashion that its anode is arranged immediately adjacent terminal **17** for the positive pole of battery **2,** and its cathode is arranged adjacent the point of junction **41** to which resistor **19,** the cathode of diode **32,** resistor **3** of emitter **4***a* of ignition coil **9** are connected. Diode **29** makes it impossible to apply a negative potential to the aforementioned components which are connected to junction **41.**

The part played by resistors **3** and **8** and that of Zener diodes **12, 13** in stabilizing the current flow in winding **9***a* is more fully described in my above referred-to patent application. Reference may be had to this application in regard to such particulars.

I claim as my invention:

1. An ignition system for internal combustion engines including

a. an ignition coil (**9**) having a primary winding (**9***a*) and a secondary winding (**9***b*);

b. a power transistor (**7**) having a current path arranged in series with said primary winding for controlling the flow of current through said primary winding;

c. a first auxiliary transistor (**4**) controlling the current flow through said power transistor (**7**);

d. an interrupter (**1**) having relatively movable contacts;

e. a second auxiliary transistor (**30**), said second auxiliary transistor (**30**) and said first auxiliary transistor (**4**) being cascade connected and said second auxiliary transistor having a current path including a capacitor (**30**) and said interrupter (**1**) arranged in series relation, whereby current flow through said second auxiliary transistor (**30**) is interrupted when said interrupter (**1**) is in the closed position thereof and said capacitor (**33**) charged;

f. a discharge circuit for said capacitor (**33**) including a first diode (**32**) for discharging said capacitor (**33**) in response to reopening of said interrupter;

g. a first resistor (**19**) arranged in series with said interrupter (**1**);

h. one end of said first resistor (**19**), the emitter (**4***a*) of said first auxiliary transistor (**4**) and the cathode of said diode (**32**) being connected to a common terminal (**17,41**);

i. the base (**4***b*) of said first auxiliary transistor (**4**) being connected to the emitter (**30***a*) of said second auxiliary transistor (**30**);

j. the base (**30***b*) of said second auxiliary transistor (**30**) being connected by the intermediary of a second resistor (**31**) and said capacitor (**33**) to the other end of said first resistor (**19**); and

k. the collector (**30***c*) of said second auxiliary transistor (**30**) being directly connected to said other end of said first resistor (**19**).

2. An ignition system as specified in claim **1** including a second diode (**29**) arranged to preclude the application of a potential to said emitter (**4***a*) of said first auxiliary transistor (**4**) and to the cathode of said first diode (**32**) which is negative relative to the potential prevailing across said first auxiliary transistor (**4**) and the potential prevailing across said first diode (**32**).

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