United States Patent [19]

Crisafulli

[11] **3,913,549**

[45] ***Oct. 21, 1975**

[54] **INDUCTOR CURRENT RELAY SWITCH**

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[73] Assignee: **V-8 Electronic Ignition Co.,** Totowa, N.J.

[*] Notice: The portion of the term of this patent subsequent to June 5, 1990, has been disclaimed.

[22] Filed: **Sept. 20, 1973**

[21] Appl. No.: **399,221**

[52] **U.S. Cl.** ..... **123/148 E;** 315/209 T

[51] **Int. Cl.²** **F02P 1/00**

[58] **Field of Search** ..... 123/148 E, 148 UC; 315/209 T

[56] **References Cited**

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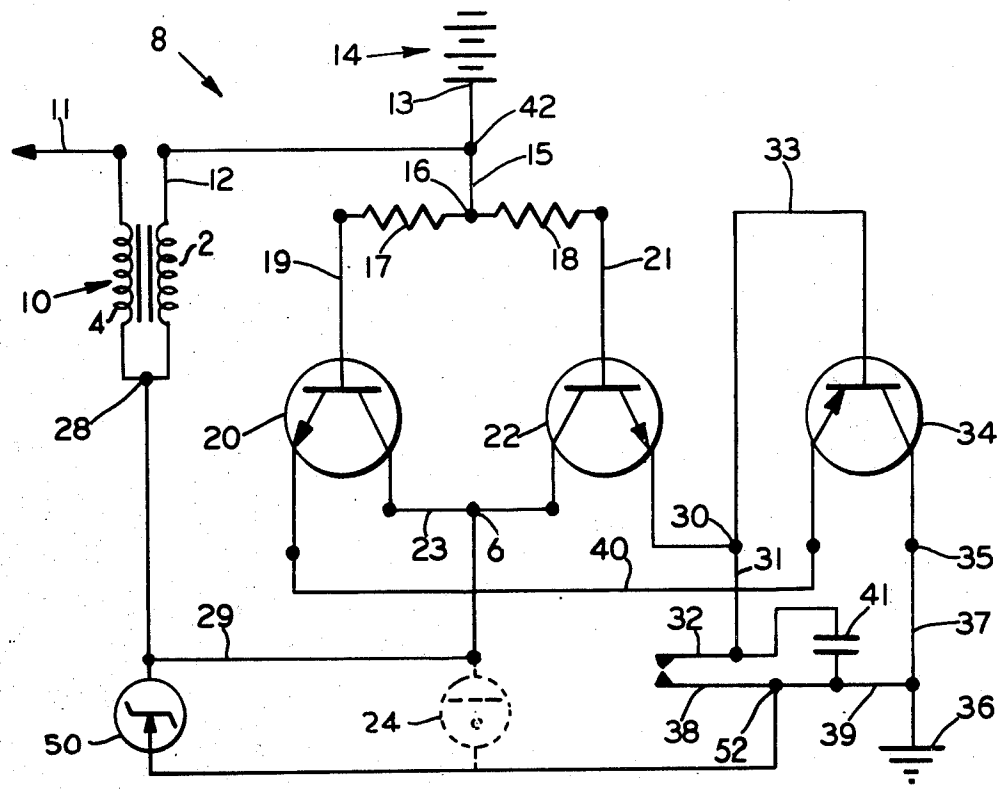
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Primary Examiner—Charles J. Myhre
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Attorney, Agent, or Firm—Omri M. Behr

[57] **ABSTRACT**

An inductor relay switch ignition system for an internal combustion engine. One side of the primary coil forming part of the ignition coil for the system is connected to a source of D.C. potential, and the second side of the coil is connected to ground through a pair of parallel transistor-switched paths. The first of these paths includes the ignition breaker points; the second path is of lower impedance than the first, and is enabled by current flowing through the first path, thereby providing a relay action. In order to prevent inductive kick back from damaging the switching transistors, the second side of the coil is connected to ground through a potential limiting means, such as a zener diode.

5 Claims, 2 Drawing Figures



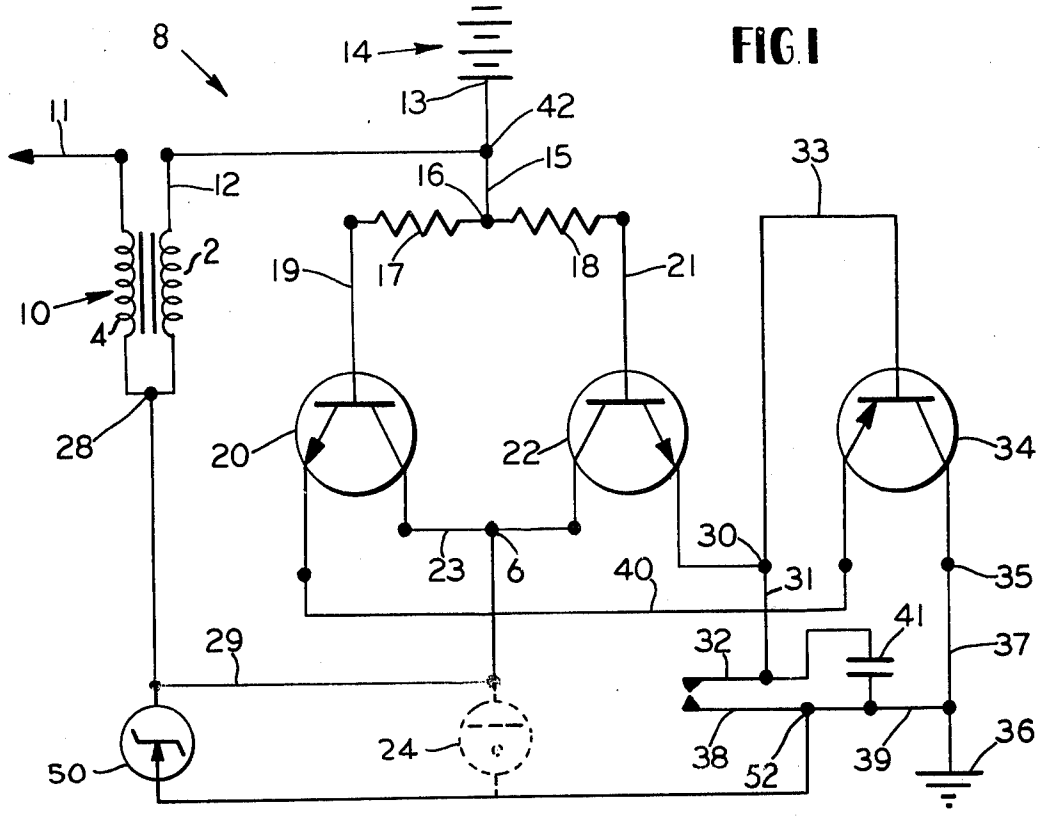

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FIG. 1

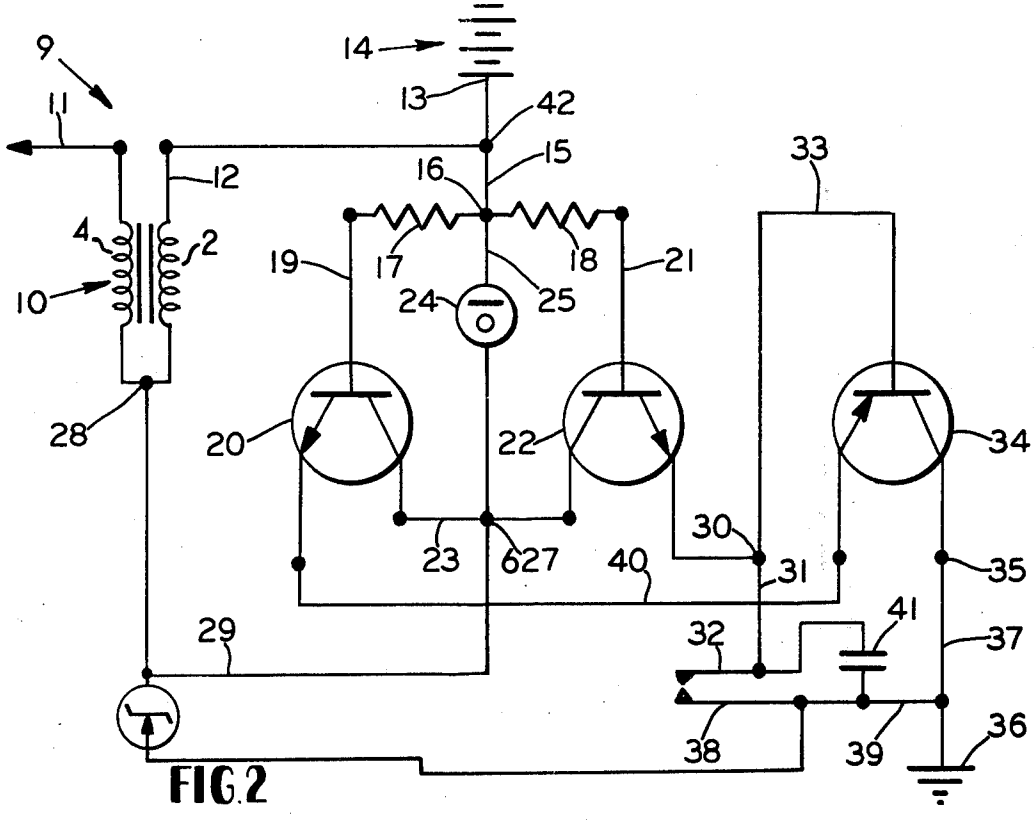

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FIG. 2

INDUCTOR CURRENT RELAY SWITCH

BACKGROUND OF INVENTION

In order to ignite the combustible mixture in the cylinder of an automobile, there are required of the order of 22 kilovolts, under worst-case conditions. Furthermore, a minimum of about 20 millijoules of energy are needed at the spark plugs to insure flame propogation originating from the spark. Thus it is apparent that the distributor points of a car are subject to severe conditions. Since a maximum current of about 4 amps can be withstood by the points before complete burnout occurs, it is not surprising that such points require frequent replacement in order to maintain full ignition coil efficiency.

Various transistorized ignition systems have been proposed in the past to control the coil current, and thus reduce the load on the distributor contacts. By and large the systems proposed in the prior art, however, have not been markedly successful. In U.S. Pat. No. 3,736,913, on the other hand, I have disclosed an ignition system wherein a solid state relay action is utilized to shunt heavy current loads away from the breaker points, and thereby limit power dissipation at such points. In particular, the said circuit utilizes a pair of parallel switching circuits of differing characteristics. The first circuit includes a single switching transistor, the output of which proceeds through the breaker points to ground. Upon closing of the breaker points this first circuit, which also includes the primary coil, provides a relatively limited current flow path to ground. Once the first switched circuit is activated however, bias provided at an appropriate point of the first circuit is shunted to a control point in the second switched circuit. The latter is in parallel with the first circuit, and includes a pair of transistors. This second circuit is of relatively low impedance and carries the high current density which is essential to operation of the ignition coil. In consequence of this sequence of events, a relay-type action occurs, to thus enable shunting of the high density current away from the breaker points.

The aforementioned U.S. Pat. No. 3,736,913 furthermore discloses the use of a neon lamp connected across the primary coil, which lamp serves a dual purpose: namely, controlling inductive kick-back to a resonably safe level; and secondly, providing a low level visual flicker, in order to indicate operation of the said system. The development of modern transistors, however, while making possible increased spark voltage, has increased the inductive kick-back voltage in the system of the foregoing type to a point which is above the control capability of the neon lamp. This in turn has limited the usefulness of the foregoing systems.

SUMMARY OF INVENTION

Now in accordance with the present invention an improved inductor relay switch ignition system is set forth, for use in an internal combustion engine or related environments. According to the principles of the invention, one side of the primary coil forming part of the ignition coil for the system is connected to a source of D.C. potential, and the second side of the coil is connected to ground through a pair of parallel transistor-switched paths. In correspondence to the disclosure of my U.S. Pat. No. 3,736,913, the first of these paths includes the ignition breaker points; and the second path

is of lower impedance than the first, and is enabled by current flowing through the first path, to thereby provide a relay type action. In order, however, to prevent inductive kick back from damaging the switching transistors, the second side of the primary coil is connected to ground through a potential limiting means. Such potential limiting means preferably comprises a zener diode. In a further embodiment of the invention a neon discharge lamp may be also connected across the said primary coil or in parallel with the zener diode, to further control the inductive kick-back and also provide visual indication of system operation. The potential limiting means may alternatively constitute a simple capacitor.

BRIEF DESCRIPTION OF DRAWINGS

The invention is diagrammatically illustrated by way of example in the drawings appended hereto in which:

FIG. **1** is a schematic electrical diagram of an ignition system in accordance with the present invention; and

FIG. **2** is a schematic electrical diagram of an alternate embodiment of the system set forth in FIG. **1.**

DESCRIPTION OF PREFERRED EMBODIMENTS

In FIG. **1** herein, an electrical schematic diagram appears of an ignition system **8,** in accordance with the present invention. With respect to the relay-type switching action occurring in system **8,** the operation thereof is substantially similar to the action described in my aforementioned U.S. Pat. No. 3,736,913. In particular, an ignition coil **10** of an automobile internal combustion engine or the like, is seen to include a primary coil **2** and secondary coil **4,** wound upon a common core. Lead **11** of the ignition coil **10** is the high voltage line connected to the engine spark plugs, through conventional means not shown. The positive low voltage lead **12** from ignition coil **10** is connected to the positive terminal **13** of the automobile battery **14** (e.g. at **12** volts). From battery connections **42** a line **15** is connected to a terminal **16,** between two resistors **17** and **18,** which in turn bias the base elements of the transistors **20** and **22,** via the line **19** and **21.**

The common point **28** of coils **2** and **4** is seen to be connected via line **29** to a point **6** between the collectors of transistors **20** and **22.** When distributor contacts **32–38** are closed (during operation of the engine), the bias provided through lead **21** to the base transistor **22** turns the latter on, providing a limited current first flow path to ground at **36,** which first path includes the line **29** point **6,** transistor **22** point **30,** line **31,** breaker points **32–38,** and line **39.** A conventional condenser **41** is connected between distributor points **32** and **38.**

Upon closing of the first conductive path just described through switching transistor **22,** the bias at point **30** is provided through line **33** to the base of transistor **34,** which functions in the nature of a blocking switch. The latter is then turned on and forms part of a second, relatively low impedance path, which proceeds from point **6** through transistor **20,** line **40,** and transistor **34,** thence through point **35,** line **37,** and to ground at **36.** Transistor **20** is biased to its ON position by potential applied through resistor **17** and line **19.** The resistors **17** and **18** are appropriately valued with respect to one another, as to apply appropriate potentials to the transistors **20** and **22** to enable the actions heretofore described. It should be pointed out that to the extent operation of the system **8** has been thus far

described, it is substantially in accord with the operation of the system described in my U.S. Pat. No. 3,736,913.

In accordance with the improvement set forth in the present invention, it has been found that by use of appropriate modifying elements in the system thus far described, the transistors **29, 22** and **34,** may be of such types as to withstand higher potentials at the coil **10** than has heretofore been possible. In order to enable such result, it has, however, been necessary to prevent the irreparable damage that might otherwise occur to the said transistors, by virtue of the high voltage, self-induced potential spikes that occur as the field at coil **2** collapses when the breaker points **32–38** open. In accordance with this aspect of the invention, a potential limiting means is connected from one side of primary coil **2** to ground. In particular it is seen that a zener diode **50** is thus connected between the point **28** and a point **52** leading to ground **36.** In a typical application the said zener diode is rated at 300 volts, and 1 watt power dissipation, whereby all potential exceeding 300 volts is shunted away from the several transistors to ground, thereby protecting the transistors.

In accordance with a further aspect of the invention, a neon discharge lamp **24** (shown with shadowed lines) may be additionally connected in parallel with zener diode **50,** the said discharge lamp, in addition to providing a further safeguard against undue levels of inductive kick-back potential, serves the further purpose of providing a visual indication of operation of system **8,** in that during such operation a low level flicker will occue at the said lamp — which may be conveniently positioned within the passenger compartment of the automobile for observation by the automobile operator.

In FIG. **2** herein, an electrical schematic diagram is set forth which illustrates an ignition system **9,** which in most respects is similar to FIG. **1.** The embodiment of FIG. **2** differs from that of FIG. **1** to the extent that the neon discharge lamp **24** is now connected through the line **25,** across the points **16** and **27,** i.e. directly across primary coil **2.** The lamp in this instance performs similar functions to that described in connection with the FIG. **1** system.

While the present invention has been particularly described in connection with specific embodiments thereof, it should be understood in view of the instant disclosure, that numerous variations upon the invention are now enabled to those skilled in the art, which variations yet reside within the scope of the instant teaching. Thus, for example, while a zener diode has been set forth as constituting the preferred form of potential limiting means, it may be noted that other devices, including without limitation a capacitor, may be substituted for the zener and perform a similar function, albeit in less effective fashion.

It should also, of course, be understood, that while the present system has been particularly illustrated for the use with negative grounded automobiles, it is within the province of the invention to change the polarity of the transistors as well as of the potential connection source, and yield similar results.

I claim:

1. An inductor relay switch ignition system for an internal combustion engine, comprising in combination:

a primary coil forming part of an ignition coil for said system;

a source of D.C. potential having one side thereof connected to one side of said primary coil, and the other side thereof grounded;

a pair of parallel transistor-switched conducting paths connecting the second side of said primary coil to ground, said first path including the ignition breaker points of said ignition system, and said second path being of lower impedance than said first path;

said second conductive path being enabled by current flowing through said first path, thereby providing a relay action and a relatively low impedance path to ground shunting said breaker points; and

a potential limiting means connected between said second side of said primary coil and ground to prevent inductive kick back from damaging said transistors.

2. A system in accordance with claim **1,** wherein said potential limiting means comprises a zener diode.

3. A system in accordance with claim **2,** further including a neon discharge lamp in parallel with said zener diode, for providing additional limitation of said potential and visual indication of system operation.

4. A system in accordance with claim **1,** wherein said potential limiting means comprises a capacitor.

5. A system in accordance with claim **2,** further including a neon discharge lamp connected across said primary coil, for further controlling said inductive kick back, and for providing visual indication of system operation.

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