

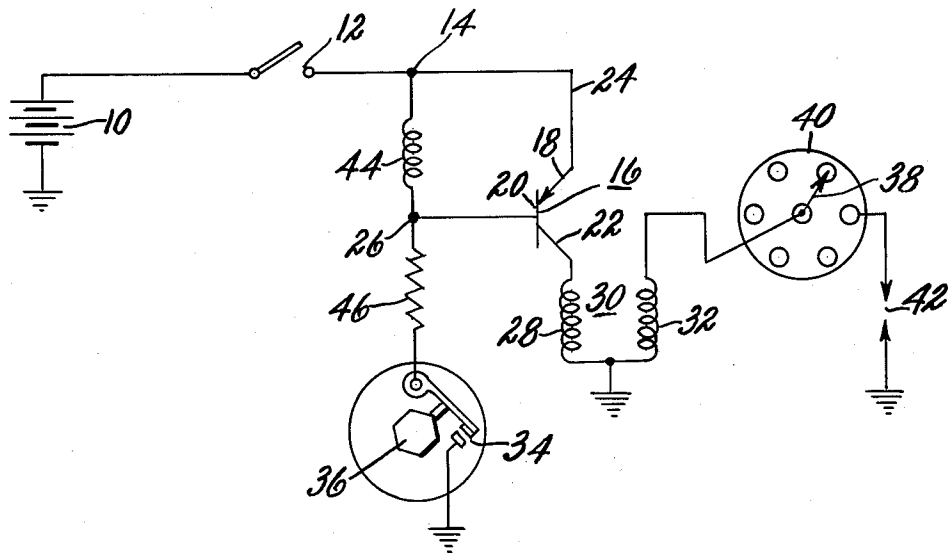
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INTERNAL COMBUSTION ENGINE IGNITION SYSTEM

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1

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INTERNAL COMBUSTION ENGINE IGNITION SYSTEM

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This invention relates to ignition systems for igniting the combustible mixture of an internal combustion engine and more particularly to ignition systems wherein a semiconductor such as a transistor is used to control current flow through the primary winding of an ignition coil.

The ignition system of this invention is an improvement of the system illustrated in a copending application of Brooks H. Short, Serial No. 579,332 filed on April 19, 1956, and assigned to the assignee of this invention, now abandoned.

In the above noted Short application, an ignition system is illustrated wherein a resistor is connected across the emitter and base electrodes of a transistor that controls the current flow through the primary winding of an ignition coil. This resistor substantially equalizes the electrical potential of the emitter and base electrodes when the breaker points are open to insure cutting off of conduction of the transistor.

It is an object of this invention to provide an improved ignition system of the type described wherein a circuit element is connected across the emitter and base electrodes of the transistor that is capable of developing a voltage that drives the base electrode positive with respect to the emitter electrode when the breaker points of the system open, thus causing a sharp cutting off of conduction of the transistor. This circuit element preferably takes the form of an inductance which develops a voltage of self-induction when the breaker contacts open that is applied across the emitter and base electrodes of the transistor.

Another object of this invention is to provide a transistor ignition system of the type described wherein one side of the breaker points is connected directly to ground.

Further objects and advantages of the present invention will be apparent from the following description, reference being had to the accompanying drawing wherein preferred embodiments of the invention are clearly shown.

The single FIGURE drawing is a schematic illustration of an ignition system made in accordance with this invention.

Referring now to the drawing, the reference numeral 10 designates a source of power on a motor vehicle which may be, for example, a storage battery. It will be appreciated that the storage battery supplies power for initially starting the engine and that the generator of the motor vehicle system thereafter supplies the power for the ignition system and for charging the battery. One side of the storage battery 10 is connected directly to ground as is shown and the opposite side thereof is connected with an ignition switch 12. The opposite side of the ignition switch 12 as is clearly apparent from the drawing is connected with the junction 14.

The ignition system of this invention includes a semiconductor such as a transistor 16 having an emitter electrode 18, a base electrode 20 and a collector electrode 22. It is seen that the emitter electrode 18 is connected with the junction 14 via lead wire 24 whereas the base electrode of the transistor 16 is connected with the junction 26. The collector electrode of transistor 16 is connected with the primary winding 28 of an ignition coil which is generally designated by reference numeral 30. The ignition coil has a secondary winding 32 inductively coupled with the primary winding and it is seen that both the primary and secondary windings have one of their ends connected directly to ground.

2

Reference numeral 34 indicates a set of breaker contacts which are opened and closed in synchronism with the operation of the engine. Thus, the engine drives the cam 36 which periodically causes the breaker contact to open in a manner well known to those skilled in the art. The engine also drives a rotor contact 38 which cooperates with a plurality of contacts located on a conventional distributor cap 40. As seen in the drawing, there are six contacts, each of which is connected with a spark plug for causing ignition of the combustible mixture of the engine. For convenience of illustration, one of the distributor cap contacts is shown connected with one side of a spark plug 42, the opposite side of the spark plug being connected to ground. It will be appreciated that in an actual system each one of the contacts of the distributor cap 40 is connected with a respective spark plug. It will also be appreciated that the rotor contact 38 is driven in synchronism with the engine and in synchronism with the cam 36.

The junction 14 which is connected to one side of ignition switch 12 is connected with an inductance 44, the opposite side of this inductance being connected with the junction 26. The junction 26 is connected to one side of the breaker contacts 34 via a resistor 46. The opposite side of the breaker contacts, as is clearly apparent from the drawing, is connected directly to ground.

In the operation of this system when the ignition switch 12 is closed and when the engine is being cranked, the cam 36 is rotated as well as the rotor contact 38. This causes the breaker contacts 34 to open and close. With the ignition switch 12 closed and with the breaker contacts 34 closed, a first circuit is made from the storage battery, which includes, the inductance 44, the resistor 46 and then through the breaker contacts 34 directly to ground. It can be seen that under this condition of operation the transistor 16 will have its base circuit completed directly to ground through resistor 46 and will also be biased to conduct from emitter to collector. This will complete a circuit from the battery through the emitter electrode 18 of transistor 16 through the collector electrode thereof and thence through the primary winding 28 of the ignition coil 30 directly to ground. As will be apparent to those skilled in the art, as long as breaker contacts 34 are closed, current will flow through the primary winding 28 of the ignition coil.

When the breaker contacts 34 open, there is no longer a base circuit to ground for the transistor 16 so that the transistor becomes non-conductive between emitter and collector to cut off current flow to the primary winding 28 of the ignition coil 30. It is to be observed that when the breaker contacts 34 do open, a voltage of self-induction is induced in the inductance 44 which is of such a polarity as to drive the base electrode 20 positive with respect to the emitter electrode 18. This causes a sharp cut off in conduction of the transistor 16 to sharply cut off the current flow to the primary winding 28 of ignition coil 30. As a result of this, a large voltage is induced in the secondary winding 32 which is applied to a spark plug 42 via the rotor contact 38 and one of the contacts carried by the distributor cap 40.

It is important to observe that without the inductance 44 the base electrode 20 would not be driven positive with respect to the emitter electrode 18 and no sharp cut off in conduction of the transistor 16 between emitter and collector would be possible. It thus is seen that the present invention provides for a sharp instantaneous cut off of transistor 16 when the breaker points 34 open to reduce internal heating of the transistor.

While the embodiments of the invention as herein disclosed constitute preferred forms, it is to be understood that other forms might be adopted.

What is claimed is as follows:

1. An ignition system for causing the firing of a spark

3

plug in an internal combustion engine comprising, a source of direct current power, a transistor having emitter, base and collector electrodes, an ignition coil having a primary winding and a secondary winding, means connecting said secondary winding with said spark plug, a pair of breaker contacts operated in synchronism with said engine, a series connected inductance and resistor having a common junction, means connecting said series connected inductance and resistor between one side of said power source and one of said breaker contacts, means connecting the other of said breaker contacts with the other side of said power source, means connecting the emitter electrode of said transistor with said power source, means connecting the collector electrode of said transistor with one side of the primary winding of said ignition coil, means connecting the opposite side of said primary winding with one side of said power source, and means connecting said junction of said inductance and resistor with the base electrode of said transistor.

2. An ignition system for causing the firing of a spark plug in an internal combustion engine comprising, a source of direct current power, means connecting one side of said source of power directly to ground, a pair of breaker contacts, means connecting one side of said breaker contacts directly to ground, a circuit connecting the opposite side of said power source with the opposite side of said breaker contacts including a series connected inductance and resistor having a common junction, a transistor having emitter, base and collector electrodes, an ignition coil having a primary winding and a secondary winding, means connecting the secondary winding of said ignition coil with said spark plug, means connecting the collector electrode of said transistor with one side of the primary winding of said ignition coil, means connecting the opposite

4

side of said primary winding with one side of said power source, means connecting the base electrode of said transistor to said common junction of said inductance and resistor, and means connecting the emitter electrode of said transistor to one side of said inductance and to one side of said power source.

3. An ignition system for causing the firing of a spark plug of an internal combustion engine comprising, a pair of terminals energized from a source of direct current, an ignition coil having a primary winding and a secondary winding, means connecting said secondary winding with said spark plug, a transistor having emitter, base and collector electrodes, a first current path connecting said terminals including in a series connection, the emitter-collector circuit of said transistor and the primary winding of said ignition coil, a pair of breaker contacts opened and closed in timed relationship with operation of said engine, an inductance, a second current path connecting said terminals including in a series connection, the emitter-base circuit of said transistor and said breaker contacts, and a third current path connecting said terminals including in a series connection, said inductance and said breaker contacts said inductance directly connecting the emitter and base electrodes of said transistor.

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