March 16, 1965 N. A. JUKES 3,174,075

TRANSISTOR OSCILLATOR SPARK IGNITION APPARATUS FOR INTERNAL COMBUSTION ENGINES

Filed Feb. 6, 1961

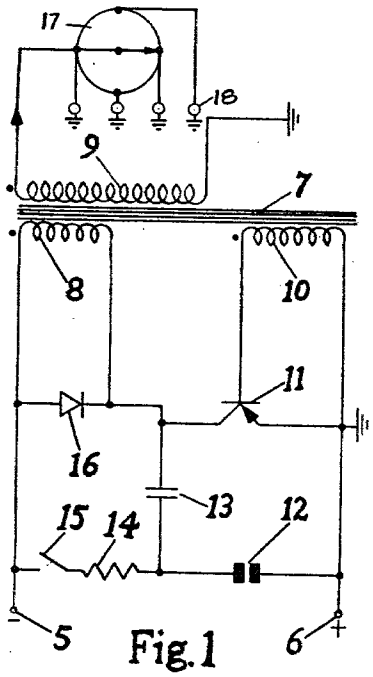


Fig. 1

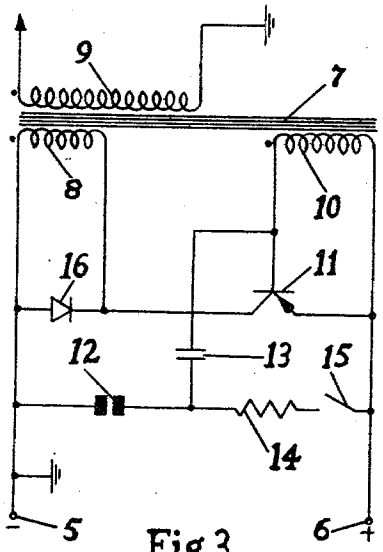


Fig. 3

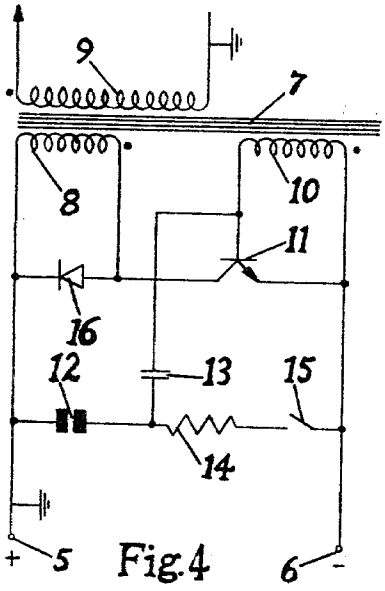


Fig. 4

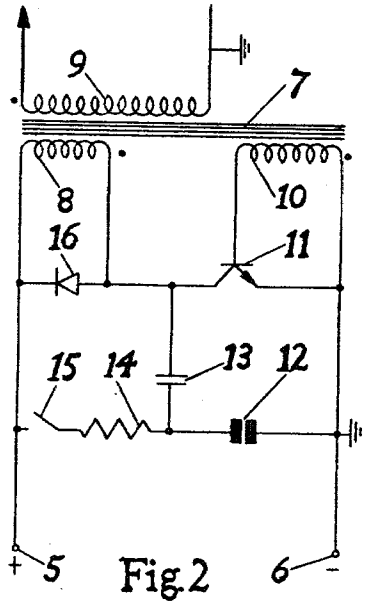


Fig. 2

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TRANSISTOR OSCILLATOR SPARK IGNITION APPARATUS FOR INTERNAL COMBUSTION ENGINES

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2 Claims. (Cl. 315—206)

This invention relates to spark ignition apparatus for internal combustion engines, and has for its object to provide such apparatus in a convenient and efficient form.

Apparatus in accordance with the invention comprises first and second terminals adapted for connection to a source of direct or rectified alternating current, an iron core, a primary winding mounted on the core and having its one end connected to the first terminal, a control winding mounted on the core and having its one end connected to the second terminal and its other end connected to the other end of the primary winding through the base and collector terminals of a transistor the emitter terminal of which is connected to the second terminal, a secondary winding mounted on the core and adapted for connection to the sparking plugs, an interrupter and capacitor connected in series between one of the terminals and a point intermediate the said other ends of the primary and control windings, a resistor connected between the other terminal and a point intermediate the interrupter and capacitor, and a diode interconnecting the ends of the primary winding, the arrangement being such that the transistor is biased so that it is alternately conductive and non-conductive in use.

Preferably, either the first or second terminal is earthed in use, and said one terminal is the earthed terminal.

In the accompanying drawings FIGURES 1 to 4 respectively are diagrammatic views illustrating four examples of the invention, similar parts in the four views being designated by similar reference numerals, and the secondary circuit of the ignition transformer being shown in FIGURE 1 only.

Referring first to FIGURE 1 of the drawings, there is provided first and second terminals **5**, **6** which are adapted for connection to a 12 volt battery or other source of direct or rectified alternating current, the arrangement being that in use the terminal **5** is of negative polarity whilst the terminal **6** is earthed.

There is further provided an iron core **7** on which are mounted a primary winding **8** capable of generating the required magnetic flux in the core, a secondary winding **9** connectible through a distributor **17** to the sparking plugs **18** of the engine in turn and arranged to produce the required sparking voltage, and a control winding **10**.

One end of the winding **8** is connected to the terminal **5**, whilst one end of the winding **10** is connected to the terminal **6**. Further, the other ends of the windings **8**, **10** are interconnected through the collector and base terminals of a p-n-p type transistor **11**, the emitter terminal of which is connected to the terminal **6**.

Connected in series between the terminal **6** and a point intermediate the said other end of the winding **8** and the collector terminal of the transistor **11** are an engine-driven interrupter **12** and a capacitor **13**. Further, a resistor **14** is connected through a switch **15** between the terminal **5** and a point intermediate the interrupter **12** and capacitor **13**, and the ends of the primary winding are bridged by a diode **16**.

The operation of the apparatus is as follows:

When the contacts of the interrupter **12** close, the capacitor **13** is charged through the winding **8**. The charging current induces a voltage in the winding **10** which biases the base of the transistor **11** and allows a larger current to flow through the winding **8**. The larger current induces a further voltage in the winding **10** causing rapid magnetisation of the core and thereby inducing a high voltage in the winding **9**. The primary current reaches its peak value in a very short period and when this value is reached the core **7** is magnetically saturated. Hence there is no further change of flux in the core and no further energy is fed back to the winding **10**. The transistor **11** thus reverts to its initial state, and the back E.M.F. appearing across the winding **8** by virtue of the switching off of the transistor is conducted through the diode **16**, which suppresses high voltage peaks which would otherwise damage the transistor, and prevents the generation of a second high voltage in the secondary winding. Finally, the contacts of the interrupter **12** open whereafter the cycle is repeated.

In the modification of the invention illustrated in FIGURE 2 an n-p-n type transistor is employed. In this case the terminal **6** is still earthed, but the polarities of the terminals **5**, **6** are positive and negative respectively. The arrangement and operation of this modification is the same as that of the example above described.

In the further modifications illustrated in FIGURES 3 and 4 the arrangement and operation is somewhat different. In both modifications the terminal **5** is earthed, and the positions of the resistor **14** and interrupter **12** are reversed. Further the capacitor **13** is connected between a point intermediate the interrupter and resistor and a point intermediate the base terminal of the transistor **11** and said other end of the winding **10**. The terminals **5**, **6** are of negative and positive, or positive and negative polarity respectively depending on whether a p-n-p or an n-p-n type transistor is employed.

The operation of the last two modifications is as follows:

When the interrupter **12** closes the capacitor **13** charges through the winding **10**, the current flow in the latter being such as to render the transistor **11** conductive, whereafter a regenerative action commences and the apparatus operates in similar manner to that already described.

All the examples described will operate when neither terminal is earthed, and in this case the relative positions of the interrupter **12** and resistor **14** are unimportant. In the examples described, however, it is preferable, though not essential, that the interrupter **12** be connected to the earthed terminal, since if it were connected to the unearthed terminal it would be necessary to insulate both its contacts.

By the present invention, since the principal source of current passing through the winding **8** does not pass through the interrupter the electromagnetic energy which can be transmitted through the coil is not limited by the amount of current which can be effectively controlled by the interrupter.

Having thus described my invention what I claim as new and desire to secure by Letters Patent is:

1. Spark ignition apparatus for internal combustion engines, comprising a direct current source, an ignition transformer having a core, a primary winding on the core, a secondary winding on the core connectible through a distributor to the spark plugs of the engine in turn, and a control winding on said core, a monostable oscillator producing upon each operation thereof a spark in the secondary circuit as a result of rising current in said primary winding, said monostable oscillator including a transistor having its emitter and base interconnected through said control winding, said control winding providing feedback to said transistor, a series circuit con-

nected to said source, said series circuit including said primary winding and the collector and emitter of said transistor, and a second series circuit connected to said direct current source, said second series circuit including said primary winding, a capacitor, and an engine-driven interrupter operating said oscillator in timed relationship to the engine to produce sparks at said plugs in turn, said apparatus further including a diode connected across said primary winding to absorb back electromotive force after production of each sprak, and a resistor and a switch connected in series with said interrupter to said direct current source, said switch controlling operation of the spark ignition apparatus, and said capacitor discharging through said diode and said resistor when a spark is produced.

2. Spark ignition apparatus for internal combustion engines, comprising a direct current source, an ignition transformer having a core, a primary winding on the core, a secondary winding on the core connectible through a distributor to the spark plugs of the engine in turn, and a control winding on said core, a monostable oscillator producing upon each operation thereof a spark in the secondary circuit as a result of rising current in said primary winding, said oscillator including a transistor having its base and emitter interconnected through sad control winding, said control winding providing feedback to said transistor, a first series circuit connected to said direct current source, said first series circuit including said primary winding and the collector and emitter of said transistor, a second series circuit connected to said direct current source, said second series circuit including said control winding, a capacitor, and an engine-driven interrupter operating the oscillator in timed relationship to the engine to produce sparks at said plugs in turn, said apparatus further including a diode connected across said primary winding to absorb back electromotive force after production of each spark, and a resistor and a switch connected to said direct current source in a series circuit including said interrupter, said switch controlling operation of the apapratus to produce sparks, and said capacitor discharging through said control winding, said switch and said resistor after production of each spark.

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