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TRANSISTORIZED IGNITION SYSTEM USING PLURAL PRIMARY WINDINGS

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FIG. 1

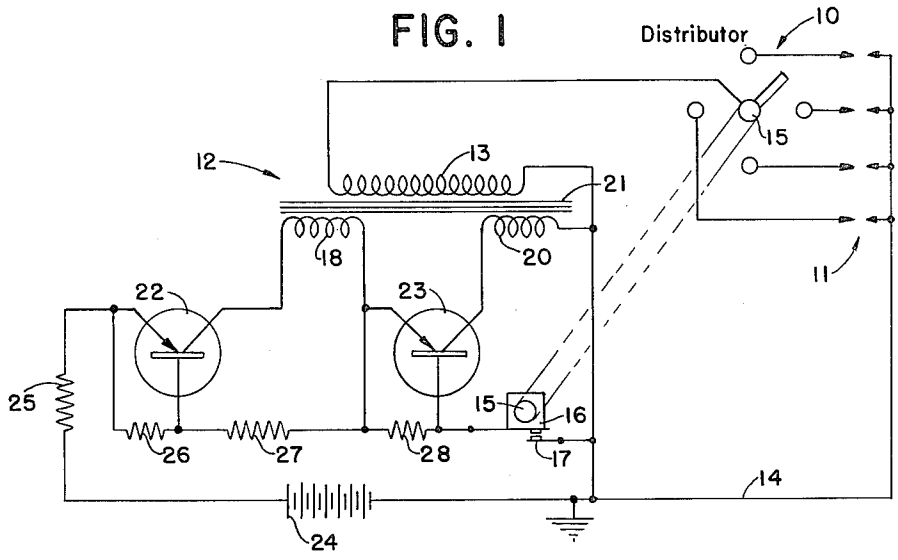
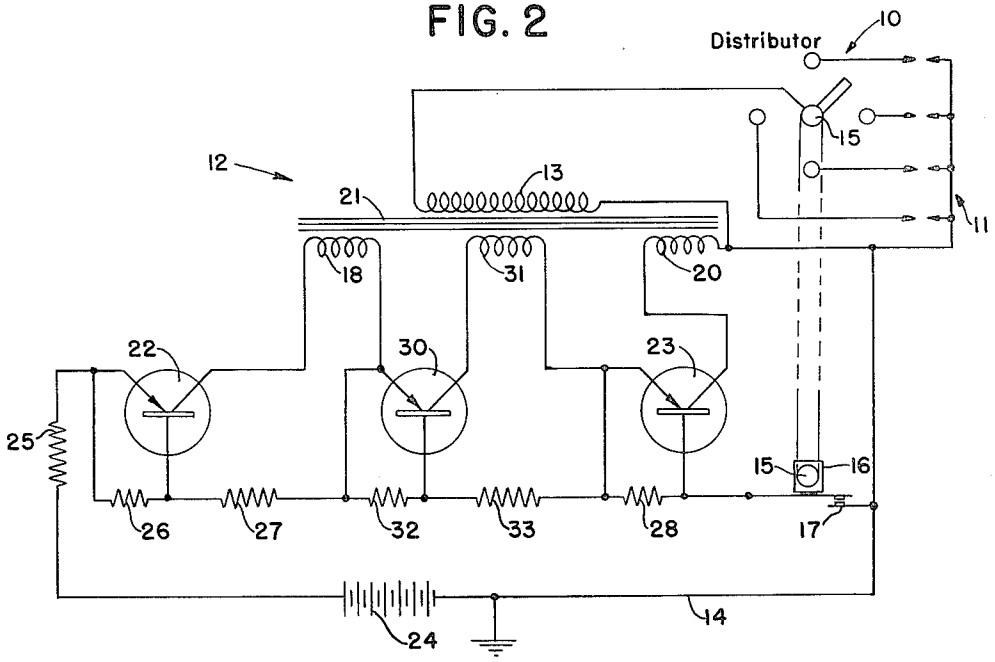


FIG. 2



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TRANSISTORIZED IGNITION SYSTEM USING PLURAL PRIMARY WINDINGS

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This invention relates to an ignition system which employs an induction coil for generating a high voltage which is applied to a plurality of spark plugs in an internal combustion engine. A plurality of primary windings are used in the induction coil and are connected in series with transistors which act as switches to control direct current pulses from a source of electric power.

The modern ignition systems now in use include a pair of breaker contacts connected in series with the primary of a transformer and a source of current. The secondary of the transformer is connected through a distributor to a set of spark plugs and a portion of the distributor structure controls the opening and closing of the contacts so that a series of direct current pulses is applied to the transformer primary. While this system is simple and effective, the high current through the breaker contacts and the primary winding causes the contacts to pit and spark. The sparking is due mainly to the inductive reactance of the primary winding. The present invention practically eliminates sparking from the contacts because the current through them is quite small and also because the current which is broken passes through a number of resistors which are not inductive. The current through the primary windings is turned on and off by means of transistors. Since the transistors cut off the current pulses abruptly, a larger voltage is generated in the secondary of the induction coil, thereby providing ignition voltage for the spark plugs.

One of the objects of this invention is to provide an improved ignition system which avoids one or more of the disadvantages and limitations of prior art systems.

Another object of the invention is to reduce the current broken by the breaker contacts.

Another object of the invention is to increase the firing voltage applied to the spark plugs.

Another object of the invention is to eliminate the inductive spark at the breaker contacts by substituting a resistive control circuit for the primary current pulses.

Another object of the invention is to connect a plurality of transistors in series connection so that the battery voltage is evenly divided between them.

The invention includes, in its simplest form, a high voltage induction coil having its secondary winding connected through a distributor to a set of spark plugs. Two primary windings are wound on the core and these windings are connected in series with the emitter-collector electrodes of two transistors. The charging circuit for the primary windings includes a source of direct current potential, which may be a storage battery, the emitter-collector electrodes of each transistor and the two primary windings. The transistors are controlled to be either conductive or nonconductive by a control circuit which includes a pair of breaker contacts in series with a biasing circuit coupled to the transistor bases. The biasing circuit is connected across the terminals of a source of potential.

For a better understanding of the present invention, together with other and further objects thereof, reference is made to the following description taken in connection with the accompanying drawings.

FIG. 1 is a schematic diagram of connections showing the ignition system with two transistors and two primary windings.

FIGURE 2 is also a schematic diagram of connections similar to FIG. 1 but employing three transistors and three primary windings.

Referring now to the figures, the ignition system includes a distributor **10**, a set of spark plugs **11**, and a high voltage induction coil **12**. The high voltage coil includes a secondary winding **13** which is connected between a grounded conductor **14** and the center **15** of the distributor **10**. The center **15** is mechanically coupled to a cam **16** which opens and closes a pair of breaker contacts **17**.

The primary circuit of coil **12** includes two windings **18** and **20** as shown in FIG. 1. These windings, in addition to the secondary winding **13**, are all wound on a ferromagnetic core **21**. Winding **18** is connected between two transistors **22** and **23**, each having the usual three electrodes. Winding **20** is connected between the collector of transistor **23** and the ground conductor **14**. A source of potential **24** supplies the electrical power for the operation of the device and may be a storage battery or any other source of direct current power. The storage battery has its negative terminal connected to the grounded conductor **14** and its positive terminal connected to the emitter of transistor **22** in series with a limiting resistor **25**.

In order to control the conductance of the transistors, a biasing circuit is provided which includes three resistors **26**, **27** and **28** connected between the breaker contacts **17** and the emitter of transistor **22**. The base of transistor **22** is connected to the junction point of resistors **26** and **27** while the emitter of transistor **23** is connected to the junction of resistors **27** and **28**. The base of transistor **23** is connected to one of the contacts **17** and resistor **28**.

The operation of this circuit is as follows: when contacts **17** are open, both transistors **22** and **23** are made non-conductive because their bases are connected to the positive terminal of battery **24** through the resistive control circuit. This makes the bases of the transistors equal in potential to the emitters. When the contacts **17** are closed, the base of transistor **23** is connected directly to the negative terminal of the source of potential and the base of transistor **22** is given a potential more negative than that of its emitter, thereby making both transistors conductive and sending a current pulse from the battery, through resistor **25**, through the emitter-collector electrodes of transistor **22**, through the primary winding **18**, through the emitter-collector electrodes of transistor **23**, through primary winding **20**, and back to the negative terminal of battery **24**. This current increases slowly to its maximum value because of the inductance in the circuit and, because of the slow rise, little voltage is generated in the high potential secondary winding **13**. When contacts **17** are broken, the conductance of transistors **22** and **23** is reduced abruptly to zero and the magnetic flux in core **21**, which was created by the currents through windings **18** and **20**, now collapses and generates a high voltage across secondary winding **13** with a very fast rise time. This voltage is transmitted to one of the spark plugs through distributor **10** in the usual manner.

The circuit diagram shown in FIG. 2 is the same as that shown in FIG. 1 except that an additional transistor **30** and an additional primary winding **31** have been added to the circuit. The additional transistor and winding reduce the voltages applied across the transistors and windings by an appreciable amount. In order to control the conductance of transistor **30**, biasing resistors **32** and **33** are added to the circuit in series with the control circuit terminated by contacts **17** and the source of potential **24**. The operation of this circuit is the same as that described for the circuit shown in FIG. 1.

The following circuit constants may be used in the circuit shown in FIG. 1 and are illustrative of a specific application of the invention.

Transistors **22** and **23**		2N1970
Resistor **25**	ohms	.5
Resistors **26** and **28**	do	2.2
Resistor **27**	do	2.2
Battery voltage	volts	12

The foregoing disclosure and drawings are merely illustrative of the principles of this invention and are not to be interpreted in a limiting sense. The only limitations are to be determined from the scope of the appended claims.

I claim:

1. An ignition system for an internal combustion engine comprising: an induction coil including a high voltage secondary winding connected to a distributor and a first and a second primary winding, all of said windings wound on a ferromagnetic core; a first and second transistor each having a base, an emitter, and a collector; a charging circuit including a source of direct current with its positive terminal connected to the emitter of the first transistor, said first primary winding connected between the collector of the first transistor and the emitter of the second transistor, and said second primary winding connected between the collector of the second transistor and the negative terminal of the source of current; and a biasing circuit for controlling direct current pulses through said primary windings including a pair of contacts operated by the distributor, said contacts connected between the negative terminal of the source and the base of said second transistor, said biasing circuit also including circuit connections between both bases and both emitters for cutting off the current through the primary windings when the contacts are open.

2. An ignition system for an internal combustion engine comprising: an induction coil including a high voltage secondary winding connected to a distributor and a plurality of primary windings, all of said windings wound on a common ferromagnetic core a source of direct current; a plurality of transistors equal in number to the number of primary windings, each of said transistors having a base, an emitter, and a collector; one of said primary windings connected between the collector of a first transistor and the negative terminal of the source of current; the other of said primary windings each connected between the collector of one transistor and the emitter of another transistor; a charging circuit for sending direct current pulses through all of said primary windings to generate magnetic flux in the core, said circuit including in series connection, said source of direct current, the emitter-collector electrodes of each transistor and all the primary windings and a biasing circuit for controlling said current pulses through the primary windings, said biasing circuit including a pair of contacts operated by the distributor and connected between the negative terminal of the current source and the base of said first transistor, said biasing circuit also including resistive connections between all the other transistor bases and all emitters for cutting off the current through the primary windings when the contacts are open.

3. An ignition system as claimed in claim **2** wherein the induction coil includes three primary windings and the charging circuit includes three transistors.

4. An ignition system as claimed in claim **2** wherein said biasing circuit applies a potential to each transistor base to render the emitter-collector electrodes conductive when said contacts are closed.

5. An ignition system for an internal combustion engine comprising: an induction coil including a secondary winding connected through a distributor to a plurality of spark plugs, a plurality of primary windings, and a ferromagnetic core which supports all the windings; a plurality of transistors, each having a base, an emitter, and a collector; a charging circuit for sending direct current through all of said primary windings to generate a magnetic flux in the core, said circuit including a source of direct current, the emitter-collector electrodes of each transistor and said primary windings, a biasing control circuit for controlling the conductance of the emitter-collector paths in all of said transistors, said biasing circuit including a pair of contacts operated by the distributor and a plurality of resistors connected in series between one of the contacts and the positive terminal of the source of potential; and connections between all the transistor bases and points on said resistors for making the charging circuit conductive when the contacts are closed and making the charging circuit non-conductive when the contacts are open.

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