

April 26, 1966

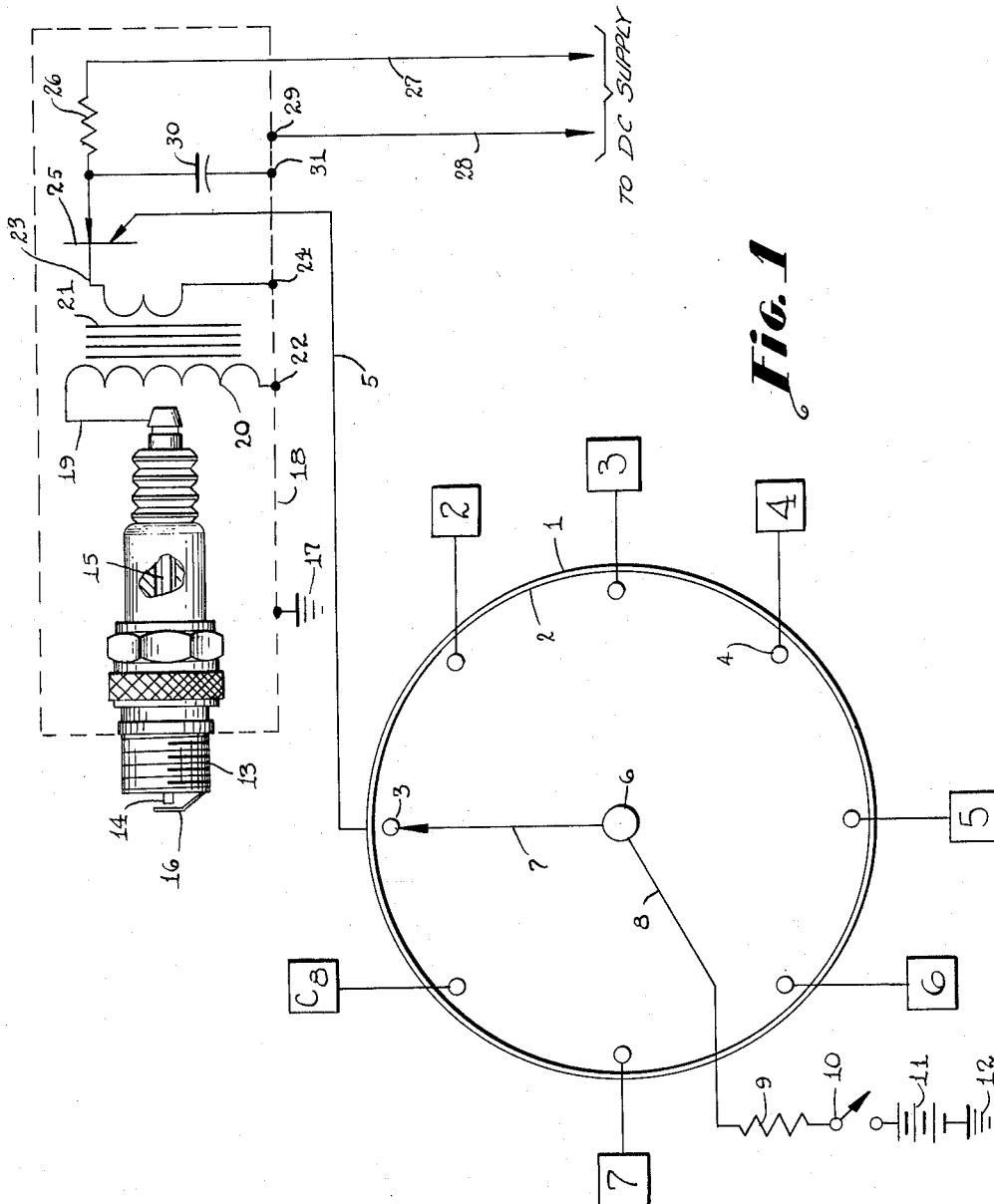
J. R. RICHARDS

3,248,604

FUEL IGNITION SYSTEM PREVENTING RADIO FREQUENCY INTERFERENCE

Filed Jan. 9, 1962

4 Sheets-Sheet 1



INVENTOR
JAMES R. RICHARDS

BY *Otto John Murray*
ATTORNEY

April 26, 1966

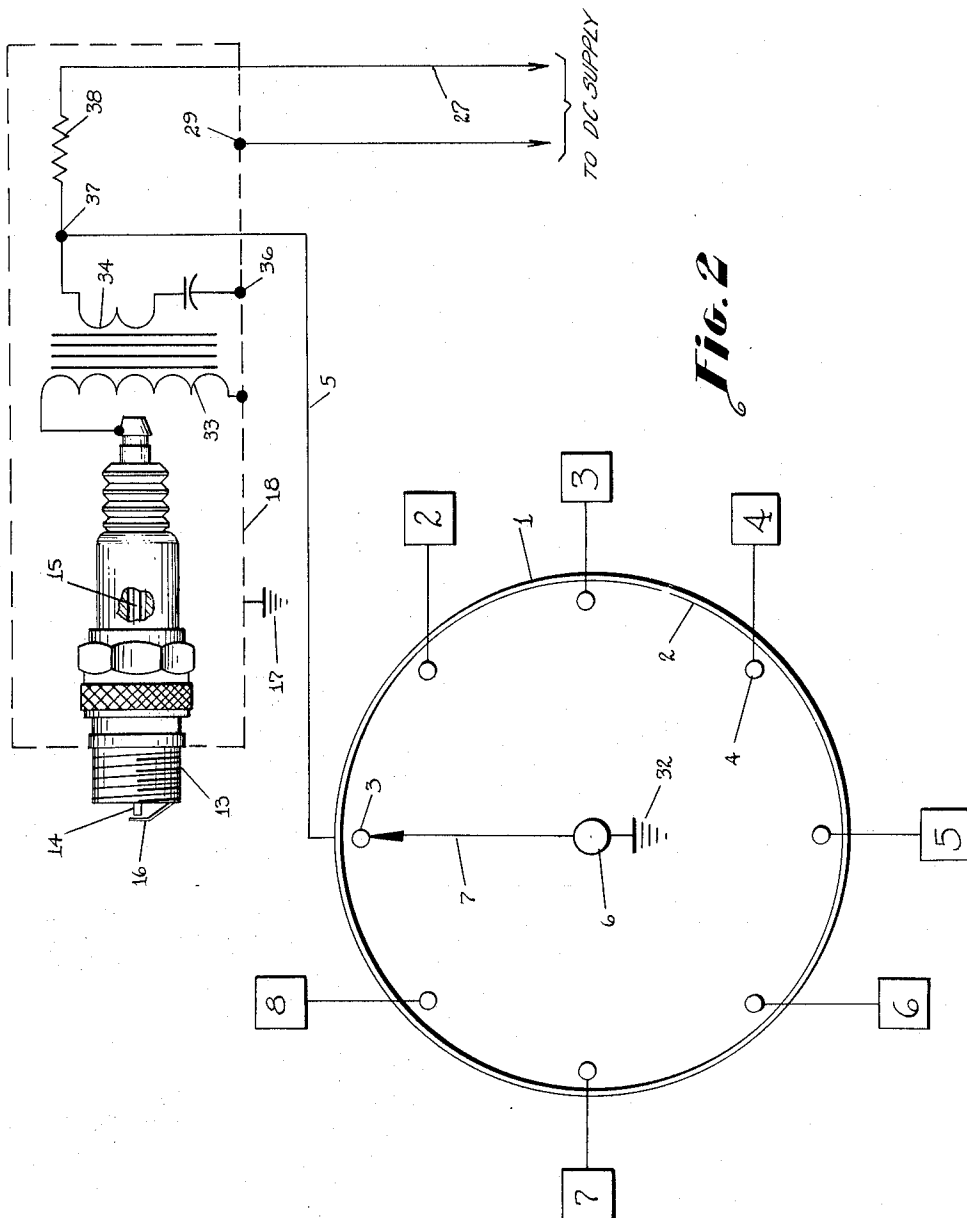
J. R. RICHARDS

3,248,604

FUEL IGNITION SYSTEM PREVENTING RADIO FREQUENCY INTERFERENCE

Filed Jan. 9, 1962

4 Sheets-Sheet 2



INVENTOR

JAMES R. RICHARDS

BY John Lee Murray
ATTORNEY

April 26, 1966

J. R. RICHARDS

3,248,604

FUEL IGNITION SYSTEM PREVENTING RADIO FREQUENCY INTERFERENCE

Filed Jan. 9, 1962

4 Sheets-Sheet 3

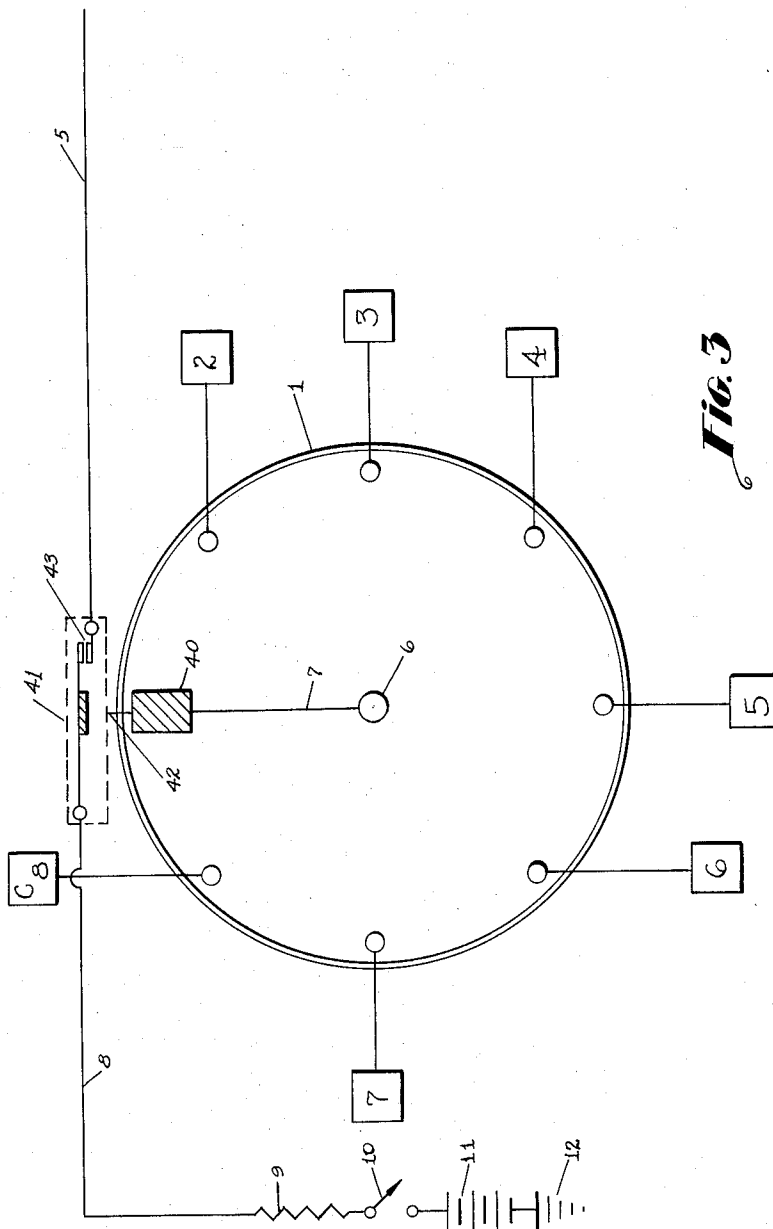


Fig. 3

INVENTOR
JAMES R. RICHARDS

BY *Olto John Murray*
ATTORNEY

April 26, 1966

J. R. RICHARDS

3,248,604

FUEL IGNITION SYSTEM PREVENTING RADIO FREQUENCY INTERFERENCE

Filed Jan. 9, 1962

4 Sheets-Sheet 4

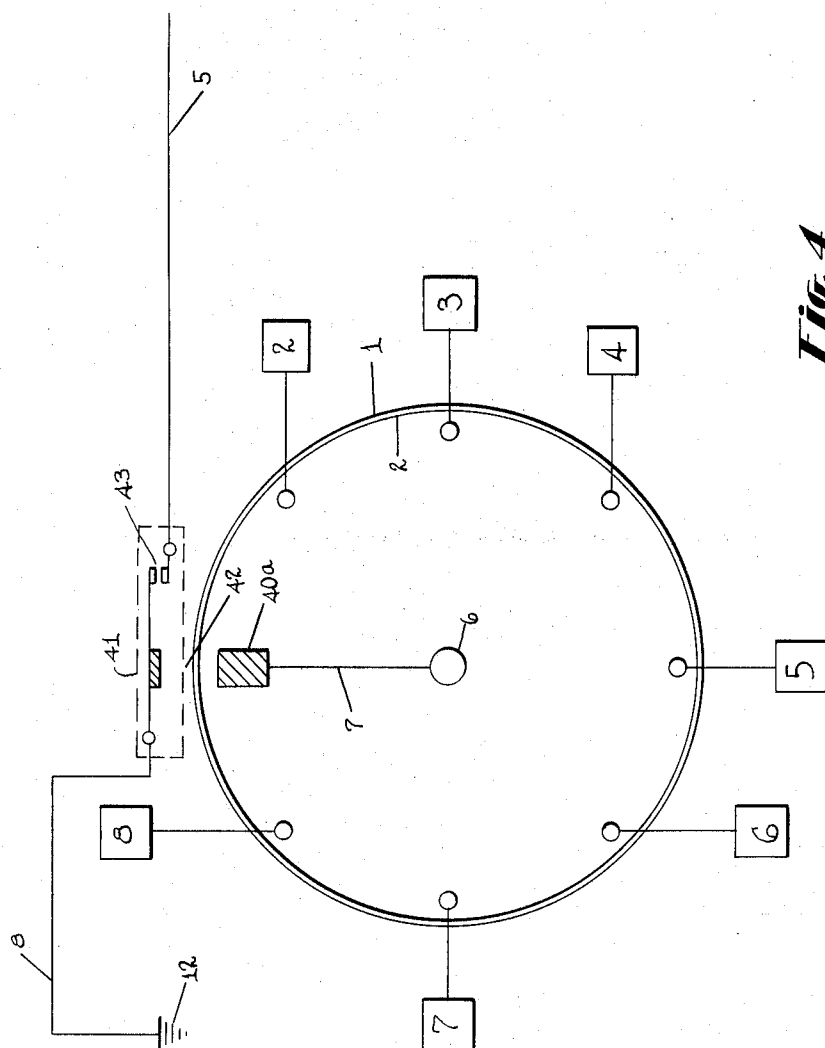


Fig. 4

INVENTOR

JAMES R. RICHARDS

BY *Otto John Mueg.*

ATTORNEY

1

3,248,604

FUEL IGNITION SYSTEM PREVENTING RADIO FREQUENCY INTERFERENCE

James R. Richards, 2813 63rd Ave., Cheverly, Md.

Filed Jan. 9, 1962, Ser. No. 165,207

4 Claims. (Cl. 315-213)

This invention relates to ignition systems for internal explosion engines and to component parts of the system, more particularly, to a system which is a simplification and improvement over the conventional high-voltage system presently widely used for firing internal explosion engines. It is the chief object of the invention to provide an ignition system wherein the step-up of low D.C. voltage to high-voltage sufficient to produce the ignition spark, is effected by a number of units, one for each cylinder and forming a unitary or component part of the sparking device, or spark plug itself, or in the nature of an attachment thereto.

Another object is to provide an ignition system which practically and efficiently eliminates radio interference from the engine's ignition system, and without the need for expensive and complicated shielding procedures and attachments.

Still another object is to provide a system as aforesaid which greatly simplifies the ignition distributor commonly used at the present time, by elimination of the low-voltage circuit closer or "points" thereof, so that, as a result, the distributor becomes merely a low voltage contact device, directing a low D.C. voltage to the respective cylinders in synchronism with the rotation of the engine and in the proper sequence or firing order.

As a corollary, it is an object to provide a compact efficient combination or unit which will include a spark gap or spark plug adapted to be connected with each cylinder of an internal combustion engine, as by screw threads presently used, and, in addition a small transformer and other electrical elements, as subsequently described.

Still another object of the invention is to produce an ignition system for internal explosion engines, which is long-lived, reliable throughout its useful life, which can be manufactured and sold at a price comparable to the over-all costs of the present ignition systems and necessary auxiliaries, and which is easily replaced.

Other objects and advantages will be obvious to those skilled in the art, after a study of the following detailed description in connection with the accompanying drawing.

In the accompanying drawing:

FIG. 1 is a diagrammatic view of an ignition system embodying the invention;

FIG. 2 is a diagrammatic view of a modified form of the invention shown upon FIG. 1;

FIG. 3 is a diagrammatic view of a modified form of the circuitry of FIG. 1; and

FIG. 4 is a diagrammatic view of a modified form of the circuitry shown in FIG. 2.

Referring in detail to the drawing, the number 1 identifies generally a distributor for an engine, assumed to have eight cylinders, and including a dielectric cap or casing 2, with distributor contacts 3, 4, etc., each connected by low-voltage wiring such as 5, with a respective one of the engine's cylinders. A shaft 6 is connected to rotate in synchronism with the crankshaft of the engine which, in a four cycle engine, is in the ratio 1:2, as is well known in the art. A distributor arm 7 is fixed to and radially of shaft 6, for rotation as a unit therewith, and may include a base of dielectric material keyed to the shaft, and carrying a conducting element 7a to make contact as by carbon brush means, in sequence and in the proper pre-designed firing order, with contacts 3, 4, etc. The arrange-

2

ment is such that arm 7 makes electrical contact at 3, 4, etc. at the proper instant to fire each respective cylinder.

The aforesaid conducting element of arm 7 is in continuous electrical contact, as by a slip-ring and brush, not shown, with a lead 8 in series with a resistance 9, an ignition switch 10, and one terminal of a battery 11, the other terminal of which is grounded at 12.

In FIGURE 1 being described, there is shown but one of the firing devices forming a component part of the invention, connected by lead 5 with the distributor; but it will be understood that the number of these devices used in any given installation corresponds to the number of cylinders of the engine, and that each such device is connected in firing relation with its cylinder, and connected by an electrical lead with the corresponding contact 3, 4, etc. at the distributor.

The firing device itself may comprise a metallic base or frame 13 as in a conventional spark plug, adapted to be threadedly connected with an aperture in communication with the combustion chamber of the corresponding cylinder, and including a gap 14 between the end of an insulated central, longitudinal electrode 15 and a radial electrode 16, grounded at 17 through the shell or base 13.

In a preferred form of the invention a metal sleeve 18 may have one end open and adapted to fit down over and about the metallic base 13 of the plug or other firing device, to make good electrical contact therewith. Frictional, threaded, or bayonet joint connections are contemplated. The upper end of the sleeve contains potted elements including a lead or terminal 19 adapted to make electrical contact with the contiguous end of electrode 15 when in operating relation with the plug and in circuit with the high-voltage secondary 20 of a small transformer 21; the other terminal of this secondary is grounded to sleeve or shell 18 at 22.

The low-voltage primary 23 of transformer 21 is grounded at 24 to shell 18 and has its other end connected with a solid state switching device 25, such as a four-layer diode, otherwise known as a controlled rectifier, or a switching transistor. One lead from this switching device is connected through a charging resistor 26 with a lead 27 connected to one terminal of any suitable source of D.C. voltage, not shown. The remaining lead 28 from the aforesaid source of D.C. is grounded to shell 18 at 29. A condenser 30 is also included in the components potted within shell 18 and is connected, as shown, between the low-voltage terminal of resistor 26 and ground to shell 18, at 31. The remaining terminal of switching device 25 is connected through lead 5 with the corresponding terminal of distributor cap 2. It will be understood, of course, that the ends of lead 5 and 27 are detachably connected with respective components within the shell, through insulated contacts or binding posts fixed with the shell, and also that leads similar to 27 and 28 extend from the source of D.C. to each of the firing devices. All circuits may be closed by a single switch such as 10, and the source supplying these leads may be battery 11 or, alternatively, the D.C. generator of the engine. In other words, the hook-up may be the conventional one presently used, wherein a battery is used for the supply of ignition voltage at starting, after which shift is automatically made to a D.C. generator driven from the engine, for supplying voltage to arm 7 as well as to condenser 30.

As is well known, a switching device of the type indicated at 25 will not conduct due to its high resistance, until triggered by a control signal. The voltage applied to the terminals of condenser 30 through series resistor 26, charges the condenser during the interval between explosions. At the proper instant for firing, arm 7 makes contact at terminal 3 and applies the necessary triggering voltage to the switch device 25 which then fires and

applies the necessary voltage to primary 23, thus inducing a voltage in secondary 20 sufficient to cause a spark to jump gap 14.

It will be understood that precise ignition timing of all cylinders may be effected in the usual way by making the support for cap 2 adjustable about the axis of shaft 6 and also by adjusting it for spark advance by means responsive to absolute manifold pressure and/or engine speed. In the contemplated commercial embodiment of the invention shell 18 will bear insulated terminals of any approved or suitable type, for the connection of lead 5 and 27. Since the shell 18 is grounded, the lead 28 is merely for clarity of description, and in a practical embodiment, a circuit including resistor 26 and condenser 30, would be completed by grounding the remaining terminal of the D.C. supply, that is, the terminal to which lead 28 is described as connected.

FIG. 2 shows a modified form of the invention, wherein the distributor cap, shaft, arm, etc. may be the same as in the species of FIG. 1 and are hence identified by the same reference numerals, so that it is sufficient to refer to cap 2, shaft 6, arm 7 and terminals or contacts 3 fixed with and carried by the cap, to be engaged sequentially by the arm in its synchronous rotation with the engine crankshaft. In this species, arm 7 is grounded at 32 directly or through a conventional ignition switch, not shown.

The spark plug or arcing assembly includes a spark gap device which may be substantially identical with the one described in connection with FIG. 1, so that it is sufficient to identify base 13, gap 14, central electrode 15, radial or grounded electrode 16 and shell 18. As previously described, this shell may have one end shaped and sized for a snug fit over and about the plug per se, to be grounded as at 17 and to enclose in its other end remote the high tension secondary 33 of a small compact transformer whose low-voltage primary 34 is in series with a condenser 35 grounded to shell 18 at 36. The other terminal of primary 34 is connected at 37 with lead 5, in turn connected with one terminal 3 of distributor 1. A source of D.C. voltage, not shown, has a lead from one terminal thereof grounded at 29 to shell 18, while the other terminal is connected by lead 27 with one terminal of a charging resistor 38, having its other end connected to terminal 37.

The operation of this form of the invention will be clear from the foregoing description. When the engine is in operation, condenser 35 is continuously charged from the described source of D.C., lead 27, charging resistor 38, primary transformer winding 34 and ground connections 36 and 29. At the instant arm 7 makes contact at 3 the condenser is discharged through the circuit completed thereby with the result that a high-voltage surge is induced in secondary 33 which causes an arc or charge-igniting spark at gap 14.

I have therefore provided an improved ignition system for internal combustion engines which fulfills all of the objects previously stated. All external wiring and switching in the system takes place at low voltage and low current. For example, the voltage in the form of the invention disclosed at FIG. 1 may be of the order of three volts and a current of 2 microamperes. Hence no radio frequency interference is produced and the external wiring may be of small gage, and light and simple in construction.

It is contemplated that the firing assembly which includes shell 18, may be made and sold separately from the actual spark gap or plug 13, etc., or alternatively made integral therewith and sold as a unitary device. In the former case conventional spark plugs may be adapted for use as a part of the invention, merely by inserting the high voltage electrode end of the plug into the open end of shell 18 to make a press or snug fit therewith. The transformer embodied within shell 18 may be a small compact unit, potted in place, so that the

shell may have a maximum diameter no greater than the corresponding diameter of the plug itself. The unit, including shell 18 and parts permanently encased therein could thus be made and sold independently of the plug itself, and with proper use could be retained when a new set of spark plugs is required, to last at least the life of the engine. In such a construction, the unit would come equipped with a snap or resilient terminal constructed and arranged to automatically effect electrical connection with the outer end of electrode 15, when the shell is pressed down over the body 13. The system embodied in this invention also eliminates the usual multi-lobed cam and associated breaker points commonly used at the present time with internal combustion engines. Correspondingly eliminated is the critical adjustment of maximum point separation by feeler gage or dwell angle indicator. The over-all cost of my system will be less than that of comparable systems presently used; and this is especially true when there is considered the elimination of expensive high frequency shielding which the invention makes possible.

FIG. 3 is a diagrammatic view of a modification shown upon FIG. 1. A preferred embodiment of this modification substitutes for the conducting element 7a a permanent magnet 40, mounted on arm 7. The magnet 40 rotates in proximity with contacts 43 and gap 42. Contact 43 in this instance may be mounted in a conventional magnetically operated switch 41 such as provided with spring loaded leaves to maintain the contacts normally open or closed, mercury wetted or dry. The switch preferably may be mounted in a vertical plane of the distributor cap.

In FIG. 4 the same system is applied with reference to FIG. 2. Here the lead 8 is switched to ground by contacts 43. The small permanent magnet mounted on the end of arm 7 and rotating in close proximity in the air gap magnetically closes a set of contacts at 3, 4, etc., at the proper time to fire each respective cylinder. In the system of FIGS. 3 and 4, the contact speed, at which the magnet rotates, determines the pull and the fall-out of the switch-contacts. This provides a novel method and structure for automatically advancing the timing by utilizing the variability of the rotating speed.

It is within the scope of this invention to employ instead of the magnetic switch 41 and magnet 40 any other conventional type switch, actuated magnetically or otherwise by any other rotational or centrifugal principle.

As numerous changes in shape, form and construction will readily occur to those skilled in the art, after a study of the foregoing description, such description should be taken in an illustrative rather than a limiting sense; and it is my desire and intention to reserve all modifications within the scope of the subjoined claims.

Having fully disclosed the invention, what I claim and desire to secure by Letters Patent is:

1. In an ignition device for an internal combustion engine, a metallic shell, an arcing device secured in one end of said shell and including an electrode base grounded to said shell and a central insulated electrode forming a spark gap with said base, a condenser, a resistor, a transistor switch, and a transformer including primary and secondary windings, all fixed within the other end of said shell, one terminal each of said windings and condenser being grounded to said shell, first and second insulated contacts fixed with said shell, said first contact being connected with one terminal of said resistor, the remaining terminals of said condenser and resistor being connected with said switch, said second contact being connected with the triggering element of said switch, and means connecting the remaining terminal of said secondary winding with said insulated electrode.

2. An ignition system for a multi-cylinder internal combustion engine, including a device as recited in claim 1, a breaker arm mounted for rotation in timed relation with rotation of the engine crankshaft, a fixed contact

5

engaged by said arm, once for each rotation thereof, a circuit including a battery, a switch, said arm, fixed contact and said second contact of said shell, in series, and a lead connecting one terminal of said battery with said first contact.

3. In a high voltage electric ignition device for an internal combustion engine, a metallic shell adapted to receive and make electrical contact with the grounded base of an electric spark plug, a transformer, a switching transistor, a condenser and a resistor, all fixed within said shell, one terminal each of the primary and secondary windings of said transformer and said condenser being grounded to said shell, the other terminals of said primary winding and said condenser being electrically connected with first and second terminals of said transistor, respectively, one terminal of said resistor being connected with said other terminal of the condenser, first and second discrete means for electrically connecting, respectively, the remaining terminal of said resistor and the triggering terminal of said transistor, with respective discrete leads extending externally from said shell, and a contact with said shell for connecting the insulated electrode of said spark plug with the remaining terminal of said secondary winding, on insertion of the spark plug into said shell.

4. In an ignition device for an internal combustion engine, a metallic shell, an arcing device fixed with a first end of said shell and having an electrode base grounded thereto and an insulated electrode forming a spark gap

6

with said base, a condenser, a resistor and a transformer, including primary and secondary windings, all fixed with the second end of said shell, one terminal each of said secondary winding and said condenser being grounded to said shell, first and second insulated contacts fixed with said shell, one terminal of said resistor being connected with said first contact, means in said shell and connected with the other terminal of said resistor and said second contact for discharging said condenser through the primary winding of said transformer, and an electrical connection between said insulated electrode and the remaining terminal of said secondary winding, said last-mentioned means being a transistor switching device having its triggering terminal connected with said second contact.

References Cited by the Examiner

UNITED STATES PATENTS

2,467,725	4/1949	Berkey et al.	123—148
2,819,428	1/1958	Bowlus et al.	315—213
2,852,588	9/1958	Hartman	315—209
2,929,896	3/1960	Ronning	200—19
3,030,549	4/1962	Johnston	315—209
3,045,148	7/1962	McNulty et al.	315—209

GEORGE N. WESTBY, *Primary Examiner*.

ARTHUR GAUSS, *Examiner*.