

April 3, 1962

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3,028,524

IGNITION SYSTEM FOR INTERNAL COMBUSTION ENGINE

Filed Feb. 15, 1960

2 Sheets-Sheet 1

Fig. 1.

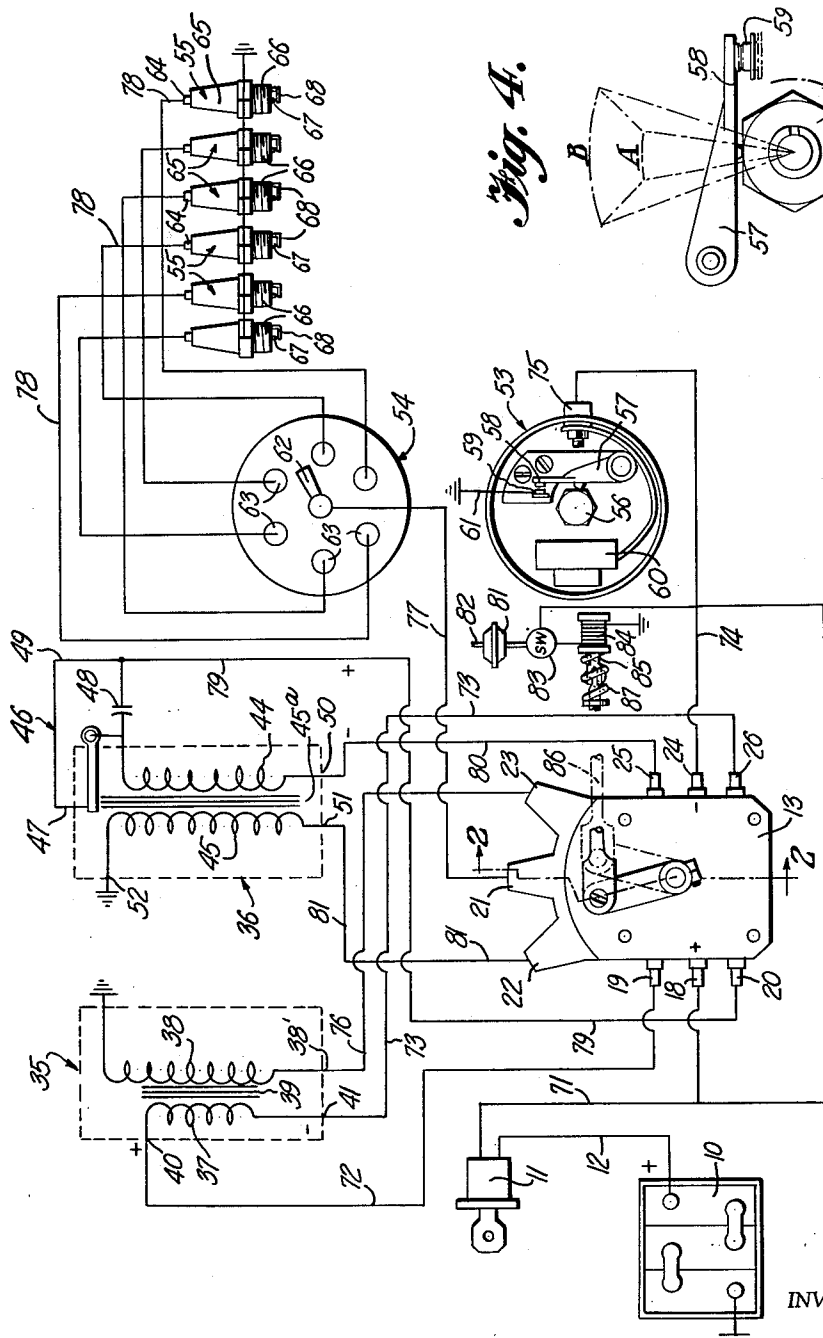
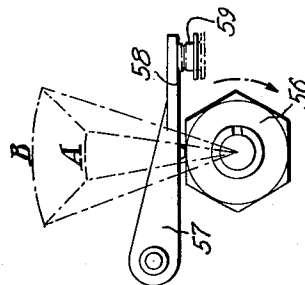


Fig. 4.



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Fig. 3.

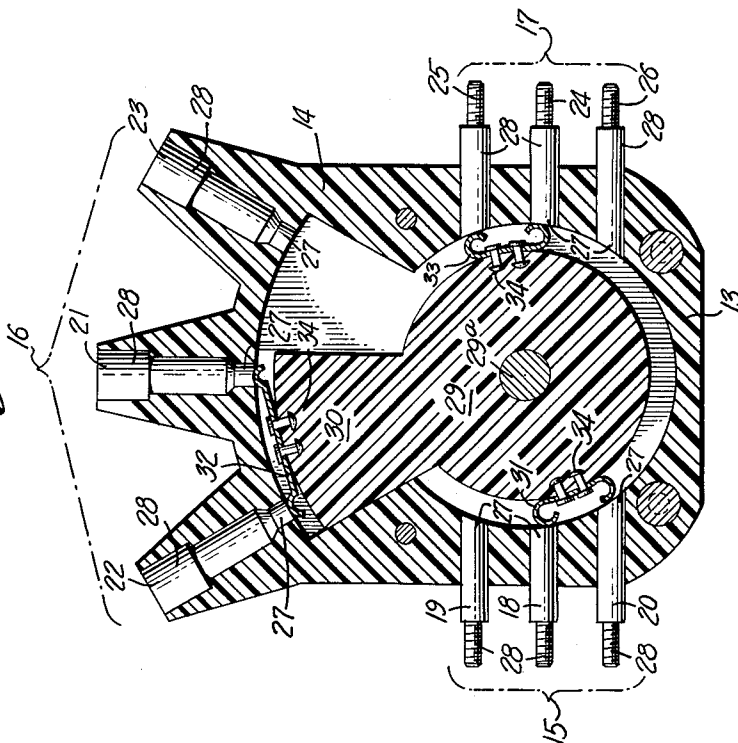
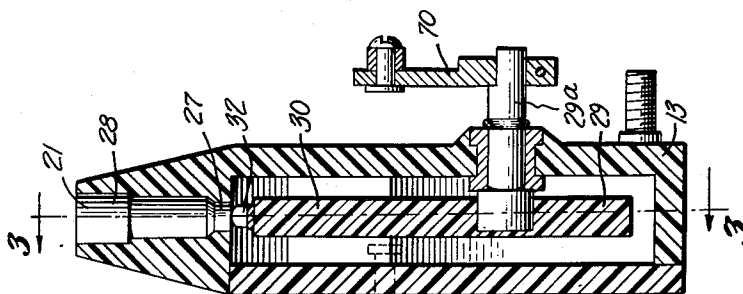


Fig. 2.



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IGNITION SYSTEM FOR INTERNAL COMBUSTION ENGINE

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6 Claims. (Cl. 315-214)

This present invention relates to ignition systems for internal combustion engines, and more particularly to a dual ignition system which may be alternatively brought into use as required for optimum operation of the engine.

With the ordinary ignition system consisting of a battery, contact breaker and condenser, high voltage induction coil distributor and spark plugs, the spark is supplied to the spark plug for only a brief period of time during which the breaker points are apart. This is sufficient only to initiate the burning of the fuel and not to continue to influence the ignition of the fuel until all of the fuel has been burned. The burning of the fuel is not instantaneous, and requires time, although the time is short. Consequently, the fuel is not completely burned where ordinary ignition systems are used and a great deal of potential power is lost. Also, where there is not complete combustion, harmful by-products are formed by the incomplete combustion, and foul the engine.

Also, electronic ignition systems employing a transistor are known. Such a system is described in "El Automovil Americano" (American Automobile) magazine of September 1958, entitled "Electronic Ignition Employing Transistors." Such a system is capable of supplying a prolonged spark, instead of a momentary spark, as in the ordinary type of ignition system.

Dual ignition systems are well known in the prior art and such systems, and switching from one to the other automatically or by the user's choice, is also known.

The disadvantages of the known dual ignition systems is that each system is essentially the counterpart of the other and one system is substantially no more than a spare for the other.

Consequently, it is an object of the present invention to provide a dual ignition system for internal combustion engines, wherein one system operates on the principle of the well-known ordinary ignition system using a simple ignition coil, and the other system operates with a self induction coil of the vibrator type.

A further object of the present invention is to provide the above system by adapting the well known electro mechanical elements of the ordinary ignition system for use in the system, having a self induction coil, so that they may be used interchangeably in the two systems.

Still another object of the present invention is to provide a means for manually and automatically switching from one system to the other.

A further object of the present invention is to provide a means for producing a sustained spark for a longer time than the instantaneous opening of the breaker points in an ordinary ignition system, to obtain better combustion in the cylinders of the engine.

Another object of the present invention is to provide an automatic means for changing from one system to the other, according to the requirements of the engine.

Other objects and advantages of the present invention will become apparent to those skilled in the art, from the following description when read in conjunction with the accompanying drawings wherein:

FIGURE 1 is a diagrammatic schematic view of the components of the dual system ignition for an internal combustion engine in accordance with the present invention, some of the parts being shown in plan or elevation, and others being schematically shown, and some of

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the parts being enlarged out of proportion, for clarity of illustration;

FIGURE 2 is an enlarged vertical transverse sectional view of the switch shown in FIGURE 1;

FIGURE 3 is a vertical longitudinal sectional view taken on the line 3-3 of FIGURE 2; and

FIGURE 4 is a partial plan view of the cam, breaker arm and points of the current breaker of an ignition system, showing the lengths of time the points are open for different cam angle settings.

The present invention will be described with respect to application to an automobile. However, it will be realized that the present invention is equally applicable to internal combustion engines of other vehicles or stationary internal combustion engines.

Adverting now to the drawing, and more particularly FIGURE 1, there is shown diagrammatically applicant's alternately selective ignition system. A battery 10 supplies current for both systems through a switch 11, such as a lock type switch used on automobiles, the battery being grounded to the automobile frame, or engine, and the positive side of the battery being connected to the switch 11 by means of a cable 12. A selector switch 13 is provided for directing the current through one system or the other, either manually or automatically. The selector switch 13 is a triple pole double throw switch having leaf spring bridge type contacts to connect two of the three poles on each throw. As best seen in FIGURE 3, the selector switch 13 has a casing 14, having three groups 15, 16, 17 of poles extending therethrough, the group 15 being the input group and having the poles 18, 19 and 20, the group 16 being the high tension group and having the poles 21, 22 and 23, and the group 17 being the regulating group and having the poles 24, 25 and 26. Each of the poles has an inwardly extending end terminating in a switch contact point 27 and a connector end 28 extending outwardly from the casing.

Mounted on a shaft 29a within the casing is a rotor 29 having a key portion 30. The rotor 29 is swingably revolvable through a small arc, and the key portion 30 serves two purposes. It serves as a limit stop for the revolution of the rotor from one limit to the other of the circular traverse of the rotor, and it spaces the poles for the high tension group of poles 16 away from the low tension groups of poles 15 and 17.

The casing 14 and the rotor 29 are made of electrical non-conductor material such as hard rubber or Bakelite, and the poles are made of an electrical conducting material such as copper or brass, and may be tipped with silver.

Mounted on the rotor 29 are two bridge type switch elements 31 and 33, and a third bridge type switch element 32 is mounted on the end of the key portion 30. Each of the switch elements 31, 32, and 33 are made of a springy electrical conductor material such as spring brass, and each makes contact between two adjacent poles of the groups of poles. Thus, switch element 31 makes contact between the poles 18 and 20 when the rotor 29 is in one position and makes contact between the poles 18 and 19 when the rotor 29 is moved to its other position. Switch element 33 makes contact between poles 24 and 25 in one position and between 24 and 26 in the other position, and switch element 32 makes contact between poles 21 and 22 or between poles 21 and 23. The switch elements 31, 32 and 33 are attached to the rotor 29 by any suitable means, such as the rivets 34.

An ignition coil 35 is provided for one of the alternative ignition systems, and the self induction coil 36 is provided for the other. The coil 35 is the well known ignition coil commonly used for automobile ignition systems and comprises a primary coil 37 and a secondary coil 38 mounted on a suitable core 39. The ignition coil is mounted in a casing having suitable terminals 40, 41

for the primary coil, and terminal 38' and ground connection 43 for the secondary coil.

The self induction coil 36 is of the well known type of vibratory self induction coils and comprises a primary coil 44, secondary coil 45 and core 45a. A vibrator 46 having the armature 47 is mounted in the primary coil circuit in well known manner. A condenser 48 is shunted across the vibrator to reduce sparking. The primary and secondary coils, vibrator and condenser are mounted in a casing provided with the terminals 49, 50 for the primary coil and terminal 51, and ground connection 52 for the secondary coil.

To complete the dual ignition systems, the well known interrupter 53 and distributor 54 are provided, the distributor 54 being timed with the motor to fire the spark plugs 55 in the proper order.

The interrupter 53 comprises a cam 56, interrupter arm 57, points 58, 59 and condenser 60 shunted across the points, and ground 61. While the interrupter 53 is a well known element in ignition systems and will function in its usual manner in one of the present dual systems, it will function in a different manner soon to be described for the other system.

The distributor 54 comprises the distributor arm 62 and contacts 63, the distributor arm 62 and cam 56 being timed with the engine in well known manner.

The spark plugs 55 are of the well known type, having a terminal 64, insulator 65, base 66 and points 67, 68, the latter point 68 being grounded to the base 66 and engine, as indicated at 69.

The common ignition system provides easier starting and operation under about 18 miles per hour for an average automobile. This speed varies for the type of vehicle and motor, and will be referred to hereafter as low speed operation.

For low speed operation, the rotor 29 of switch 13 is manually moved to the right, as seen in FIGURE 3, by means of leverage (not shown) attached to the operator 70 and extended to the dashboard of the automobile or other convenient location for the driver, or the rotor 29 may be automatically operated by the requirements of the motor, by means soon to be described. When the key of switch 11 is turned on, current flows from the battery 10 through conductor 12, switch 11, conductor 71, pole 18 of selector switch 13, across the bridging element 31, pole 19, conductor wire 72 to terminal 40 of ignition coil 35, through the primary coil 37, terminal 41, conductor 73, pole 26 of selector switch 13, bridge element 33, pole 24, conductor 74, terminal 75 of the interrupter 53, through the interrupter arm 57 and points 58, 59 to ground 61. When the points 58, 59 are closed, the flux in core 39 builds up, and when the points are opened, the flux collapses, inducing a high voltage in coil 38. The high voltage flows through coil 38, terminal 38', conductor 76, pole 23 of selector switch 13, bridge element 32, pole 21, conductor 77, distributor arm 62, one of the contacts 63, associated conductor 78, spark plug terminal 64, and arcs across the points 67, 68 to fire the charge in the cylinder of the automobile.

For high speed operation, the rotor 29 is revolved to the left position, as seen in FIGURE 3, and current flows from the switch 11 through conductor 71, pole 18, bridge member 31, pole 20, conductor 79, terminal 49, vibrator 46, primary coil 44, terminal 50, conductor 80, pole 25, bridge 33, pole 24, conductor 74, terminal 75 of interrupter 53, arm 57, points 58, 59 to ground 61. Self induction coil 36 provides a continuous high voltage current as long as current is supplied to the primary, as distinguished from ignition coil 35 which provides high voltage current only upon collapse of the magnetic flux in core 39. Therefore, interrupter 53 allows current to pass through primary coil 44 only when points 58, 59 are in contact, and cuts off the current to primary coil 44 when points 58, 59 are separated. When the current ceases to flow in primary coil 44, it also ceases to flow in

secondary coil 45. Therefore, interrupter 53 is a regulating or metering switch in the circuit for self-induction coil 36.

When the points 58, 59 are closed, high voltage current flows through secondary coil 45, terminal 51, conductor 81, pole 22, bridge 32, pole 21, conductor 77, distributor arm 62, one of the contacts 63, conductor 78, spark plug terminal 64 and arcs across points 67, 68 to fire the mixture in the cylinder of the engine. As illustrated in FIGURE 4, the cam angle of the interrupter may be set for building up current in the core for different lengths of time, A representing a small cam angle and B representing a larger cam angle, however the speed of the engine reduces the amount of build-up for an ordinary ignition coil.

In the magazine "El Automovil Americano" (American Automobile) of September 1958, an article "Electronic Ignition Employing Transistors" described the use and advantages of a system employing a continuous spark generator. However, the present invention provides a better means of regulating the spark than in the reference article.

The system using the self induction coil may conveniently be termed "a full ignition system." In this full ignition system the spark is applied to the gas mixture until propagation of the ignition is complete and not merely initiated as in the case of the ignition coil. Also, by using the low of the interrupter cam for gating the spark instead of the high of the cam, the spark is automatically advanced without in any way mechanically changing the timing of the engine.

The maximum efficiency of the ordinary ignition system is achieved at slow speeds and under heavy loads, whereas, the maximum efficiency of the herein described full ignition system is achieved at high speeds and light loads. To automatically obtain the maximum benefit of each system, the selector switch arm 70 may be coupled, for instance, with a diaphragm operated valve connected with the manifold so that when the manifold pressure drops below a fixed pressure, the ordinary ignition system will be switched on, and when the manifold pressure increases above a certain pressure, the full ignition system is switched on. As an example of a means by which this may be accomplished, there is diagrammed a vacuum operated diaphragm valve 81 having an inlet 82 connected to the manifold (not shown) of the automobile. This diaphragm valve 81 operates a switch 83, which energizes a solenoid 84, the armature 85 of which is connected by leverage 86 to the operator arm 70 of the selector switch 13. When the solenoid 84 is energized, it moves the selector switch to operate the ordinary ignition system, and when it is de-energized the compression spring 87 biases the selector switch to operate the full ignition system.

The present invention may be incorporated in the ignition system of an automobile by simply adding a self induction coil 36, a selector switch 13, solenoid 84, and the associated vacuum operated diaphragm valve and necessary circuitry.

By use of the full ignition system of the present invention, carbon formation in the engine is eliminated, greater efficiency is obtained, and dilution of the crankcase oil by unburned gasoline is also eliminated.

While there has been disclosed in the foregoing description a practical embodiment of the efficient ignition system in accordance with the present invention, it will be understood by those skilled in the art that variations in the implementation of the concept of the invention are within the purview and scope of the invention.

What is claimed is:

1. In an ignition system for an internal combustion engine including a plurality of spark plugs, a current source, a distributor having a plurality of stationary contacts respectively connected to the spark plugs and a rotary arm serially engaging the contacts for supplying

current to the spark plugs, and a cam-controlled interrupter having a pair of contacts and a cam driven in timed relation with the engine for closing and opening said contacts, the improvement comprising circuit means for supplying current to the spark plugs through said distributor during high-speed operation of the engine comprising an induction coil having a secondary winding and a primary winding circuit including a primary winding and vibrator means for alternately making and breaking the primary winding circuit responsive to variation in the magnetic field produced by said primary winding, means connecting said primary winding circuit in series circuit relation through said cam-controlled interrupter contacts with said current source, and means connecting said secondary winding to said distributor for supplying current to said distributor arm for supplying current to said spark plugs producing a sustained electric arc between the points of each spark plug connected therewith through the distributor for the duration of the period said interrupter contacts are closed.

2. In an ignition system for an internal combustion engine including a plurality of spark plugs, a current source, a distributor having a plurality of stationary contacts respectively connected to the spark plugs and a rotary arm serially engaging the contacts for supplying current to the spark plugs, and a cam-controlled interrupter having a pair of contacts and a cam driven in timed relation with the engine for closing and opening said contacts, circuit means for supplying current to the spark plugs through said distributor during high-speed operation of the engine to provide a sustained electric arc at each spark plug connected therewith comprising an induction coil having a secondary coil, a primary coil, and vibrator contacts in series with said primary coil for alternately making and breaking a supply circuit including said primary coil responsive to collapse and generation of the magnetic field about said primary coil, means connecting said primary coil and vibrator contacts in series circuit relation through said cam-controlled interrupter contacts with said current source, and means connecting said secondary coil to said distributor arm for supplying current thereto, said induction coil, interrupter, distributor and current source coacting to supply current producing a sustained electric arc to each spark plug interconnected with said secondary coil for the duration of the period said interrupter contacts are closed.

3. A dual ignition system for an internal combustion engine comprising a plurality of spark plugs, a current source, a distributor having a plurality of stationary contacts respectively connected to the spark plugs and a rotary arm for serially engaging the contacts to supply current to the spark plugs, a cam-controlled interrupter having a pair of contacts and a cam driven in timed relation with the engine for closing and opening said contacts, a first ignition means for starting and low speed operation including an ignition coil having primary and secondary windings, and switch means for intercoupling said interrupter in series circuit relation with the primary winding of said ignition coil and said distributor with the secondary winding thereof to generate high tension current surges responsive to opening of said interrupter contacts and apply the same through said distributor to the spark plugs, and a second ignition means for high-speed operation comprising an induction coil having a secondary winding and a primary winding circuit including a primary winding and vibrator contacts for alternately making and breaking the primary winding circuit responsive to variations in the magnetic field produced by said primary winding, said switch means including means for disconnecting said first ignition means from said interrupter and distributor and for connecting said secondary winding of said induction coil with said distributor and said primary winding circuit in series circuit relation with said interrupter, said induction coil being operative to supply current producing a sustained electric arc to the

spark plugs connected therewith through said distributor for the duration of the period said interrupter contacts are closed.

4. In a dual ignition system for an internal combustion engine the combination recited in claim 3 including engine suction operated means intercoupled with said switch means operable to change the position thereof responsive to variations in engine pressure conditions to render said first ignition means or said second ignition means operative in accordance with the engine operating speed.

5. In an ignition system for internal combustion engines, the improvement comprising, in combination, a source of electrical power, an ignition coil, a self-induction coil, a breaker point interrupter coupled with the timing of the engine, a spark plug mounted in each cylinder of the engine, a distributor having a distributor arm coupled with the timing of the engine and contacts coupled with the spark plugs of the engine, and a selector switch, said selector switch having a casing through which poles may be mounted to extend from outside to the inside thereof, a group of three input poles radially mounted in said casing, a group of three regulating poles radially mounted in said casing, a group of three high tension poles mounted in said casing, each of said groups of poles having an intermediate pole and poles adjacent on each side thereof, circuit means coupling said source of electrical power to said intermediate pole of said input group of poles, circuit means coupling one of said adjacent poles of the input group to the primary of the ignition coil, circuit means coupling the other adjacent pole of the input group to the primary of the self-induction coil, circuit means coupling the intermediate pole of said regulating group of poles to the timed interrupter, circuit means coupling one of said adjacent poles of the regulating group in the primary circuit of the ignition coil to cause collapse of the magnetic flux in the core of said ignition coil when the points thereof open, circuit means coupling the other of said adjacent poles of the regulating group in the primary circuit of the self-induction coil to provide a switch-like gate for the operation of the self-induction coil, causing the flow of high tension current to the spark plugs during all of the time the interrupter points remain closed, circuit means coupling said intermediate pole of said high tension group of poles with the distributor arm of said distributor, circuit means coupling one of said adjacent poles of the high tension group with the secondary of the ignition coil, circuit means coupling the other adjacent pole of the high tension group with the secondary of the self-induction coil, a shaft axially mounted within said selector switch casing and extending outside thereof, a rotor mounted on said shaft, bridging contact elements mounted on said rotor adjacent each of said groups of poles, each of said bridging contact elements extending between said intermediate pole and one of said adjacent poles, and an operator arm mounted on the outer extension of said shaft to swing said rotor in one direction to establish a bridging contact between each of said intermediate poles and one of said adjacent poles and in the other direction to establish a bridging contact between each of said intermediate poles and the other of said adjacent poles.

6. In an ignition system for an internal combustion engine as claimed in claim 5, means coupled between the manifold of said engine and the operator arm of said selector switch to automatically switch the ignition system from the ignition coil to the self-induction coil.

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