May 1, 1962 J. G. RUCKELSHAUS 3,032,683

IGNITION SYSTEM

Filed Jan. 6, 1959 3 Sheets-Sheet 1

Fig. 1

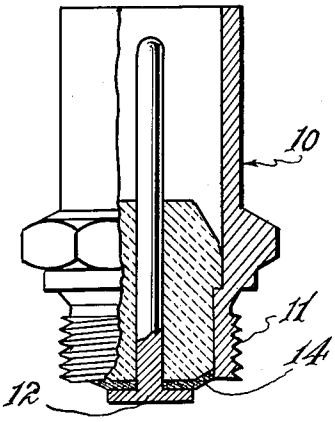


Fig. 2

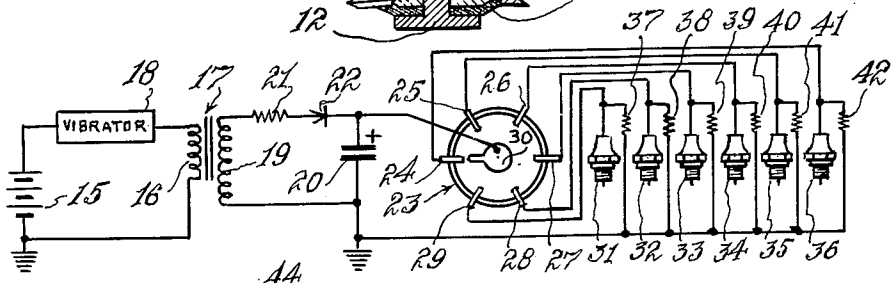


Fig. 3

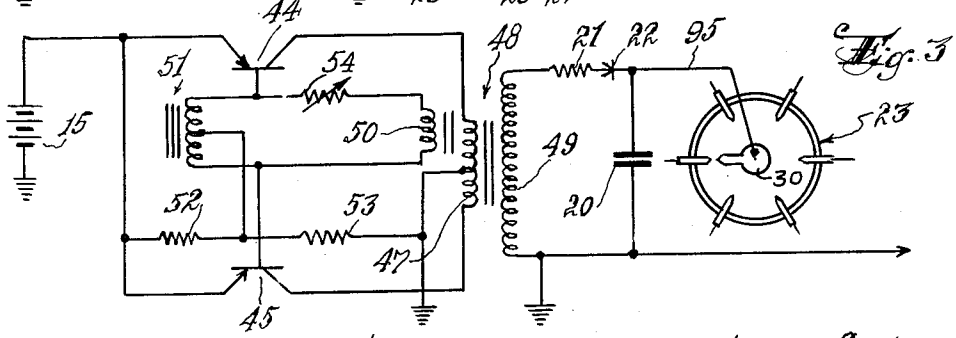


Fig. 5

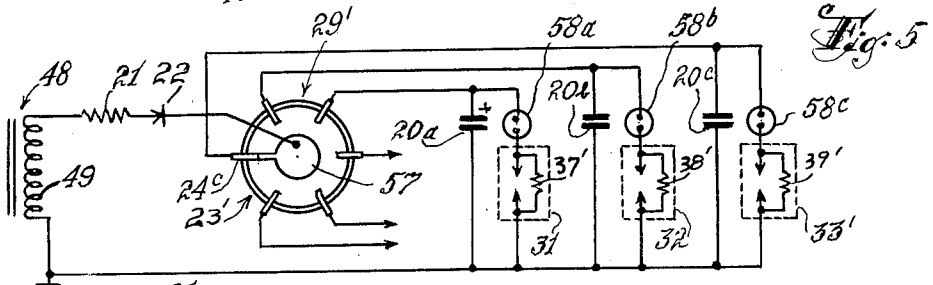
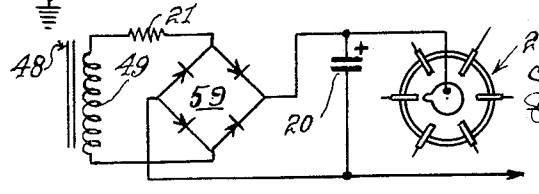


Fig. 4



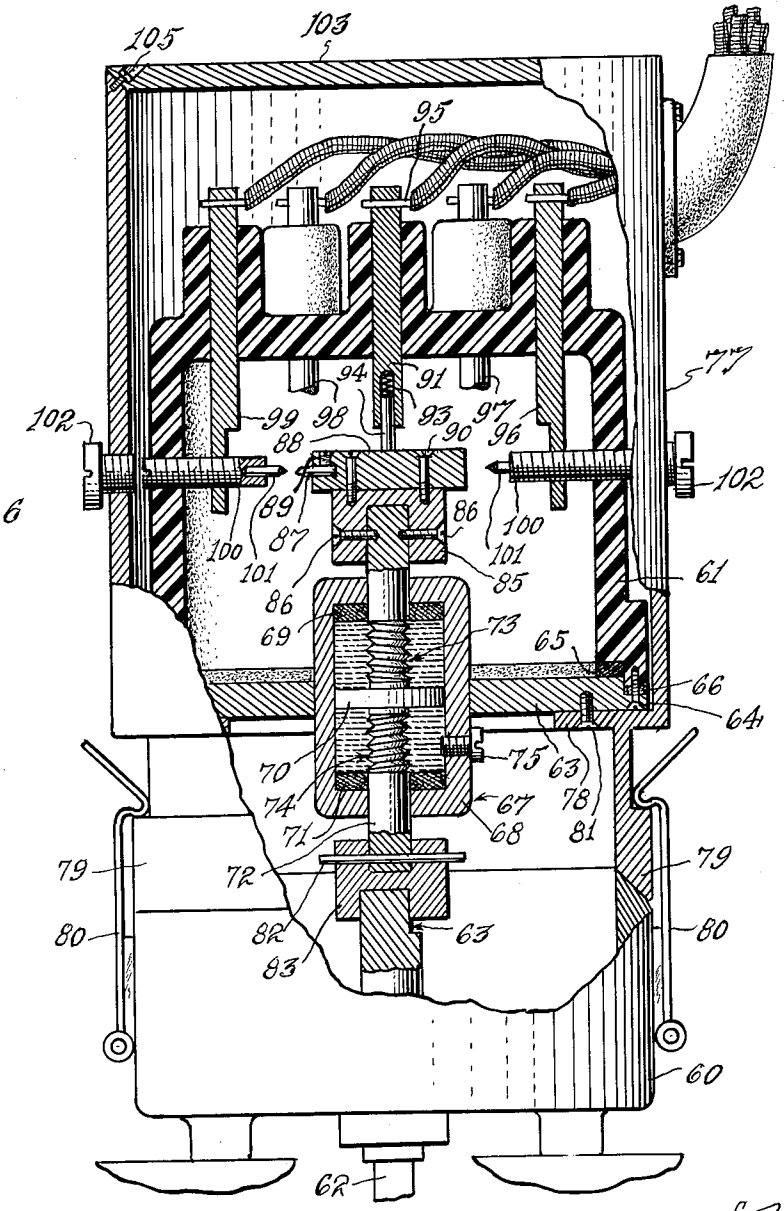
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May 1, 1962 J. G. RUCKELSHAUS 3,032,683

IGNITION SYSTEM

Filed Jan. 6, 1959 3 Sheets-Sheet 2

Fig. 6



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IGNITION SYSTEM

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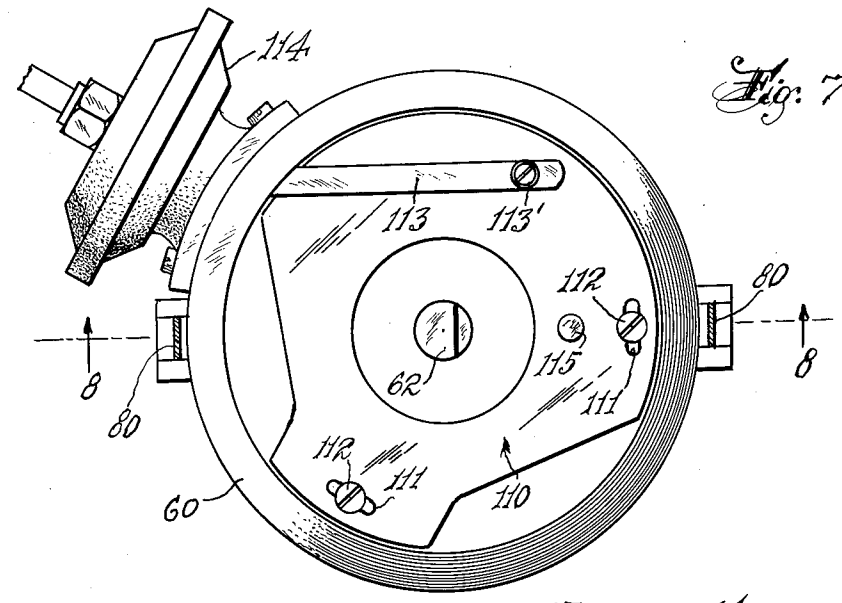


Fig. 7

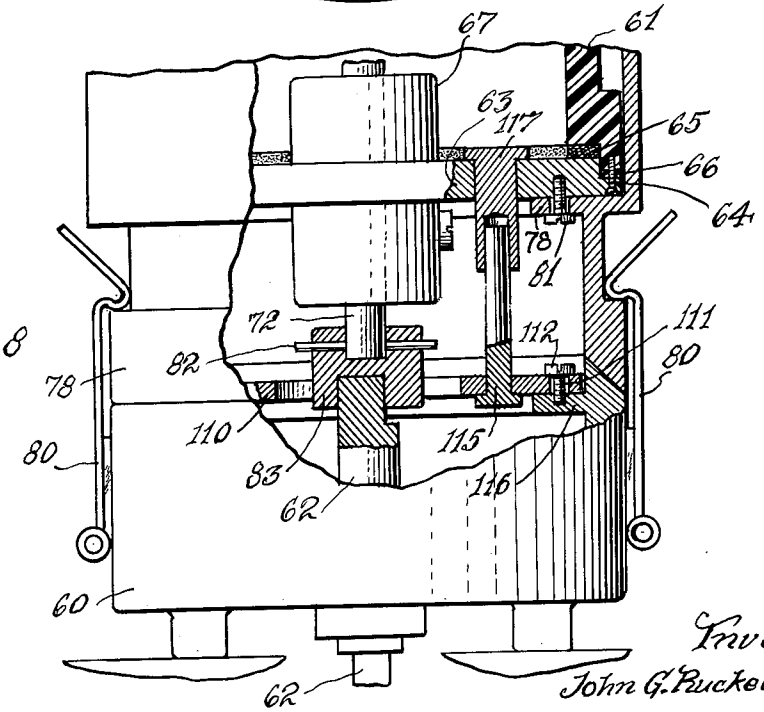


Fig. 8

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3,032,683

IGNITION SYSTEM

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Filed Jan. 6, 1959, Ser. No. 785,173
6 Claims. (Cl. 315—180)

This invention relates to an ignition system utilized in internal combustion engines and more particularly to a novel, low voltage system for distributing power to surface gap ignition plugs in a multi-cylinder engine.

Present ignition systems utilized in multi-cylinder internal combustion engines include a spark plug associated with each engine cylinder. Each spark plug has a pair of spaced electrodes electrically insulated from each other. A high voltage is developed from a storage battery by means of an electro-mechanical vibrator and step-up transformer and such voltage is applied across the electrodes of the individual spark plugs in proper firing sequence by a distributor having a rotating contact maintained in timed relation to the motor speed. It is known that the conventional ignition system suffers numerous practical disadvantages in addition to the high voltage requirement such as, for example, deterioration of the distributor contacts, the generation of interfering radio-frequency waves, deterioration of the spark plug electrodes, and loss of efficiency due to the accumulation of carbon on the spark plug electrodes.

In an ignition system having conventional spark plugs, a high voltage, of the order of 20,000 volts, is required to produce a hot spark across the electrodes to thereby ignite the compressed gasoline-air mixture within the engine cylinder. Although the voltage requirement is high, the magnitude of the current flowing across the electrode gap during the spark period is relatively low.

There has recently been developed a surface gap plug, or igniter, which differs fundamentally from the conventional spark plug in that there is provided between the electrodes a semi-conductor material having an initial resistance of 30,000–500,000 ohms. When a voltage of 150–400 volts is applied across the electrodes of a surface gap igniter the resistance of the semi-conductor material decreases to a very low value permitting a current of several hunderd amperes to flow between rather than jump across the electrodes.

The advantages of the surface gap igniter are numerous as, for example, such igniter will operate in extreme moisture (even immersed in water), it provides a tremendously hot spark which promotes easier engine starting at low temperature, permits the use of more economical gasoline, and it is not adversely affected by the accumulation of carbon deposits on the electrodes, thereby resulting in a longer, uniform operating life.

To date, the surface gap igniter has been employed only in single cylinder engines, such as jet engines, where the ignition system is required only to start the engine. It has not been utilized in multi-cylinder engines because of the impracticability of switching, or distributing, a current in excess of 200 amperes at voltages up to 2,000 voltages without excessive arcing and disintegration of the distributor contacts.

An object of this invention is the provision of an efficient, economical system for the distribution of power to surface gap ignition plugs in a multi-cylinder engine.

An object of this invention is the provision of a low voltage ignition system for actuating a multi-cylinder engine, which system operates at relatively low voltages, does not require an electro-mechanical vibrator, does not include mechanical contact points, and produces a minimum of radio interference.

An object of this invention is the provision of a rotary

gap distributor for sequentially distributing electrical energy to a plurality of surface gap igniters.

An object of this invention is the provision of a novel distributor adapted for converting a conventional distributor for use in an ignition system utilizing surface gap igniters.

These and other objects and advantages will become apparent from the following detailed description when taken with the accompanying drawings illustrating several embodiments of the invention.

In the drawings wherein like reference characters denote like parts in the several views:

FIGURE 1 is an elevation view of a surface gap igniter, with parts shown in cross-section;

FIGURE 2 is a schematic diagram of an ignition system made in accordance with this invention;

FIGURE 3 is a diagram showing a transistor power supply for energizing the ignition system;

FIGURE 4 is a fragmentary diagram showing a full wave rectifier for rectifying the output voltage of the high voltage transformer;

FIGURE 5 is a fragmentary diagram showing another embodiment of the invention;

FIGURE 6 is an elevation view of my novel distributor with portions of the housing broken away and with parts shown in cross-section;

FIGURE 7 is a fragmentary, plan view, looking down into the distributor base and showing the essential parts of a conventional distributor for automatic spark advancement by means of conventional vacuum bellows; and

FIGURE 8 is essentially, a cross-sectional view taken along the line **8—8** of FIGURE 7 and with the distributor top attached to the distributor base, portions of the housings being broken away.

Referring to FIGURE 1, the surface gap igniter, or spark plug, comprises a metal shell **10** provided with a lower, threaded end **11** adapted to be threaded into a suitable hole provided in the wall of an engine cylinder. The threaded end **11** constitutes the outer electrode which is grounded to the engine and the other electrode comprises an axially-disposed, headed rod **12** that extends upwardly through an insulator **13**, which may be glass, ceramic, or etc. Extending along the gap between the electrodes **11** and **12**, at the lower ends thereof, is a semi-conductor material **14**, which is fired on to the lower end of the ceramic and which, by reason of the concentric disposition of the electrodes, takes the form of a washer. Intimate contact between the semi-conductor material and the electrodes is desirable although not required for efficient ignition. The initial resistance of the semi-conductor material, taken radially between the electrodes, may vary from 30,000 to 500,000 ohms and this resistance may increase or decrease after the igniter has been used, depending upon the atmosphere within the combustion chamber of the cylinder. With a voltage of between 150–400 volts applied across the electrodes **10** and **12** the resistance of the semi-conductor material decreases tremendously, whereby a current having a magnitude of hundreds of amperes flows along the surface of the semi-conductor material from the center electrode to the outer electrode, thereby producing a tremendously-hot spark to ignite the gasoline-air mixture within the combustion chamber. It is interesting to note that the igniter will fire at 150–400 volts, regardless of the compression ratio of the engine in which the igniter is used.

Surface gap igniters are well known, but such devices are generally produced with a flush surface between the electrodes and the semi-conductor material. I prefer to construct the igniter so that the end of the inner electrode extends somewhat beyond the lower surface of the outer

electrode whereby the semi-conductor material forms a truncated cone, as specifically shown in FIGURE 1. In an igniter so constructed, the inner electrode tip and the semi-conductor material extends substantially into the gasoline-air mixture and I have found by actual tests such igniters provide instant and positive ignition at high engine speeds.

Reference is now made to FIGURE 2 which is a diagrammatic showing of my novel ignition system as applied to a six (6) cylinder engine. A conventional 6 or 12 volt storage battery **15** is connected to the primary winding **16** of a step-up transformer **17** through a vibrator or chopper **18**, the battery being grounded in accordance with conventional practice. The vibrator may be of any standard construction and its function is to apply the battery voltage across the transformer winding in a series of pulses so as to produce in the secondary winding **19** a periodically-varying voltage of increased level, as is well known. In this particular application, I prefer to make the transformer turns ratio such that the voltage developed in the secondary winding is approximately 2,000 volts. The output voltage of the transformer is applied across a capacitor **20**, through a current-limiting resistor **21** and a rectifier **22**. With the rectifier conducting in the indicated direction, the capacitor will become charged as indicated by the polarity marking during each half cycle of the transformer output voltage.

The reference numeral **23** identifies the distributor comprising a sealed chamber with six (6) fixed electrodes or points, **24–29**, extending therethrough and a rotatable electrode **30**. The rotatable electrode is secured to the distributor shaft whereby such electrode rotates throughout 360 degrees in precise, timed relation with the engine speed. The construction of the distributor will be described in detail hereinbelow, with specific reference to FIGURE 6. Suffice to say, at this point, that the rotatable electrode **30** has a pointed tip spaced from the pointed, inner tips of the fixed electrodes thereby forming what may be termed a rotary gap.

In FIGURE 2, there are shown six (6) surface gap igniters **31–36** of the general construction shown in FIGURE 1. When installed in a six cylinder engine, the outer electrodes of the igniters are grounded and there exists a resistance of 30,000 to 500,000 ohms between the inner and outer electrodes of each igniter as represented in the drawing by the resistances **37–42**. Because of this resistance, an air gap is required between the igniter and the capacitor **20**, so that the latter can be instantly and fully charged. Assuming a fully charged capacitor, it will be apparent that as the distance between the distributor rotatable electrode **30** and, for example, the fixed electrode **24**, is reduced to a minimum, pre-set air gap, the voltage existing across the capacitor will ionize the gap between the aligned distributor electrodes and the capacitor will discharge through a series circuit consisting of such air gap, the igniter electrodes and the ground return to the other side of the capacitor. If the frequency of the rectified voltage applied across the capacitor exceeds the time during which the rotatable distributor electrode **30** moves between adjacent fixed electrodes, the capacitor will become substantially fully charged during the time interval that the rotatable electrode rotates from one to the next fixed electrode. By applying approximately 2,000 volts across the capacitor during the charging period, the voltage level to which the capacitor becomes charged, during even minute charging periods, will at least exceed the minimum voltage required to ionize the gap between aligned distributor electrodes and result in a voltage applied across the igniter electrodes to cause positive firing. Consequently, upon continuous rotation of the rotatable electrode **30**, current will flow from the rotatable electrode successively to each of the fixed electrodes and through and over the surface of the semi-conductor material between the electrodes of the associated igniter. Those skilled in this art will understand that the individual igniters are connected to the fixed contacts of the distributor so as to obtain the correct firing order. Also, although I have shown, in FIGURE 2, an ignition system for a six cylinder engine, it is apparent that the system may be used on an engine having any number of cylinders in which instance the number of fixed contacts equally spaced in the distributor will correspond to the number of igniters and the frequency of the voltage applied to the capacitor will be selected to assure full charging of the capacitor at maximum engine speed.

The energy discharged by the capacitor **20** is very high for ignition use, being of the order of 0.2 joule and running as high as 5.0 joules. The current during the discharge period can be as high as a few thousand amperes. This current, at 2,000 volts, produces a very serious switching problem, especially in confined space, as in the cap of a distributor, and has been the main reason why surface gap igniters heretofore have not been adapted for use in multi-cylinder engines. I have overcome this problem by providing a rotatable gap disposed within a sealed chamber so as to exclude oxygen and other gases which promote and enhance the burning of electrical contacts breaking heavy currents at high voltages.

There is still another reason why the switching problem is not as serious as in prior art circuits. Conductor **95** and other conductors coupled to the capacitor **20** and ground include some small resistance values and some inductance. When the capacitor first discharges through the gap and ignitor, the current builds up to a maximum value and then is reduced to a negligible amount as the capacitor is fully discharged. Because of the inductance in the wiring, the current is made slightly oscillatory and the current is reversed by a small amount, charging the capacitor **20** in an opposite direction. The resistance in the conductors, gap, and igniter reduce the oscillatory voltage to a very small amount, the net result being a steep reduction in igniter current to zero before the distributor arm leaves the stator electrode. This action reduces spark deterioration and permits higher engine speeds.

FIGURE 3 illustrates a transistor inverter, or power supply for energizing my ignition system. The two transistors **44**, **45** operate as switches, one being on while the other is off. Assume that the transistor **44** is conducting and the transistor **45** is blocked. This effectively connects the battery **15** across the upper half of the center-tapped primary winding **47** of the transformer **48**, thereby inducing a voltage in the secondary winding **49** and in the auxiliary winding **50**. At the instant that transistor **44** starts to conduct, the voltages in the transformer windings will assume a maximum voltage level. This condition will continue to exist until the core of the saturable reactor **51** begins to saturate at which time the rate of change of flux will decrease. During the same time interval, the induced voltages first decrease in value and then become zero. This decreases and then removes the base drive to transistor **44**. The current now begins to decrease and causes the transformer flux to build up in the opposite direction whereby a voltage of opposite polarity is induced in the transformer windings and the transistor **45** begins to conduct. The cycle is then repeated. The voltage output of the inverter will be a square wave whose frequency and amplitude are determined by the number of turns on the primary winding of the transformer, the voltage of the battery, and the saturation flux of the reactor. The resistors **52** and **53** implement the starting of oscillation of the circuit by biasing the transistors out of the non-linear, low current region, and the R-L network, consisting of the auxiliary winding **50**, inductance **51** and the variable resistor **54**, determines the oscillation frequency of the inverter circuit. I prefer to design the inverter components so that the voltage appearing across the transformer secondary winding **49** will have a frequency of about 800 cycles per second and a magnitude of 2,000 volts. I have found

that a voltage of this level and frequency results in sufficient charging of the capacitor **20**, when the rotatable electrode of the distributor **23** rotates at maximum engine speeds normally encountered in eight cylinder engines, to assure proper firing of the igniters. Toward this same purpose, the alternating voltage of the high-voltage transformer may be fully rectified as shown in the fragmentary circuit diagram of FIGURE 4. In such arrangement, the charging voltage pulses applied to the capacitor **20** will be at a rate twice that of the half-wave systems shown in FIGURES 1 and 2, since both positive and negative waves are rectified by the rectifier **59**.

FIGURE 5 illustrates a modification of the ignition system. In this case, the rotatable contact **57** of the distributor **23'** has a tip which actually engages the tips of the fixed electrodes, thereby clsoing the electrical circuit between the secondary winding **49** of the transformer **48** and one of the igniters **31'**, **32'**, **33'**, etc. The igniters are here presented in terms of electrical equivalents, namely, a gap formed between the inner and outer electrodes with the resistances **37'**, **38'**, **39'** representing the shunting resistance across the gap arising by reason of the semi-conductor material. Separate capacitors **20***a*, **20***b*, **20***c*, are associated with each igniter as are separate fixed, gaps **58***a*, **58***b*, **58***c*. As shown in the drawing, the rotatable contact **57**, of the distributor, is in contact with the fixed contact **24***c*, thereby completing the electrical circuit between the transformer winding **49** and the capacitor **20***c* through the current-limiting resistor **21** and the rectifier **22**. This charges the capacitor **20***c*. When the rotatable contact **57** moves out of contact with the fixed contact **24***c*, the capcaitor **20***c* discharges through the gap **58***c* and through the igniter. This cycle is repeated as the rotatable distributor contact is brought sequentially into and out of engagement with the fixed contacts, resulting in a corresponding sequential charging of the individual capacitors **20***a*, **20***b*, **20***c* and the discharging thereof through the associated igniter and gap. Since the switching is done ahead of the capacitor, the contacts carry only a small current which, together with the sealed casing **29'**, results in a long contact life. Further, by making the rotatable and fixed contacts of a radio active material, the cooperating contacts need not actually come into physical contact, in which case the distributor becomes a rotary gap similar to the one in the FIGURE 2 embodiment.

FIGURE 6 illustrates the construction of the rotary gap distributor used in the ignition systems shown in FIGURES 2, 3 and 4. Although such distributor may include a housing of any appropriate design, the housing shown in the drawing is that of a conventional distributor consisting of the base **60** and cap **61**. This is intended to show that my novel distributor is adapted for quick and easy substitution for the present distributor on an engine to thereby adapt the engine for operation with surface gap igniters. In fact, my distributor cap is readily mounted on the base of a conventional distributor installed on an engine without requiring adjustment of the timing. Toward this end, the contact and breaker points of the conventional distributor merely are removed.

Extending centrally through the distributor base **60** is a conventional distributor shaft **62** provided with a flat portion **63** which serves for removably coupling my distributor to such shaft while maintaining a proper timing relation. The open end of the distributor cap **61** (which may be molded of a clear plastic, as shown), is closed by means of a metal plate **63** that is secured in position by a plurality of circumferentially-spaced screws **64**. It is preferable that the interior of the cap be sealed, the washers **65**, **66** being provided for this purpose. To maintain the sealed character of the distributor, a Vander Graff shaft seal **67** is utilized. Such seal comprises a metal housing **68** (which, in this instance, is welded centrally to the plate **63**) and the washers **69**, **70**, **71** tightly encircling the shaft **72**. It will be noted that the shaft **72** is provided with reversely-threaded portions **73**, **74** so that rotation of the shaft **72** will tend to throw grease (which fills the chamber within the bushing **68**) toward the central washer **70** and away from the end-sealing washers **69**, **71**, thereby promoting the maintenance of a good seal between the shaft **72** and the interior of the distributor cap **61**. The grease may be inserted into the seal **67** through the opening provided upon removal of the screw **75**.

In order to reduce radio-frequency interference to a minimum, the plastic distributor cap **61** is disposed within a metal shell **77**, which shell has an inwardly-directed flange **78** and a reduced-diameter, extended portion **79**. The latter is provided with an undercut ridge whereby the metal shell **77** may be removably secured to the distributor base **60** by conventional latching clamps **80**. The flange **78** provides a convenient means for securing the cap **61** to the shell **77** as by a plurality of circumferentially-spaced screws **81**. It will be noted that the outer end of the shaft **72** is provided with a diametric hole through which is inserted a drive pin **82**. A coupling collar **83** has a diametric slot formed therein for accommodating the pin **82** and the forward end of the collar is provided with a bore such that the coupling collar can be inserted over the end of the distributor shaft **62**. It will be apparent that such arrangement affords a means for quick, positive and accurate coupling and uncoupling of the shafts **62** and **72**. Thus, to remove the metal housing **77**, which carries the cap **61**, from the base **60**, it is only necessary to unsnap the latching clamps **80** and draw the housing **77** away from the base, the latter generally being firmly secured to the engine. Conversely, to install the distributor in operative position, it is only necessary properly to align the bore in the coupling collar **83**, slide same over the shaft **62** and close the latching clamps **80**.

The inner end of the shaft **72** has secured thereto an insulator bushing **85**, as by the screws **86**. The rotatable electrode **87** extends radially from a contact plate **88**, being secured thereto by a set screw **89**, and the contact plate is, in turn, firmly secured to the insulator bushing **85** by suitable screws **90**. It may here be pointed out that the electrode **87** is preferably made of tungsten and the contact plate **88** is made of brass or copper and has a substantial mass so that it acts as a heat sink to keep the electrode relatively cool.

A conventional distributor cap, such as the cap **61**, shown in FIGURE 6, includes integral, upstanding bosses or insulator bushings which serve to position individual terminal rods. These terminal rods, which may be molded directly into the plastic cap or otherwise firmly secured in position, have individual leads soldered thereto, which leads preferably are of the shielded cable type and pass outside of the metal shell **77** through a suitable opening. The center terminal rod **91** has an axial bore formed in the inner end for the accommodation of a helical spring **93** and the inner end of a carbon brush **94**. Thus, it is apparent that a good electrical circuit is established between the rotatable electrode **87** and the terminal rod **91** through the medium of the contact plate **88** and the spring-biased brush **94**. Circuitwise, the lead **95**, secured to the center terminal rod **91**, is connected to the positive side of the capacitor, see particularly FIGURE 3. Each of the other leads (connected to the other terminal rods) individually are connected to the center electrode of the associated igniter.

Although only four terminal rods, namely, those identified by the numerals **96–99**, are visible in FIGURE 6 in addition to the center rod **91**, those skilled in this art will understand that the number of such additional terminal rods corresponds to the number of spark plugs, or igniters, associated with a particular engine. The fixed electrodes of the distributor are carried by individual screws **100** which are threaded through aligned, threaded holes formed in the side wall of the cap **61** and the asso-

ciated terminal rod. Force-fitted into an axial bore formed in each screw is a pointed electrode **101**, the tips of such fixed electrodes lying in the plane generated by the rotatable tip **87** upon rotation of the distributor shaft **62**. Access to each of the screws **100**, as by means of a screwdriver, is obtained upon removal of the threaded plugs **102** whereby the spacing between the tip of the rotatable electrode and the tips of the fixed electrodes may be individually adjusted to a precise distance. It is here pointed out that the tips **87** and **101** preferably are made of tungsten and are pointed, the former promoting long, operating life and the latter providing very accurate timing inasmuch as the gap distance may be adjusted, with due consideration given to the discharge voltage of the capacitor, so that the capacitor will discharge when the rotatable tip **87** is substantially in precise alignment with a fixed electrode point.

The open end of the metal, outer shell **77** is closed by a metal plate **103** secured by screws **105**. Thus, the entire distributor is enclosed within a metal housing which, together with the use of shielded cable leads, practically completely eliminates radio interference. The sealed character of the distributor chamber makes it possible to evacuate such chamber and/or fill same with an inert gas, all directed toward promoting long, trouble-free operation.

A conventional ignition system using convetnional spark plugs generally includes an automatic spark advance arrangement to promote quicker and easier engine starting. Briefly, such an arrangement utlizes a vacuum-operated bellows mechanically coupled to a plate carried in the base of the distributor, which plate is adapted for limited rotary movement and carries the distributor points. In tests which I have conducted with my low voltage ignition system installed on a six (6) cylinder marine engine, I have found no need for a spark-advance function. However, by making a slight modification in the construction of the distributor cap, my distributor is made adaptable for installation on a conventional distributor base provided with the automatic, spark-advance mechanism. FIGURE 8 illustrates the modified form of my distributor, but reference is first made to FIGURE 7.

FIGURE 7 is an elevational view of a conventional distributor base **60** with the conventional breaker points removed. A rocker plate **110** is mounted for limited rotary movement as defined by the arcuate slots **111** through which pass the locating and positioning screws **112**. A flat rod **113** is mechanically coupled to the plate **110** by means of a pin **113'** that is secured to the plate and passes through a clearance hole provided in the rod. The other end of the rod **113** is attached to the vacuum-operated bellows disposed within the housing **114** that is secured to the base **60**. It will be apparent that as the bellows expand and contract the plate **110** will rotate in a clockwise and counter-clockwise direction, respectively. Secured to the plate **110**, and extending upwardly therefrom, is a pin **115**. This pin normally serves as one means for rotatably supporting the conventional breaker points. For my purpose, the conventional breaker points are removed and the pin **115** is utilized for coupling the rocker plate **110** to the cap of my distributor as will now be described with specific reference to FIGURE 8.

As shown in FIGURE 8, the rocker plate **110** is supported by a flange **116** extending inwardly from the side wall of the distributor base **60**. The locating screws **112**, which pass through the arcuate clearance holes **111** formed in the plate, are threaded into suitable holes provided in the flange **116**. The coupling pin **115**, which is secured to the plate **110**, extends into an axial bore formed in the aligned bushing **117** secured to the plate **63** which closes the end of the distributor cap **61**. The sealed character of the cap is maintained by the screws **64** and the washers **65** and **66**. In this modified construction, however, the screws **81**, which secure the cap **61** to the outer shell **77**, pass through enlarged holes formed in the flange **78**, thereby permitting a slight rotation of the entire cap **61** in correspondence with rotation of the plate **110** through the coupling means comprising the pin **115** and the bushing **117**. Inasmuch as the fixed electrodes are carried by the cap **61**, rotation of the cap will change the angular position at which the center rotatable electrode comes into precise alignment with the individual, fixed electrodes, thereby changing the firing point with respect to the angular disposition of the shaft **62**.

From the above description, it is apparent that I have provided a low voltage ignition system making it possible to use surface gap igniters in a multi-cylinder engine. In the preferred form, the system does not require a switching function involving the opening and closing of an electrical circuit by the engagement and disengagement of breaker points (such as is required in conventional high voltage ignition systems) thereby promoting dependable and positive ignition with a minimum of maintenance. By using tungsten electrodes disposed within a sealed chamber the operating life of the electrodes is increased substantially. A further increase in the electrode life may be obtained by filling the sealed distributor chamber with dry air or an inert gas. In order to reduce the voltage necessary to ionize the gap between aligned electrodes, the rotary and fixed electrodes may be made of a radio active material. Of equal importance is the fact that my rotary gap distributor can be installed on the base of a conventional distributor having a spark advance mechanism of the vacuum-operated and/or centrifugal type, without requiring alterations, without need of special tools, and without the necessity of retiming.

Having now described my invention in detail, in accordance with the patent statutes of the United States, those skilled in this art will find no difficulty in making changes and modifications to meet specific operating conditions or requirements. It is intended that such changes and modifications shall fall within the scope and spirit of the invention as recited in the appended claims.

I claim:

1. A low voltage high current ignition system for an engine having a plurality of surface gap igniters comprising a rotatable gap distributor consisting of a sealed chamber, a rotatable electrode disposed within the chamber and fixed electrodes each having an end disposed within the chamber and radially-spaced from an end of the rotatable electrode; leads individually connecting each fixed electrode to the center electrode of an associated igniter; a capacitor having one side connected to the said rotatable electrode and the other side connected to the outer electrode of each igniter; a D.C. voltage source; a transformer having a secondary winding connected to the capacitor through a rectifier, a center-tapped primary winding and an auxiliary winding; and a push-pull oscillator energized by the said voltage source and supplying energy alternately to the two portions of the said center-tapped primary winding, said oscillator including an iron core inductor connected across the said auxiliary winding and having a center tap connected to the center tap of said primary winding.

2. The invention as recited in claim 1, wherein the oscillator includes a pair of transistors each having a base, an emitter and a collector with the emitters connected to opposite ends of the said center-tapped primary winding, and the bases connected to opposite ends of the said inductor.

3. A low voltage, high current ignition system for an engine having a plurality of surface gap igniters comprising a rotary gap distributor consisting of a sealed chamber, a rotatable electrode disposed within the chamber and fixed electrodes each having an end disposed within the chamber and radially-spaced from an end of the

rotatable electrode; leads connecting each fixed electrode to the center electrode of an associated igniter; a capacitor having one side connected to said rotatable electrode and the other side connected to the outer electrode of each igniter; a D.C. voltage source; a transformer having a secondary winding, a center-tapped primary winding and an auxiliary winding; circuit elements applying the voltage developed in the transformer secondary winding to the capacitor through a rectifier; a pair of transistors each having a base, an emitter and a collector; means connecting the said center-tapped primary winding between the transistor collectors; an iron core inductor having a center-tapped winding; means connecting the ends of the inductor winding between the transistor bases and across the transformer auxiliary winding; means connecting the transistor emitters to the positive side of the D.C. voltage source; a pair of resistors connected in series across the said voltage source; and a lead connecting the center tap on the inductor winding to the common point of said resistors.

4. The invention as recited in claim 3 including a third resistor connected between ends of the said auxiliary winding and the inductor winding.

5. The invention as recited in claim 4, wherein the distributor is enclosed within a metal housing and the leads extending therefrom are shielded cables.

6. An ignition system for engines having a plurality of surface gap igniters to be fired sequentially, said system comprising a storage capacitor, a source of voltage

connected across the capacitor for charging it, a rotary gap distributor including a rotatable electrode and a plurality of spaced, fixed electrodes radially spaced from an end of the rotatable electrode, conductors individually connecting each fixed electrode to the center of an associated igniter, and coupling means connecting the positive side of said capacitor to the rotatable electrode and the negative side of the capacitor to the outer electrode of each igniter, said storage capacitor forming a part of a resonant circuit which includes the inductance of the coupling conductors and a rectifier, said resonant circuit adapted to reduce the current through the igniters to a minimum value before the rotatable electrode leaves each of said fixed electrodes.

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