March 31, 1925. 1,531,696

T. J. FAY

IGNITION SYSTEM

Filed Nov. 7, 1922 2 Sheets-Sheet 1

Fig. 1.

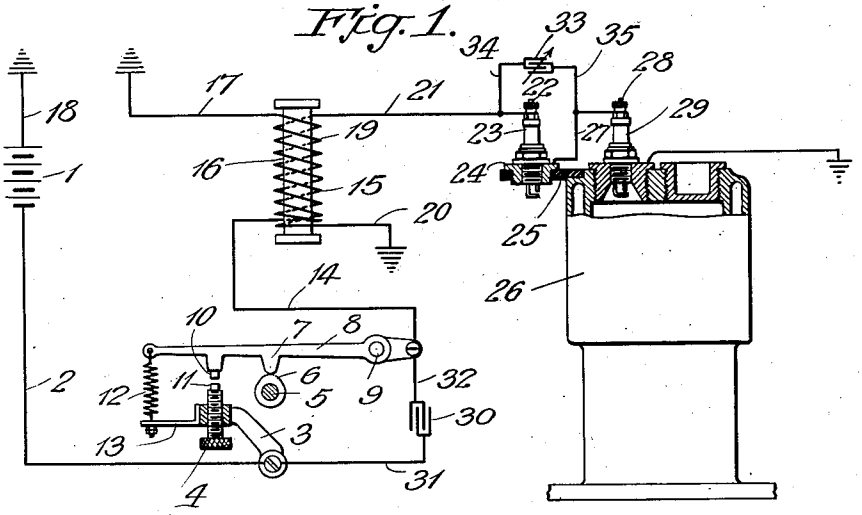


Fig. 2.

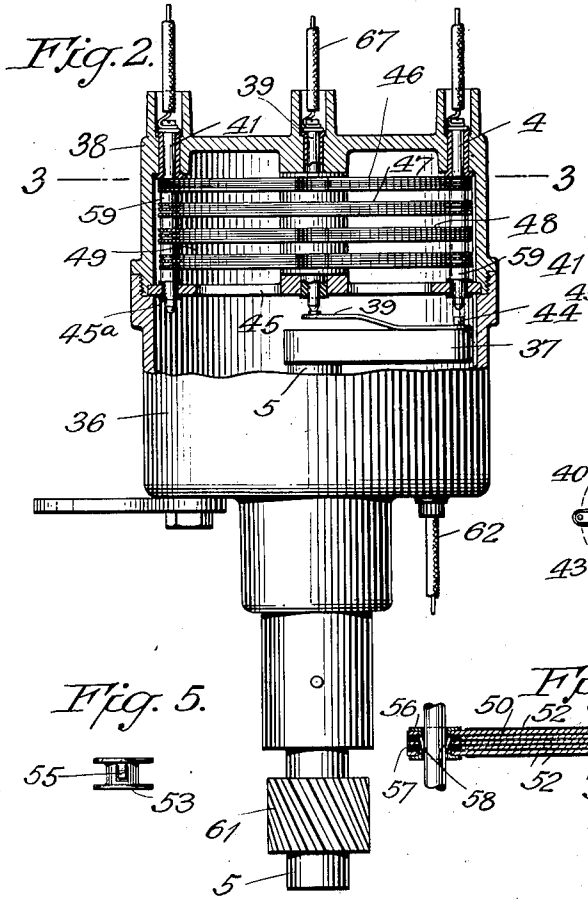


Fig. 3.

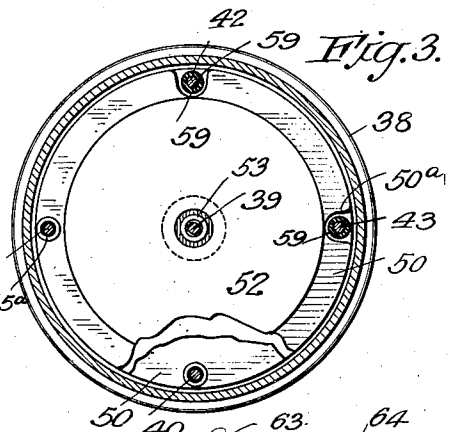


Fig. 6.

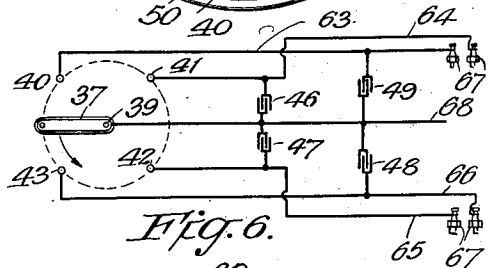
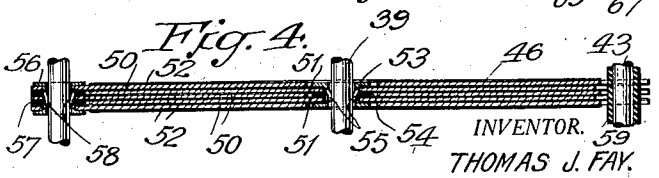


Fig. 5.

Fig. 4.



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Fig. 7.

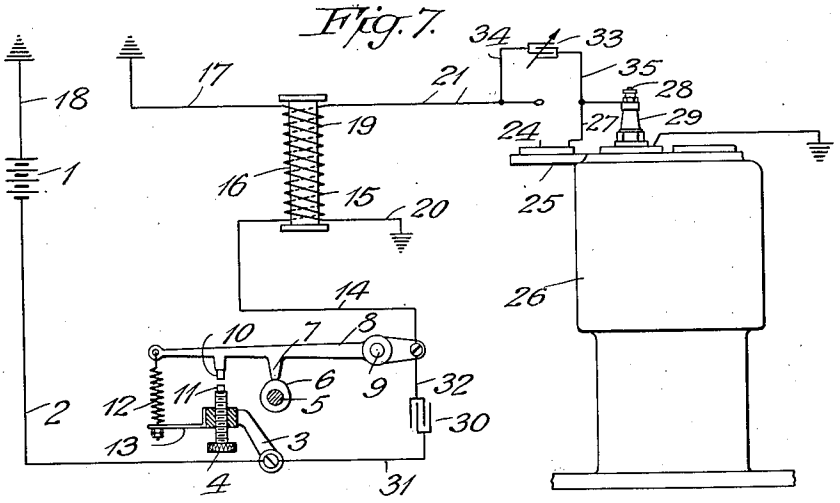


Fig. 8.

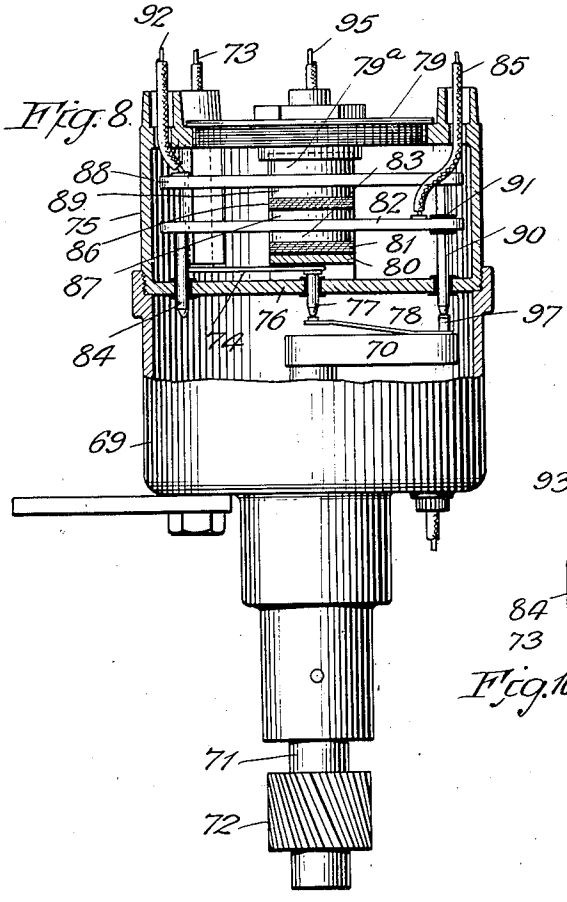


Fig. 9.

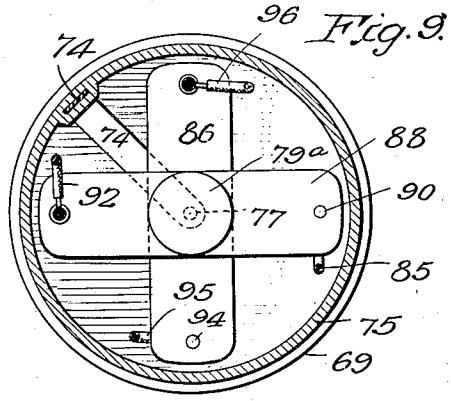
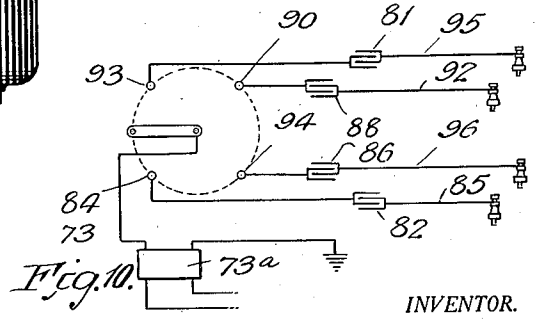


Fig. 10.



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UNITED STATES PATENT OFFICE.

THOMAS J. FAY, OF BROOKLYN, NEW YORK.

IGNITION SYSTEM.

Application filed November 7, 1922. Serial No. 599,537.

To all whom it may concern:

Be it known that I, THOMAS J. FAY, a citizen of the United States, residing at Brooklyn, in the county of Kings and State of New York, have invented certain new and useful Improvements in Ignition Systems, of which the following is a full, clear, and exact description.

This invention relates to electrical ignition systems for internal combustion engines. The fuel now commonly available for internal combustion explosion engines is comparatively heavy and is not always entirely vaporized before being carried into the combustion chambers of the cylinders. Some of the cylinders commonly run wet, and the unvaporized fuel therein is carbonized by the heat of combustion and deposited as unburned carbon upon the walls of the cylinder and spark plugs. The carbon deposit on the surfaces of the spark plugs forms a leakage path between the electrodes and along the surface of the porcelain or other dielectric of the plug, which leakage prevents the building up of a high potential between the electrodes. The result is that a hot, intense and disruptive spark is not obtained, if indeed any spark is obtained. The incomplete vaporization of the fuel also results in a leakage of some of the unvaporized portions thereof into the crank case where it dilutes the lubricating oil therein. Heretofore this dilution has been offset by the use of heavier lubricating oils, so that when diluted the lubricant would have the proper viscosity. The heavier oils, however, because of their extremely high viscosity are not as satisfactory as a lubricant as the lighter oils.

Various attempts have been made heretofore to remedy these conditions by providing various devices for increasing the intensity of the spark, and thus accomplishing a more complete combustion of the fuel. One of these attempts involved the use of two spark gaps in series, but such an arrangement proved unsatisfactory for the reason that difficulty was experienced then in starting an engine owing to the fact that the engine is rotated at a very low rate by the starter. The two gaps in series have also been unsatisfactory in preventing fouling of the spark plugs for the reason that they do not provide a sufficiently intense spark.

An object of this invention is to provide an improved ignition system which will effectively prevent or reduce crank case dilution thereby enabling the use of the lighter, and therefore, more satisfactory lubricating oils; which prevents fouling of the spark plug such as by deposits of carbon thereon; which provides an exceptionally hot, intense, variable and disruptive firing spark; which facilitates the starting an operation of an engine, and which is exceptionally simple, compact, efficient, inexpensive, and readily applicable to existing ignition systems. Other objects and advantages will be apparent from the following description of an embodiment of the invention and the novel features will be particularly hereinafter pointed out in claims.

In the accompanying drawings:

Fig. 1 is a diagram illustrating one embodiment of the invention;

Fig. 2 is an elevation partly in section of an ignition distributor in which the invention has been embodied;

Fig. 3 is a section through the same taken substantially along the line 3—3 of Figure 2;

Fig. 4 is a sectional elevation through one of the condensers;

Fig. 5 is an elevation of one of the eyelets of the condenser;

Fig. 6 is a wiring diagram of the connections when the invention is applied to a distributor of the type shown in Figure 2;

Fig. 7 is a diagram similar to the diagram of Figure 1 with an extra spark plug removed and the system operating with the condenser in series with the firing spark plug;

Fig. 8 is an elevation partly in section of an ignition distributor in which the invention is embodied, the distributor being of the type in which the rotary distributor head makes actual contact with the distributor pins;

Fig. 9 is a sectional plan of the device shown in Figure 8, the section being taken immediately below the upper wall of the cap; and

Fig. 10 is a wiring diagram of the connections employed in the distributor of the type shown in Figure 8.

In the embodiment illustrated in Figures 1 and 7, current is conducted from the battery or other source of energy 1, through the wire 2 to a contact arm 3 carrying an adjustable contact member 4. A shaft 5 is connected to the engine to be driven thereby, in timed relation thereto, and carries a cam 6 which is adapted to engage and operate a nose 7 of a make-and-break lever 8. The lever 8 is pivoted at 9 and provided with a contact point 10 which is movable with the lever into and out of engagement with a contact tip 11 on the abutting end of the adjustable contact member 4. A spring 12 is connected under tension between the free end of the make-and-break lever 8 and an extension 13 of the arm 3 so as to normally pull the make-and-break lever 8 in a direction to carry the contact tip 10 thereof into electrical contact with the tip 11 of the contact member 4. The cam 6 in rotating will engage the nose 7 of the make-and-break lever and repeatedly operate the make-and-break lever in a direction to separate the contact tips 10 and 11 and then release the same to permit them to reengage.

A wire 14 is connected to the make-and-break lever 8 through its pivot 9 and extends through the primary 15 of a suitable induction coil 16. A wire 17 connects the other side of the primary to ground and the battery 1 is connected to ground by a wire 18. When the contact tips 10 and 11 are in engagement, the current from the battery will pass through the wire 2, arm 3, contact member 4, contact tips 10 and 11, make-and-break lever 8, pivot 9, wires 14, primary 15, wire 17 to ground, and from ground through wire 18 back to battery 1. The cam 6 in rotating, oscillates the make-and-break lever 8 and this repeatedly interrupts or opens the circuit from the battery through the primary of the induction coil. The secondary 19 of the induction coil is connected at one side by a wire 20 to ground and at the other side by a wire 21 to the insulated electrode 22 of a suitable auxiliary spark plug 23.

The auxiliary plug 23 is threaded into a conducting sleeve 24 which is in turn threaded into an aperture in a plate or arm 25 of suitable insulating material. The arm 25 is secured in any suitable manner to the engine head 26. A conductor 27 is connected at one end to the conducting sleeve 24 and at its other end to the insulated electrode 28 of a firing spark plug 29. The plug 29 is threaded into the cylinder head 26 so as to position its electrodes within the combustion chamber of the cylinder head.

A condenser 30 is connected across the arms 3 and 8 by wires 31 and 32 as usual in this type of construction for the purpose of preventing arcing between the contact tips 10 and 11 when the make-and-break lever is cammed in a circuit opening direction. A condenser 33 which may be variable as shown, so as to be adjustable with varying operating conditions, is connected at one side by a wire 34 to the wire 21 and at its other side by a wire 35 to the wire 27, so as to be in effect connected in parallel across the electrodes of the auxiliary or external spark plug 23.

In operation the interruptions in the primary circuit which are caused by the operation of the make-and-break lever from the cam 6 will induce a high potential current in the secondary of the induction coil, and this current will be conducted through the two spark plugs which are connected in series, thence after jumping both gaps to ground, which is the engine cylinder, and thence from ground back to the secondary of the induction coil. As the voltage builds up in the secondary of the induction coil the condenser will store energy, and when the potential is high enough to cause a breakdown of the spark gaps which are in series, the condenser energy will advantageously augment the heat effect of the spark. The external spark gap causes a building up of the potential in the secondary until the voltage is sufficient to jump both of the gaps in series, and consequently there will not be any considerable leakage of potential along the surface of the dielectric of the firing spark plug. The result is that a very strong, hot, intense and disruptive spark is provided. The engine is easily started with the two spark gaps in series when the condenser is added. By vigorously igniting the coarser constituents of the liquid fuel along with the fine, the fuel is more completely burned and consequently the leakage of unburned fuel into the crankcase to dilute the lubricating oil is largely prevented.

Very satisfactory results under some operating conditions have been obtained when the external or auxiliary spark plug 23 is removed and the condenser 33 is utilized alone in series with the firing spark plug as shown particularly in Fig. 7. Under other operating conditions the auxiliary spark plug or gap which is external to the combustion chamber may be advantageously used in connection with the condenser.

The spark plugs 23 and 29 are preferably interchangeable, so that in case of trouble with the firing spark plug it may be interchanged with the auxiliary spark plug, and thus provide a clean plug in the combustion

chamber. Even if the plug 29 which is then serving as the external plug should be defective, the condenser will operate alone and the engine would not be disabled. The auxiliary spark plug not only is highly desirable in addition to the condenser and advantageous in the ignition system under some operating conditions but the support therefor is a convenient means of safely carrying an extra spark plug which will be always readily available and convenient for interchange with or substitution for the firing spark plug in the combustion chamber.

In Figures 2 to 6 the invention is illustrated as embodied in an ignition system employing one type of a distributor which is driven from the engine. In this embodiment the make-and-break mechanism for the primary circuit is enclosed within a casing 36 and the shaft 5 thereof also drives a distributing head or member 37. A cup shaped cap 38 is threaded upon the upper open end of the casing 36 so as to close the same. A pin 39 extends centrally through the cap and at the inner end of the same is pressed upon by a spring 39 of the distributing head in a manner usual in this type of distributor.

A plurality of distributing pins 40, 41, 42 and 43, one for each cylinder, are carried by the cap so as to extend through the upper wall thereof and to project into close proximity to the path of a contact tip or electrode 44 which is carried by the distributor head 37 eccentrically of its axis of rotation. During the rotation of the distributor head 37 with the shaft 5 it will move beneath the ends of the pins 40, 41, 42 and 43 in close proximity to but separated slightly therefrom so as to form a spark gap therebetween. Each of these gaps corresponds to the auxiliary spark gap in the system shown in Fig. 1. A disc or spider 45 is secured in the lower or open end of the cap 38 and serves to space and support the pins 40, 41, 42 and 43 at their lower ends, the disc or spider 45 having insulating bushings 45^a through which the pins pass.

A plurality of condensers 46, 47, 48 and 49 are mounted within the cap 38 between the spider or disc 45 and the closed end wall. The condensers may be of any suitable form, shape or capacity or variable, but as illustrated they are circular in shape and are fitted over the pins 39, 40, 41, 42 and 43. The condensers are all substantially identical in construction, and for convenience, but one of the condensers, such as 46, which may be used will be described in detail. This condenser comprises three metal plates 50 (Fig. 4) between which are interposed a pair of plates 51 with a suitable dielectric 52, such as waxed paper, interposed between all plates and upon both outer faces of the condenser. The plates 50 and 51 are provided with substantially aligned central apertures, the apertures of the plates 50 being considerably larger than the apertures of the plates 51. A metal eyelet 53 is passed through the central apertures of the plates 51 with the flanges of the eyelet overlying the outer faces of the plates 51 so as to make electrical contact therewith and clamp them together. A suitable insulation bushing or washer 54 may be interposed between the plates 51 within the central aperture of the intermediate plate 50 so as to prevent springing of the plates 51 by the eyelet. The eyelet is provided with one or more tongues 55 which are struck from its central passage wall into the passage so as to yieldingly press upon and form electrical contact with the pin 39 when the condenser is passed over this pin.

The plates 50 are provided in their periphery with notches or apertures 50^a providing clearance spaces through which the pins 40, 42 and 43 pass, and also with aligned apertures through which the pin 41 may pass. A metal eyelet 56, similar to the eyelet 53, is secured in the aligned apertures so as to clamp together and electrically connect the plates 50, suitable bushings or washers 57 of insulating material being interposed between the plates 50 so as to prevent springing of the plates 50 by the clamping action of the eyelet. The eyelet 56 is provided with one or more tongues 58 which are struck into the passage from the wall thereof so as to form spring fingers pressing upon and making electrical contact with the pin 41 which passes therethrough. It will thus be observed that the plates 50 are electrically and mechanically connected together and to the pin 41, and the plates 51, which are separated from the plates 50 by a dielectric, are electrically and mechanically connected together and to the central pin 39.

The other condensers 47, 48, and 49 are similar in construction except that their eyelet 56 connecting the plates 50 thereof will be placed over a different distributing pin so that each condenser will be connected at one side to the central pin 39 and at its periphery to one of the distributing pins to which the other condensers are not connected electrically. Bushings 59 of insulating material are preferably passed over the distributing pins except where they pass through the eyelets 56, so as to insure perfect insulation of the pins from the condensers except for their intended connections thereto. A shaft 5 is driven by a worm pinion 61 from a suitable part of the engine, and the make-and-break mechanism within the casing 36 is connected by wires 62 (only one shown) to the source of current and primary of the induction coil.

The connections of the condensers to

the distributing pins are diagrammatically shown in Figure 6. In this diagram the pins 40, 41, 42, and 43 are connected by wires 63, 64, 65 and 66 respectively, to the firing spark plugs 67 of the cylinders of an engine. The pin 39 is connected by a wire 68 to the secondary of the induction coil. As the distributing head 37 is rotated by the engine, it moves successively beneath the pins 40, 41, 42 and 43 and simultaneously with its movement beneath each pin, the make-and-break mechanism is operated to induce a current in the secondary of the induction coil. The induced current passes from the secondary through the wire 67 and the central pin 39 to the contact tip 44 of the distributor head, jumps to the adjacent pin and thence passes to the spark plug of the cylinder where it again jumps the spark gap to the walls of the engine. Each of the condensers is connected in parallel across the gap between a distributing pin and the distributor head and will act in the same manner as the single condenser described in connection with Figure 1.

In Figures 8 to 10 the invention is illustrated as embodied in the type of distributor in which the distributor head has rubbing contact with the distributor contacts successively. The usual make-and-break mechanism (not shown) is enclosed within the casing 69, and the cam of the make-and-break mechanism and the rotary distributor head 70 are driven from a shaft 71. The shaft 71 is driven from the engine through a suitable connection to a pinion 72 on the shaft 71. A conductor 73 from one side of the secondary of the transformer or induction coil 73^a is connected to a contact strip 74 which is embedded in the cap 75 of the distributor casing 69. The embedded conductor 74 extends down the side wall of the cap 75 and then across the bottom wall 76 thereof into a central position where it terminates in a depending contact pin 77 aligned with the axis of rotation of the head 70 and passing downwardly through the bottom wall 76. A spring end of a conducting strip 78, which is secured to the distributor head 70 presses upon the pin 77 so as to have electrical contact therewith as the head rotates.

The cap 76 of the casing is threaded into the open end of the casing 60 so as to close the same, and is itself hollow so as to provide a chamber in which condensers may be placed. A removable plug 79 is provided in the upper wall of the cap 75 through which the condensers may be inserted. The cap is provided with a bridge 80 extending diametrically across the same in spaced relation to the bottom wall 76, and a condenser 81 rests upon this bridge. A second condenser 82 is disposed crosswise of the condenser 81 and rests thereon with a washer or spacer 83 interposed between them. One terminal of the condenser 82 is provided with a contact pin 84 which extends through the bottom wall 76 of the cap. A conductor 85 from one of the spark plugs of an engine enters the cap and connects to the other terminal of the condenser 82.

A condenser 86 is disposed upon and over the condenser 82, crosswise thereof and also parallel with the condenser 81, there being a washer or spacer 87 interposed between the condensers 82 and 86 so as to hold them in spaced relation. A condenser 88 is disposed above and crosswise of the condenser 86, and parallel with the condenser 82, there being a washer or spacer 89 interposed between the condensers 86 and 88. One terminal of the condenser 88 is connected to a contact pin 90 which passes downwardly through an insulating bushing 91 in the condenser 82, and thence downwardly through the bottom wall 76 of the cap of the casing. A conductor 92 from another spark plug of the engine enters the cap of the casing and is connected to the other terminal of the condenser 88. The condensers 81 and 86 are provided each with terminal contact pins 93 and 94 respectively (see Fig. 10) which extends through the bottom wall 76 of the cap. Conductors 95 and 96, extend from other spark plugs of the engine to the other terminals of the conductors 81 and 86 respectively. The contact pin of the condenser 86 extends through an insulated bushing (similar to 91 but not shown), in the condenser 81. A spacer or washer 79^a is interposed between the plug 79 and the uppermost condenser 88 so as to permit clamping of the condensers by the plug 79 against the bridge 80.

The distributor head 70 is provided near its outer end with a spring contact shoe 97 which is adapted to have rubbing contact with the depending contact pins 84, 93, 90 and 94, successively as the distributor head rotates. Thus as the distributor head 70 rotates, the contact shoe 97 thereof which is continually in circuit connection with the conductor 73 from the source of high frequency current, will be successively connected to one terminal of each of the condensers, and through the condensers will be successively connected to the spark plugs of the engine. Each condenser would thus be in series with the spark plug and will act in the manner described in connection with the embodiment shown in Figures 1 and 7 for providing a very hot, intense and disruptive spark. The wiring connections are shown in Fig. 10. It will of course be understood that if desired an extra spark plug similar to 29 may be connected in parallel to each condenser of this embodiment, in the manner described in connection with the embodiment shown in Figures 1 and 7.

In the embodiments shown in Figs. 2 to 6 and 8 to 10 inclusive, the condensers for the sake of simplicity are shown as of fixed capacity, but it will be understood that, if desired, they also may be constructed of variable capacity so as to be varied with changing operating conditions. It will also be obvious that a single condenser either fixed or variable may be utilized for all spark plugs, but it is thought that a separate condenser for each firing plug is preferable.

It will be understood that if desired the condensers may be connected in series with the firing spark plug and the auxiliary or external spark plug or gap omitted, although more satisfactory results are obtained when both are used. It will be also understood that various changes in the details and arrangements of parts herein described and illustrated for the purpose of explaining the nature of the invention, may be made by those skilled in the art within the principle and scope of the invention.

I claim:

1. In an ignition system for internal combustion engines having a plurality of cylinders with a spark plug for each cylinder, a distributor casing, a plurality of contacts supported in the casing in spaced relation to one another, a rotary distributor member in the casing adapted to make electrical contact with said contacts successively as it rotates, a current supply member connected to supply current to the distributor member, a circuit connection from each spark plug to said casing, and a plurality of condensers in said casing, each condenser being connected in series between a circuit connection and one of the contacts.

2. In an ignition system for internal combustion engines with a plurality of cylinders, an ignition circuit including a casing housing a distributor that completes, in a desired order, the circuit to said cylinders, and a plurality of condensers contained in the said casing and included individually in the circuits to said cylinders.

3. In an ignition system for internal combustion engines with a plurality of cylinders, an ignition circuit, including a distributor casing, having a cap closing the same and carrying contacts, a flyer movable to cooperate with said contacts and deliver ignition currents to said cylinders successively, and a plurality of condensers mounted in said cap and associated individually with the circuits to the cylinders for changing the frequency of the currents delivered thereto.

In witness whereof I hereunto subscribe my signature.

THOMAS J. FAY.