Sept. 4, 1923. 1,466,829

W. W. HAWKINS

IGNITION SYSTEM

Filed June 26, 1916 4 Sheets-Sheet 1

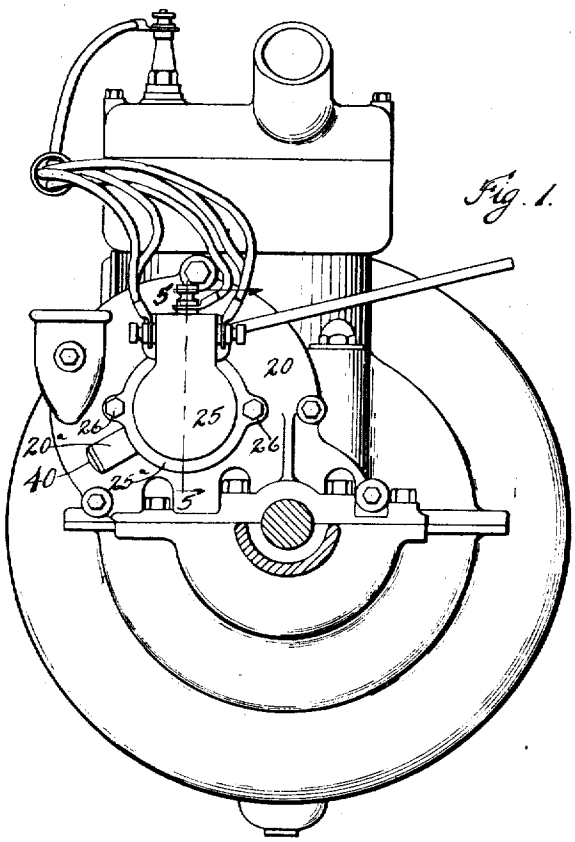


Fig. 1.

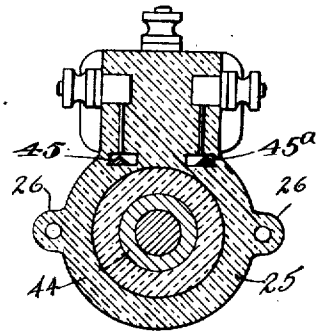
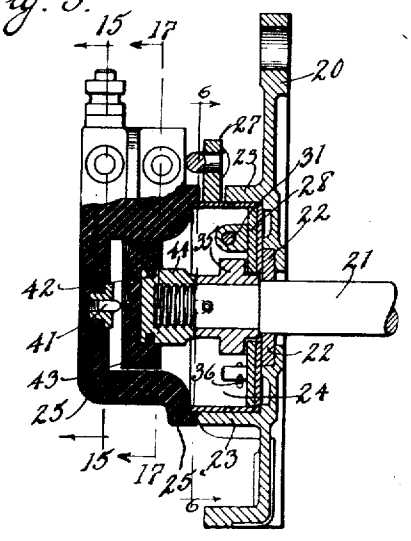
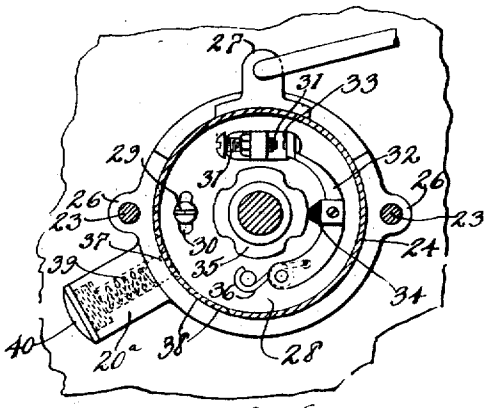


Fig. 17.

Fig. 6.

Fig. 5.





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IGNITION SYSTEM

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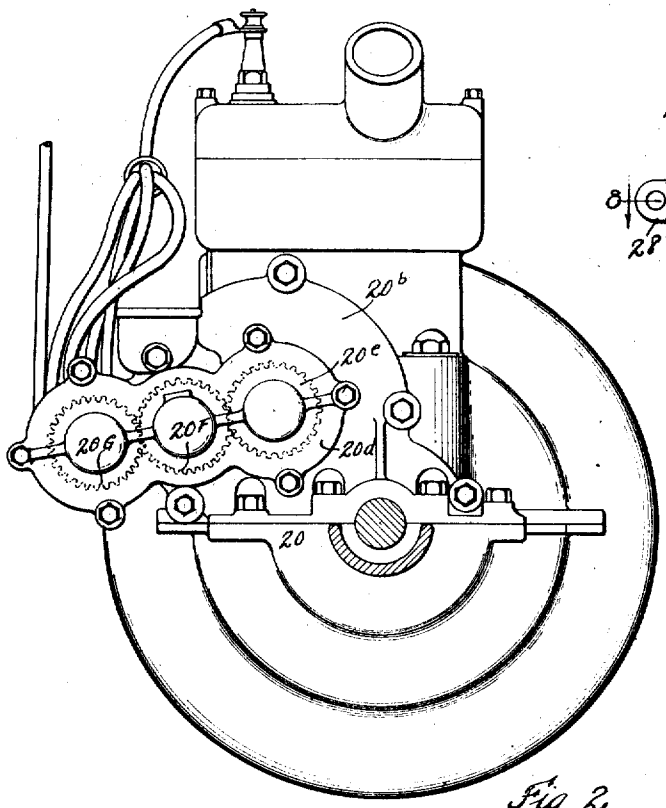


Fig. 2.

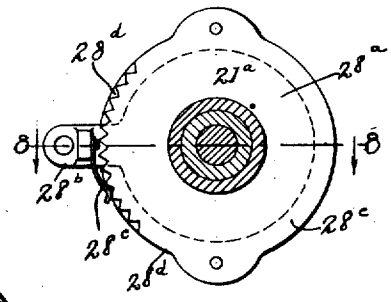


Fig. 9.

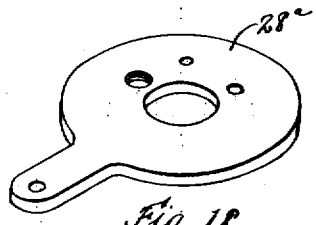
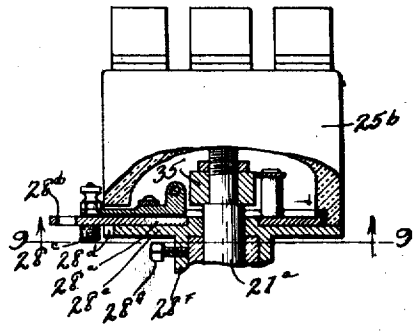


Fig. 18.

Fig 8



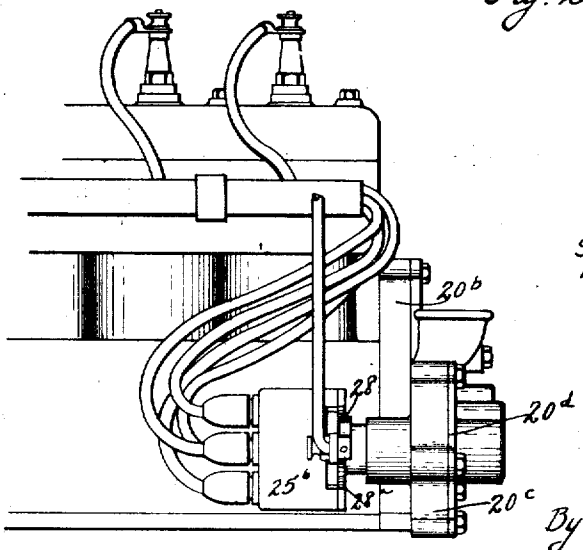


Fig. 7.

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IGNITION SYSTEM

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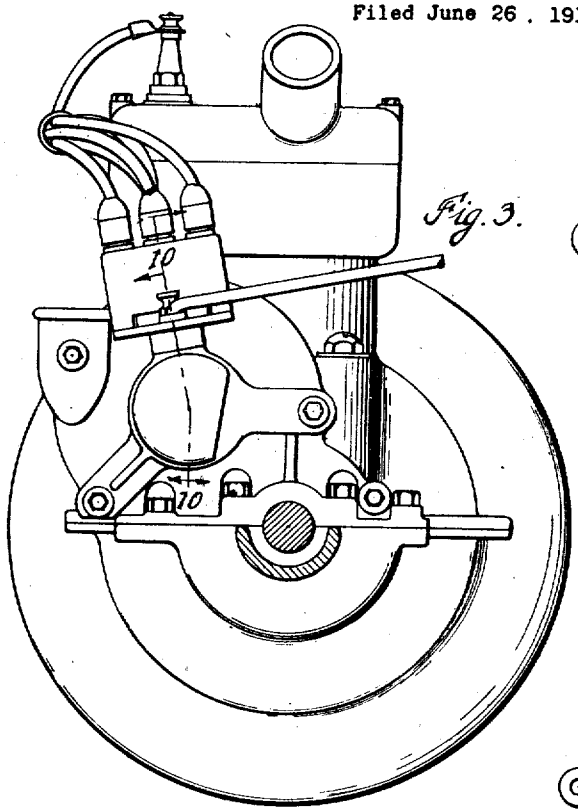
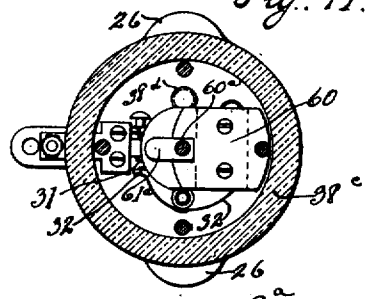


Fig. 3.

Fig. 11.



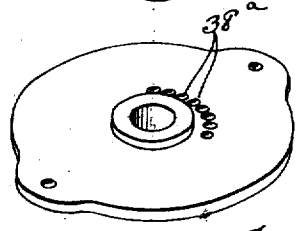


Fig. 14.

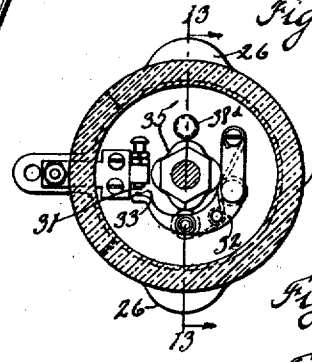
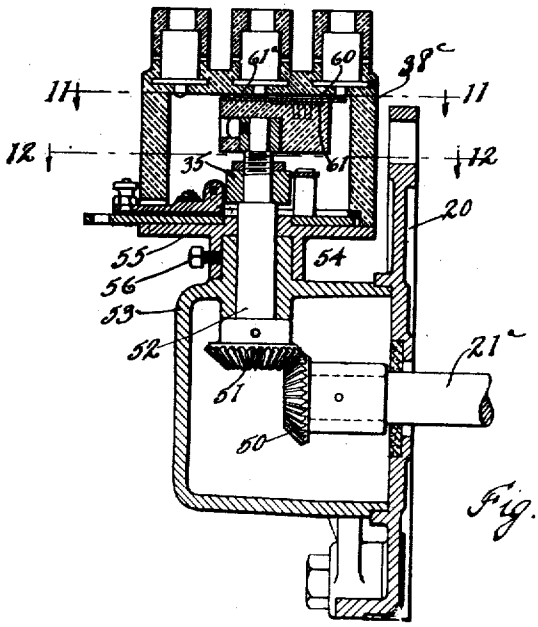


Fig. 12

Fig. 13.



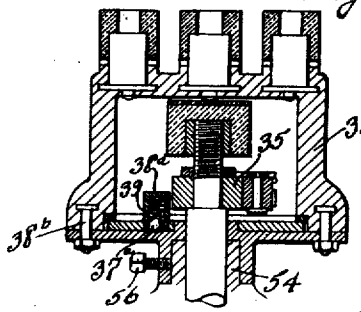


Fig. 10.

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Sept. 4, 1923. **1,466,829**

W. W. HAWKINS

IGNITION SYSTEM

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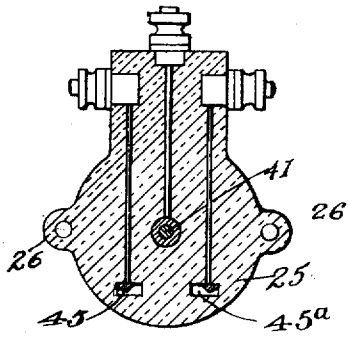


Fig.15.

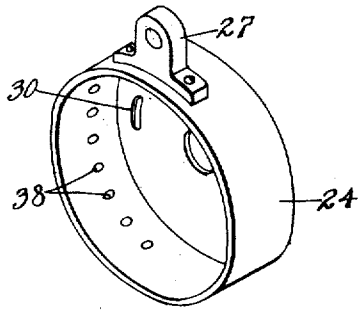


Fig. 16.

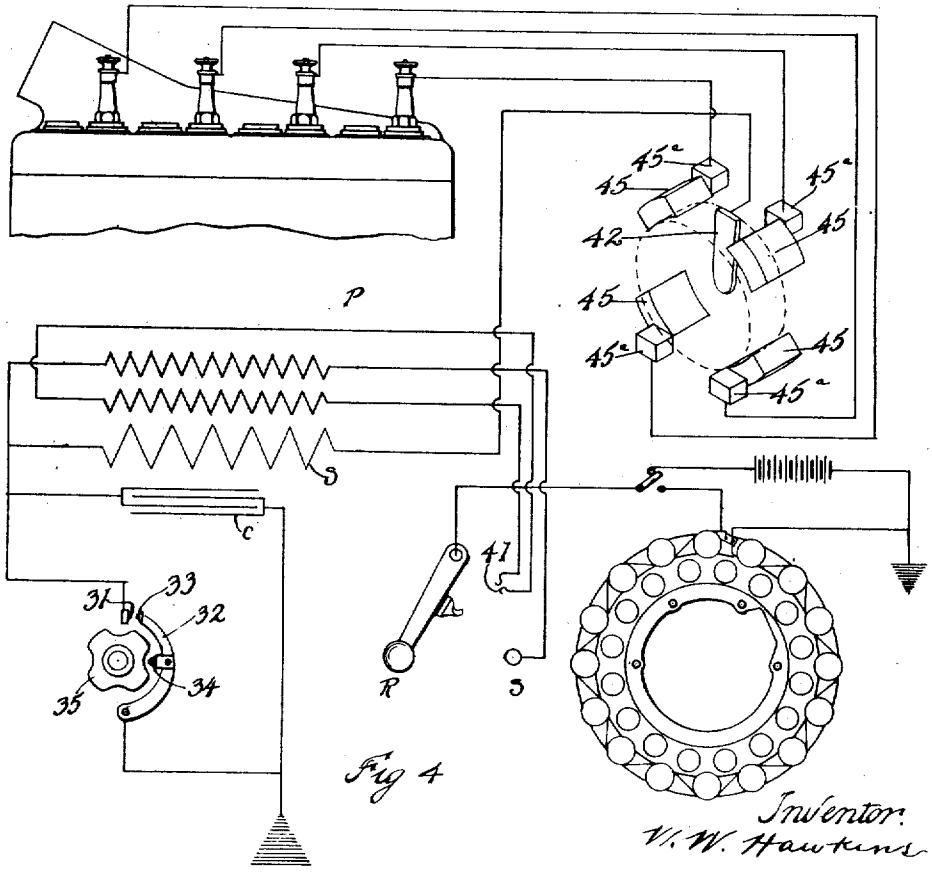


Fig 4

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Patented Sept. 4, 1923. 1,466,829

UNITED STATES PATENT OFFICE.

WILLIAM W. HAWKINS, OF NEW YORK, N. Y., ASSIGNOR TO H. & H. IGNITION CORPORATION, OF NEW YORK, N. Y., A CORPORATION OF NEW YORK.

IGNITION SYSTEM.

Application filed June 26, 1916. Serial No. 105,838.

To all whom it may concern:

Be it known that I, WILLIAM W. HAWKINS, a citizen of the United States, residing at New York, in the county of New York and State of New York, have invented a certain new and useful Improvement in Ignition Systems, of which the following is a full, clear, and exact description, reference being had to the accompanying drawings.

This invention relates generally to ignition systems for internal combustion engines and more particularly to one for use in connection with a multipolar magneto such as used upon Ford cars at the present time. This device overcomes the inherent defect of this construction of magneto as it always provides for a coordination of movement between the parts generating electrical energy, the parts requiring electrical energy at predetermined periods, and interposing in the path of said electrical energy the minimum of resistance, every part being mechanically controlled and actuated by positive mechanical means.

One object of the invention is to completely eliminate the use of separate coils for each cylinder and another object is to materially cheapen and simplify the construction of the system as a whole.

A further object of the invention is to dispense with the use of magnetic interrupters and at the same time provide a system in which there is a positive co-relation between the current wave and the firing period of the engine, and a still further object of the invention is to provide for synchronizing the ignition periods with current impulses; giving positive contact of breaker points at the maximum of current in the primary coil thus insuring a hot spark for starting.

A further and very important object is to provide a current wave of an undulating contour at the peak in contradistinction from the point of jagged contour heretofore prevalent in ignition systems of this character.

A still further object of the invention is to eliminate all sliding and rolling contacts in the primary circuit of ignition systems, having every motion and movement of parts so coordinated or synchronized that the element of time duration is reduced to a minimum and all actions performed mechanically in a positive manner so that same are repeated without lag or dwell at all speeds as required for commercial usage. All wearing parts are located to be easy of access for inspection, adjustment and repair. All moving parts are few in number and of wear-resisting material.

Another object of the invention is to provide for dispensing with the time interval necessary for the saturation of the core of the coil and movement of interrupter armature thereby materially expediting the operation of the device as a whole, and it is also an object of the invention to provide a system capable of use in either a horizontal or vertical position.

It is also intended to provide a system capable of use in connection with a battery as well as with a magneto, as a source of electric energy.

With these objects in view, and certain others which will appear hereinafter, as the description proceeds, the invention consists in the novel features of construction and the manner of arranging or combining the same, all of which will be fully described hereinafter and pointed out in the appended claims.

In the drawings forming a part of this specification, Fig. 1 is a face view of a device embodying my invention and applied in a horizontal position at the forward end of the cam shaft; Fig. 2 is a similar view, the operative mechanism however being arranged at one side of the cam shaft and driven through the interposition of the train of gears; Fig. 3 is a view showing the mechanism arranged in a substantial vertical position and receiving its power from the forward end of the cam shaft through the medium of bevel gears; Fig. 4 is a diagrammatic view illustrating the complete system; Fig. 5 is a vertical sectional view on the line 5—5 of Fig. 1; Fig. 6 is a sectional elevation on the line 6—6 of Fig. 5; Fig. 7 is a side elevation of the device illustrated in Fig. 2; Fig. 8 is a sectional view on the line 8—8 of Fig. 9; Fig. 9 is an inverted sectional plan on the line 9—9 of Fig. 8; Fig. 10 is a central section taken on the line 10—10 of Fig. 3; Fig. 11 is a sectional plan on the line 11—11 of Fig. 10; Fig. 12 is a sectional plan on the line 12—12 of Fig. 10; Fig. 13 is a vertical sectional view on the line 13—13 of Fig. 12; Fig. 14

is a perspective view of the bottom plate; Fig. 15 is a sectional view on the line 15—15 of the distributer shown in Fig. 5; Fig. 16 is a detail perspective view of the metallic cup or casing in which the interrupter is located; Fig. 17 is a sectional view on the line 17—17 of Fig. 5, the view being similar to Fig. 15; and Fig. 18 is a perspective view of the adjusting plate shown in Fig. 10.

Referring first to the construction illustrated in Figs. 1, 5, 6, 15 and 16; 20 indicates a cast metal plate bolted to the frame of the internal combustion engine and through which the cam shaft 21 of said engine passes, the casting plate being recessed to receive an absorbent packing washer 22. This washer prevents oil from following the cam shaft and seeping into the ignition apparatus. The front face of the casting plate is also formed with an annular boss 23 in which the steel cup or casing 24 of the interrupter is adapted to fit, said steel cup performing dual service being a retaining plate for the above mentioned washer that keeps oil from entering the ignition apparatus and with its closed sides entering into the distributer making the apparatus as a unit water tight. 25 is the distributer casing of bakelite electros or any suitable dielectric material, secured to the casting plate by means of cap screws 26 passing through integral lateral ears of the casing 25 into the casting plate 20, the casing being provided with an overlapping annular shoulder 25^a which bears upon the annular boss 23 at one side, said boss being cut away upon the opposite side to permit the movement of the lug 27 attached to the metallic cup 24, and it will be noted that the casing extends over and contacts with the outer edge of the metallic cup thereby positioning the same within the boss of the casting plate but permitting the same to be shifted back and forth as desired.

Attached to the bottom of the steel cup 24 is a brass plate 28 by means of a screw 29 passing through a curved slot 30 produced in said plate and by means of which the plate can be adjusted in order to cause the interrupter to become operative exactly upon the peak of the wave, and inasmuch as the mechanism herein shown and described is adapted for use in connection with a multipolar magneto having sixteen poles there will be thirty-two magnetic impulses at each revolution of the shaft inasmuch as there will be two revolutions of magneto to each revolution of cam shaft and consequently by means of an adjustment within the limits of $11\frac{1}{4}°$ it is possible to arrange the interrupter so as to break the circuit only upon the exact peak of the wave thereby securing the full force and effect of the electric impulses.

The plate 28 is provided with an adjustable contact point 31 and pivoted to said plate at substantially the opposite side is the curved arm 32 carrying a contact point 33 at the free end thereof, said arm 32 having a fiber projection 34 intermediate its ends and adapted to contact with the quadruple cam 35 by means of which the current is interrupted four times at each revolution of the cam shaft.

The contour of this cam is such that it closes the primary circuit four times for each revolution of shaft, to which it is attached, the time interval of each closed contact period is equivalent to one half of one wave period of current as generated by said multipolar magneto or to be exact $5\frac{5}{8}°$ of the cycle of cam shaft travel said cam being so positioned in relation to waves of current as generated by magneto, that the opening of closed contact points occurs coincident with the rise of voltage to its maximum. A spring 36 normally holds the arm 32 in its proper operative position with reference to the fixed contact point.

The casting plate 20 is formed with a radial tubular extension 20^a at one side thereof and in which is located a ball or sphere 37 which is adapted to engage one of a series of openings or depressions 38 produced in the side of the steel cup 24 for the purpose of holding said cup in its adjusted position, the ball or sphere 37 being held in contact with the steel cup by means of a spring 39 which in turn is secured by means of the plug 40 secured in the end of the tubular extension as most clearly shown in Fig. 6. The openings 38 are spaced $11\frac{1}{4}°$ from center to center so that in the adjustment of the cup for the purpose of retarding the spark the contacts will always be separated only at the peak of the wave.

It will be understood that the current from the magneto passes through the primary coil P before reaching the adjustable contact point 31 and at each interruption of the primary current, induced currents will be set up through the secondary coil S, and from this secondary coil the conductor wire leads to a spring pressed contact point 41 arranged centrally in the distributer casing 25 and adapted to engage the contact plate 42 embedded in a disk 43 of dielectric material, said disk being rigidly connected to a nut 44 screwed upon the end of the cam shaft 21. The contact plate 42 extends exactly to the outer edge of the disk 43 which is made slightly smaller than the internal diameter of the casing 25, and embedded in the non-conducting walls of the casing are the contact blocks 45 located at angles of 90° apart, the inner faces of said blocks being flush with the interior of the casing and curved upon the same arc as the interior walls of said casing so that as the disk rotates, carrying with it the contact plate 42, the current, being of high potential, will pass from said

plate to the contact blocks while the plate and blocks are in juxtaposition, this taking place simultaneously with the interruption of the current through the medium of the cam inasmuch as the plate 42 is positioned so as to be in juxtaposition with one of the contact blocks at each interruption of the current.

As before stated the contact blocks 45 are embedded in the casing 25 of dielectric material and each block 45 has an extension or lug 45^a, which lugs are so positioned that the conductor wires can be readily connected thereto, these extensions being positioned in such a manner with reference to the contact blocks that all interior connections are in a straight line. From the contact blocks 45 and the extensions or lugs 45^a the conductor wires lead to spark plugs in the cylinders of the internal combustion engine as most clearly shown in Fig. 4.

In addition to the primary and secondary windup heretofore referred to, I provide a supplemental winding which is in inductive relation to both the primary and secondary windings of the induction coil and which when closed has a tendency to concentrate the lines of force and keep the induced current within predetermined limits, eliminating all tendency to superimpose secondary waves, and consequent surging of magnetic action in the core, thereby retarding the magnetic flux in the coil with consequent retardation of current wave.

In Fig. 4 I have shown the switch, by means of which the current is closed, as provided with means for closing the supplemental circuit above referred to, but it will be understood that this supplemental circuit can be closed by any other independent switch if desired. It will also be understood that the usual form of condenser, C will be employed in connection with the induction coil, but experience has demonstrated that by the use of the supplemental circuit a condenser of much smaller capacity can be employed.

In the construction shown in Fig. 2 the casting plate 20^b is formed with a gear case which has a lateral extension 20^c and fitting upon said gear case and extension is a cap plate 20^d. A gear 20^e is mounted upon the end of the cam shaft 21 which gear 20^e meshes with an idler 20^f which in turn transmits power to a gear 20^g mounted upon the end of the shaft 21^a which carries the interrupter, which is substantially the same as that previously described so far as general features of construction and operation are concerned. The distributer casing 25^b differs slightly in construction inasmuch as the conductor wires are carried out horizontally instead of vertically as shown in Figs. 1 and 5. The brass plate 28^a is formed with an extension 28^b to which the operating rod is connected, said extension 28^b carrying a spring 28^c connected thereto and adapted to engage the serrated edge 28^d formed in the periphery of the plate 28^e to which the distributer casing is bolted. This plate 28^e has a tubular hub portion 28^f through which a set screw 28^g is adapted to pass for the purpose of securing the distributer in its proper adjustment in order that the distribution and interruption may take place only at the peak of the wave.

The construction and arrangement of the rotary disk and distributer plate is substantially identical with those previously described and the general mode of operation identical, it being understood that in connection with this form of device the primary, secondary and supplemental coils are arranged and operate in the same manner.

In the construction shown in Fig. 3 a bevel gear 50 is mounted upon the forward end of the cam shaft and meshes with a similar gear 51 mounted upon the lower end of a shaft 52 journaled in a casing 53 fastened upon the front casting plate 20 by means of suitable arms or extensions. The bearing 54 through which the shaft 52 passes also serves as the support for the plate 55 to which the distributer casing 25^c is attached, the plate 55 having a tubular hub portion which fits upon the bearing 54 and is secured by means of a set sscrew 56 at the proper point of adjustment in order that the current interruption may take place only at the peak of the wave. In this construction and that shown in Fig. 9 this initial adjustment is accomplished by shifting the position of the distributer casing upon the support and then securing the same, whereas in the construction shown in Figs. 1, 5 and 6 the brass plate within the metal cup is shifted in the proper direction and then secured.

This initial shifting may or may not be necessary in order to properly position the various operating parts in order to bring them all into synchronous operation, but after the initial adjustment has once been obtained no further adjustment of the distributer as a whole is necessary and the advancement or retardation of the spark is accomplished by the shifting of the metal cup in Figs. 5 and 6, and the base plates in Figs. 8 and 9 and 11 and 12, and all of the adjustments for advancing and retarding the spark are indexed upon the angle of $11\frac{1}{4}°$ so that with a sixteen-pole magneto there is bound to be proper synchrony between the various moving parts after the initial and proper position has once been obtained, as it is obvious that each and every retarding or advancing movement must be in the proper relative amount.

In the construction illustrated in Figs. 3, 10, 11, 12 and 13 the distributer is held in

its adjusted position by means of a spring pressed ball or sphere 37^a registering with one of a series of depressions 38^a produced in the metal plate 38^b to which the distributer casing is attached, the ball or sphere 37^a being held in place within a tubular cap 38^c provided with a coil spring 38^d normally holding the ball or sphere in sufficient pressure to lock the casing at the desired point of adjustment but readily permitting movement when desired.

The contact points and the means for separating them are substantially similar to those previously described. The contact plates however are of somewhat different construction, there being two plates 60 and 61 arranged one above the other and secured to the top of the dielectric disk mounted upon the end of the rotary shaft. The plate 60 has a notch 60^c at one end and the plate 61 has a tongue 61^a at its end and these two plates are placed together and fastened so that the tongue 61^a extends up through the slot or notch in the end of the plate 60 and is projected into a central position so that it contacts with the source of supply at the center of the distributor casing, while the broad unbroken end of the plate 60 projects slightly beyond the rotating disk and is positioned to contact respectively with the contacts leading to the spark plugs.

By means of the two spring plates interposed one upon the other in a manner herein shown and described any variation in the operating parts will be compensated for. In this construction as in the others the primary, secondary and supplemental coils are connected, arranged and operated in the same manner and for the same useful purposes. The operation of the system as a whole is apparent from the drawing and description and it will thus be seen that I provide a simple and highly efficient ignition system particularly adapted for use in connection with a multipolar magneto, and which will completely eliminate the use of a separate coil for each cylinder and consequently conserve a proportionate reduction in the use of current.

Furthermore I am able to initially adjust the moving parts so that the current interruption will occur only at the peak of the current wave; and finally by the use of the supplemental circuit I am able to concentrate the lines of force and keep the induced currents within predetermined limits thereby eliminating all tendency to superimpose secondary waves and consequent surging of magnetic action in the core, this being a highly advantageous result inasmuch as the current wave is transformed from a sharp jagged uneven contour into a steady undulating wave of sine form and from which a spark of much greater intensity is produced.

Having thus described my invention, what I claim is:—

1. In an ignition system, an interrupter comprising an adjustable contact point, a movable arm carrying a contact point, a rotating shaft and cam for operating said arm, and a base plate to which said arm is attached, said base plate being adjustable to synchronize said interrupter with the current impulses flowing therethrough, and independent means for adjusting said interrupter with reference to said shaft.

2. In an ignition system the combination, with a cam shaft, of a recessed casting plate, a washer surrounding said shaft and located in such recess, an annular boss upon said plate, a cup located in said boss, an interrupter mounted within said cup, and a distributer mounted upon said casting plate and covering said cup.

3. In an ignition system the combination, with a cam shaft, of a casting plate having an annular boss and a recess, a cup located in said boss and a washer located in said recess between said plate and cup, an interrupter arranged within said cup, means for adjusting said interrupter with reference to said cup, independent means for adjusting the cup, and a distributer casing attached to said casting and covering said cup.

4. In an ignition system the combination, with a cam shaft, of a casting plate having an annular boss and a recess, a cup arranged in said boss and a washer of absorbent material arranged in said recess between said cup and plate, means for adjusting said cup a definite distance, means for holding the cup so adjusted, and a distributer casing attached to said plate and covering said cup.

5. In an ignition system the combination, with an independent source of electric energy, of a casting plate, a cam shaft passing therethrough, an interrupter surrounding and operated by said cam shaft, and a distributer arranged upon said interrupter and fixedly connected to said plate, said interrupter being movable with reference to said cam shaft and distributer.

6. In an ignition system the combination, with an independent source of periodic current, of a cam shaft, an adjustable interrupter arranged therewith and operated thereby, a distributer casing arranged in operative relation to said interrupter and having a centrally arranged contact point and a plurality of spaced contact blocks, a contact plate adapted to engage said point and blocks, said plate being an extension of but insulated from said shaft, said blocks being of greater width than the thickness of the contact plate whereby lateral variance of position of said plate can be accommodated.

7. In an ignition system, a distributer comprising a casing having a cylindrical

opening, contact blocks embedded in the wall of said opening, the inner faces of said blocks being curved upon the arc of a circle and coinciding with the face of said wall, said blocks having integral extensions arranged in pairs, the extension of each pair being spaced in the direction of the axis of said opening but being in a plane including said axis, whereby straight line connections can be had within the casing and in one direction.

8. In an ignition system, a distributer comprising a casing of dielectric material, a plurality of exterior connections carried by said casing, a centrally arranged contact point having a straight line connection with one of said exterior connections, and a plurality of contact blocks spaced at definite points and having interior straight line connections with their respective exterior connections, together with a rotating member carrying a contact plate adapted to engage said contact point and blocks, said interior connections being at right angles to the axis of rotation of the said member.

9. In an ignition system, an interrupter comprising an adjustable contact point, a movable arm carrying a contact point, a rotating shaft and cam for operating said arm, and a support to which said arm is attached, said support being adjustable to cause the operation of said interrupter to bear a definite relation to the wave of an exterior source of alternating current, means for holding said support in the adjusted position and independent means for adjusting said interrupter with reference to said shaft including a plurality of equally spaced positions each bearing the same relation to the wave of said alternating current.

10. In an ignition system the combination of a casting plate having an annular boss, said annular boss having a tubular radial projection, a cup arranged in said boss, said cup having at one side adjacent the extension of the boss a plurality of openings or depressions, and openings or depressions being spaced at definite points, means for shifting said cup within said boss, and spring-actuated locking means arranged in said boss extension and adapted to engage said openings or depressions in the cup and hold the same in any one of its adjusted positions, together with an interrupter arranged within said cup.

11. In an ignition system, an interrupter comprising an adjustable contact point, a movable arm carrying a contact point, a rotating shaft and cam for operating said arm, and a support to which said arm is attached, said support being adjustable to vary the operation of said interrupter between the limits of maximum and minimum current values of an alternating current, means for retaining said support in the adjusted position and additional means for adjusting said interrupter about said shaft and cam to a plurality of positions each of which shall cause said interrupter to operate at a current value equal to that obtained by the adjusted position of said support.

In testimony whereof, I hereunto affix my signature.

WILLIAM W. HAWKINS.