W. F. NICKEL.

MAGNETO IGNITION SYSTEM FOR INTERNAL COMBUSTION ENGINES.

APPLICATION FILED NOV. 23, 1910.

1,050,162. Patented Jan. 14, 1913.

4 SHEETS—SHEET 1.

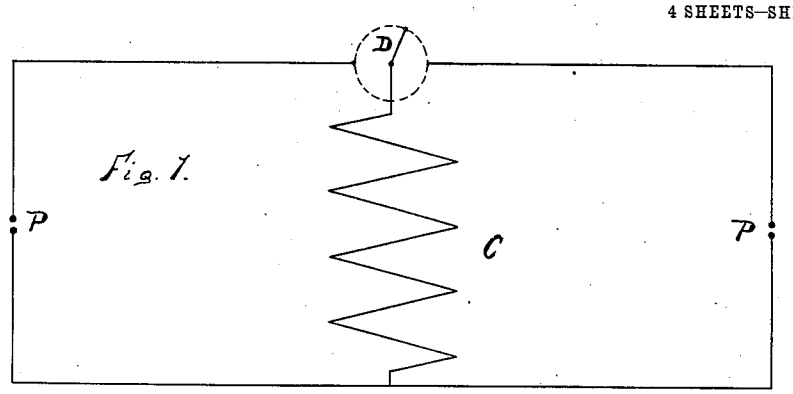

Fig. 1.

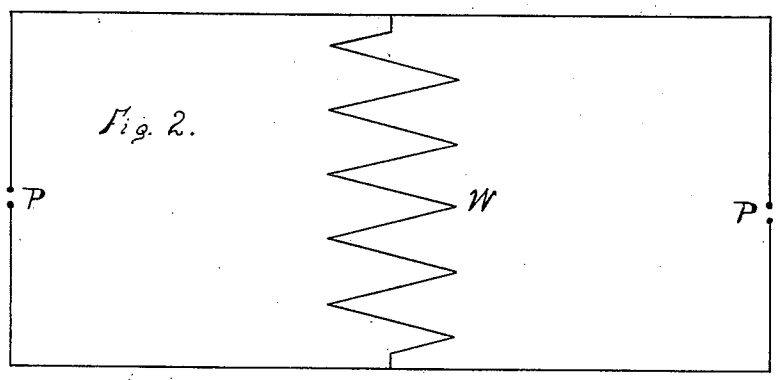

Fig. 2.

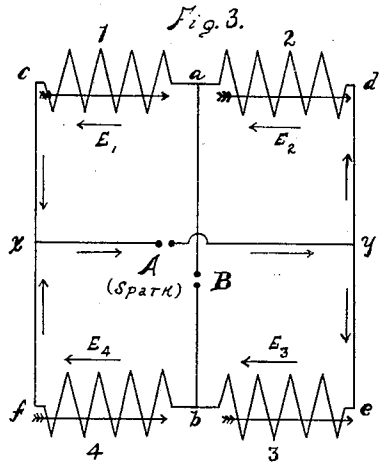

Fig. 3.

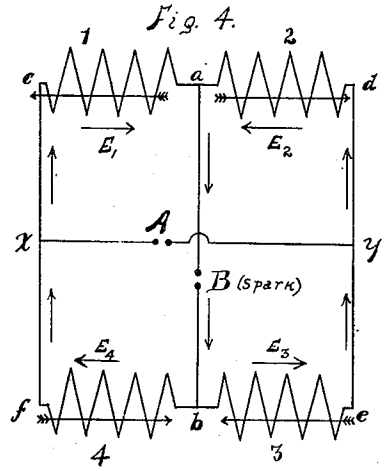

Fig. 4.

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Fig. 5.

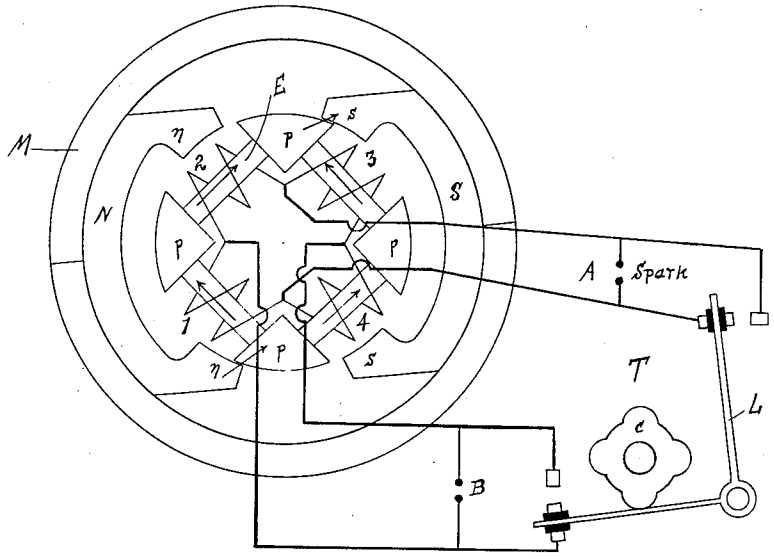

Fig. 6.

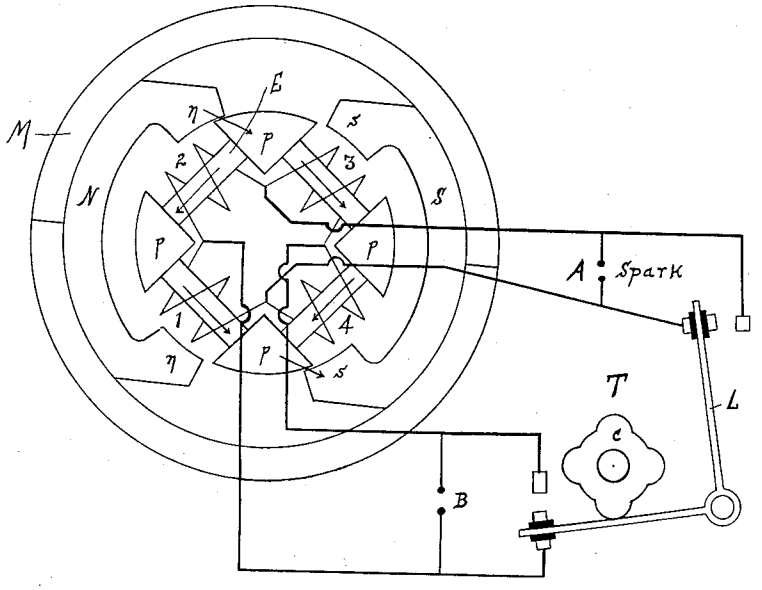

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Fig. 7.

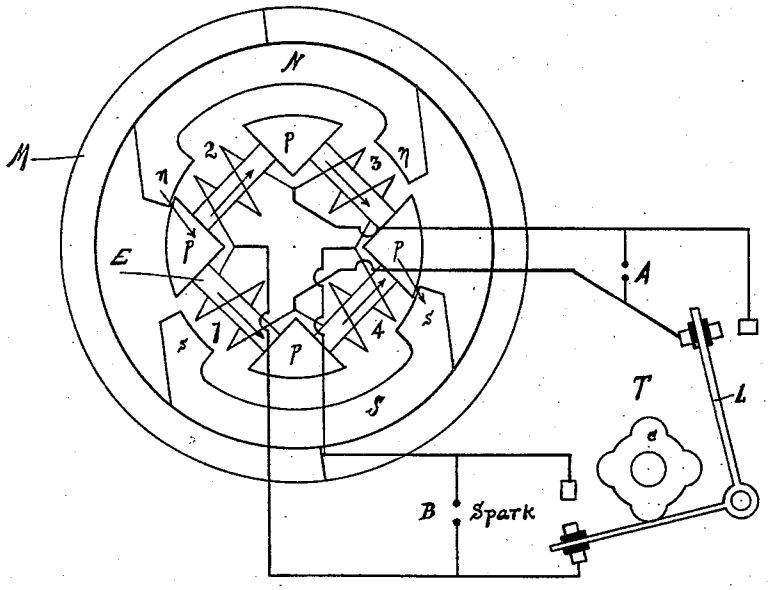

Fig. 8.

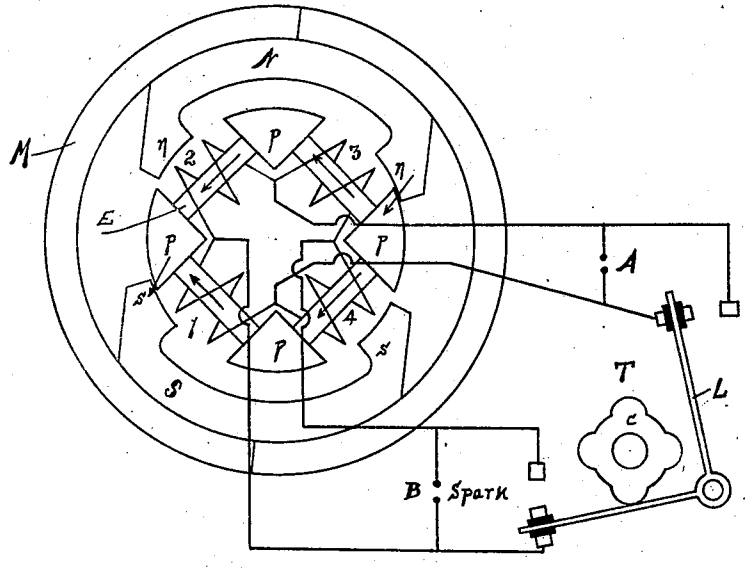

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Fig. 9.

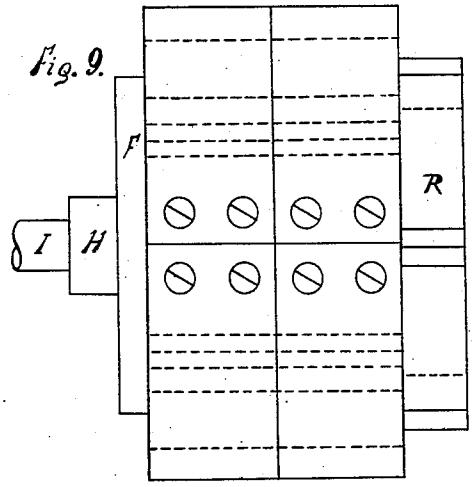
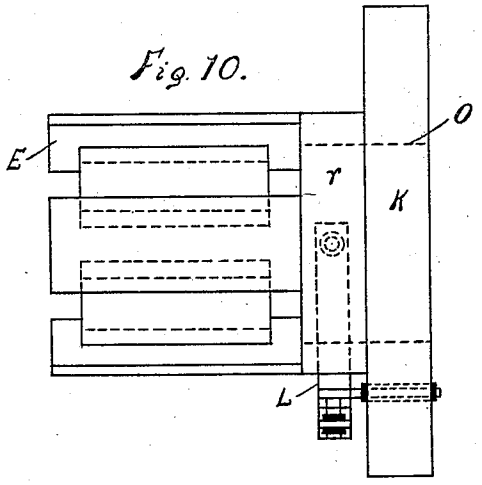


Fig. 10.



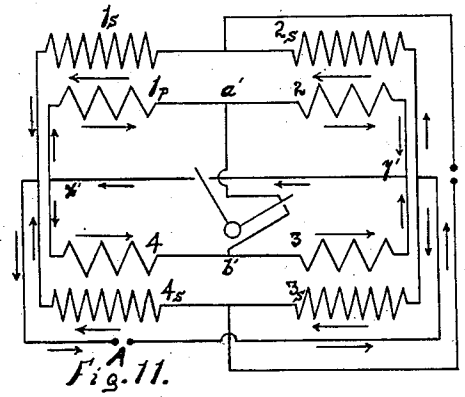


Fig. 11.

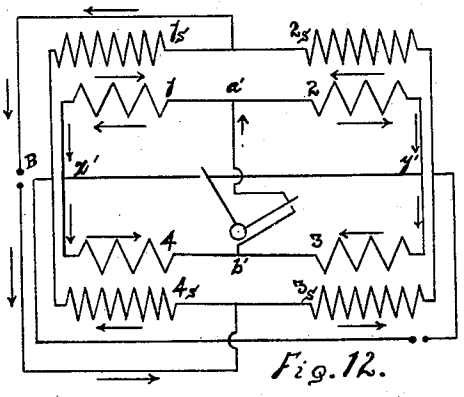


Fig. 12.

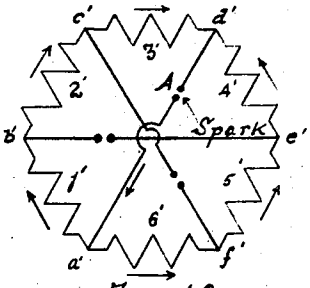


Fig. 13.

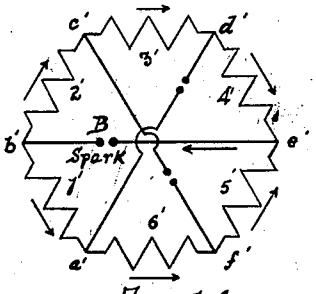


Fig. 14.

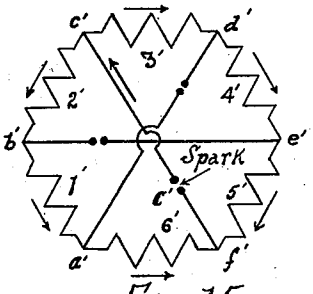


Fig. 15.

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MAGNETO IGNITION SYSTEM FOR INTERNAL-COMBUSTION ENGINES.

1,050,162. Specification of Letters Patent. Patented Jan. 14, 1913.

Application filed November 23, 1910. Serial No. 593,849.

To all whom it may concern:

Be it known that I, WILLIAM F. NICKEL, a citizen of the United States, and a resident of the city of Brooklyn, in the county of Kings and State of New York, have invented certain new and useful Improvements in Magneto Ignition Systems for Internal-Combustion Engines, of which the following is a full, clear, and exact description.

My invention relates to an ignition system of the high or low tension variety for explosion engines of the multi-cylinder type; that is, for engines having two or more than two cylinders. Its object is to produce ignition in regular sequence in the cylinders of such an engine by means of a single source of electricity comprising an electrically-conductive path formed of generating elements preferably in the form of windings in which the current is generated, and to which the igniters of the engine may be connected without the use of a distributer or circuit controller having fixed and movable contacts such as has heretofore been used in the circuits of most ignition systems that have proved to be of practical importance. Moreover I seek to attain this end without sacrificing any of the advantages incidental to ignition systems which employ the devices which it is my purpose to eliminate; such advantages being cheapness, simplicity, regularity and certainty of operation, facility in timing by advancing and retarding the spark, and others. These objects are attained, according to the best manner now known to me, by an arrangement of circuits which are supplied with current from a source of electric energy of the type above mentioned; and in which the connections, that is to say the conductors leading from the generating path through the electric source to the different igniters, may all be complete and unbroken at the moment when a spark is required in a certain cylinder, or at the times of all the events in the cycle of operations of the engine, the reed for a distributer thus being entirely obviated. It is in this respect that my invention, which as above noted, relates to a high or low tension ignition system, differs most radically from the ordinary systems now in use. In such systems, the spark plugs can not all be connected at one time to the generating path which forms the internal portion of the circuit in which the source of electricity is placed; but are put in circuit therewith by turns through the operation of the moving distributer contact only at the instant when it is desired to ignite the explosive charge.

Referring to the drawings, which exhibit an embodiment of my invention, and diagrammatically illustrate the principle employed:—Figure 1 is a diagrammatic illustration of the ordinary low tension ignition system now employed, including the distributer; Fig. 2 shows my improved ignition system in outline, the distributer being omitted, and all the spark points being connected at one time to the internal or generating portion of the ignition circuit system located within the source of electric energy; Fig. 3 and Fig. 4 are explanatory diagrams; Fig. 5 shows a magneto embodying my invention; Fig. 6, Fig. 7 and Fig. 8 show the magneto in different operative positions; Fig. 9 shows in side elevation the magneto and pole pieces (the latter being in dotted lines) of the magneto shown in Figs. 5, 6, 7, and 8; Fig. 10 shows a side elevation of the armature of the magneto and a support therefor; Figs. 11 and 12 are views similar to Figs. 3 and 4, showing an embodiment of the principle governing my invention in an arrangement of primary and secondary windings; Fig. 13, Fig. 14, and Fig. 15 are explanatory views, showing how the principle governing my invention can be applied to an engine having more than two cylinders.

On all the views, the same reference characters are employed to designate like parts.

On Fig. 1 the letter C represents the generating coil of a low tension magneto of the ordinary type. One end of this coil is connected through ground or in any other way to the terminals of a number of low tension spark plugs P, as shown, these plugs being preferably of the magnetic type, and the other terminal of this coil is arranged to be connected at the proper instant to each one of the insulated terminals of the spark plugs in turn by means of a rotating distributing arm D. The parts of the magneto are not illustrated, and it is not believed to be necessary that they should be. The object of this figure is simply to show

in diagram a low tension ignition system using a distributer to close the circuit to the spark plugs in regular order, and to contrast such a system with my own system, wherein the distributer is entirely omitted.

Fig. 2 is a diagrammatic representation of my ignition system, showing how the terminals of the low tension coil may be connected directly without using a distributer or other circuit controller to the terminals of the spark plugs P. The current passes first to the spark plug at the right; and though the spark plug at the left may be at this instant connected electrically to the terminals of the wire generating coil W no current passes to the spark plug P on the left at all. At the next ignition period the current passes to the spark plug P on the left, and though the plug at the right may remain in the circuit with the generating coil, this plug produces no spark at this instant but remains absolutely inactive. This novel mode of operation depends upon the way in which the generating coil W is wound; and I attain the production of a spark, first at one plug, and then at the other, without having to break the circuit to either, or employing a distributer to control the current, by winding the coil W in sections in the following manner.

I refer to Figs. 3 and 4, which illustrate the principle controlling the above operation. On those two views, 1, 2, 3 and 4 are four sections of a coil of wire, the four sections making a continuous generating winding, corresponding to the coil W shown on Fig. 2. Each of these sections consists of the same number of turns of the same sized wire; and each turn is to have such a shape that it will inclose a figure of the same outline or periphery and of the same cross-sectional area so that the inductance and resistance of all the sections are equal. For example, if the turns are wound circularly, all the circles would have the same diameter. Now, let an electromotive force be generated in each section by means of a magnetic flux threading through the windings; this magnetic flux consisting of the same number of lines of force for each of the four sections, and threading through each in the same instant of time. Further, let the distribution be such that the strength of the magnetic field or induction per square centimeter is the same for each of the four sections. Now, if this flux indicated by large arrows thread through all the sections in the same direction, say from left to right, and if the sections are all wound in the same direction in passing around the circuit of the four sections and back again, an equal electromotive force will be generated in each section, and these electromotive forces will all be in the same direction, that is, say from right to left. These electromotive forces are indicated on Fig. 3 by the letters E_1, E_2, E_3, and E_4, and the direction of the same is indicated by the arrows.

It follows from the above conditions that the resistance and the inductance of each of the four sections will be equal. Consequently the currents due to the electromotive forces will also be equal for each one of the four sections. It will be noted, that when the electromotive forces all take the direction shown on Fig. 3, sections 1 and 2 will be in series, and sections 3 and 4 will be in series. Sections 1 and 2, however, will be in parallel with sections 3 and 4. Current will consequently flow along conductor x—y, which connects points midway between sections 1 and 4 and 2 and 3, and across an igniter shown at A, if the voltage is high enough. Now the fall of potential, keeping in mind the above conditions, from the point d to the point a will be half the fall or drop from the point d to the point c. As the drop from d to c is the same as the drop from e to f, the drop from the point d to the point a will equal the drop from the point e to the point b. As a result there will be no difference of potential between the points a and b, and no current at this time will flow between points a and b. If the points a and b be connected at this time by an electrical conductor, no current will flow over this conductor. If this conductor lead to the sparking points of a gas engine igniter, this igniter will remain inactive, and no distributer will be needed to break the circuit and cut out this igniter, which is indicated at B. All the current will pass across at the device A, as above described. Next, let an electromotive force be generated in each of the four sections as before. Let the magnetic flux take the same direction in two of the sections, say the sections 2 and 4; but let the flux be reversed in sections 1 and 3. The electromotive forces in the two sections 1 and 3 will likewise be reversed in consequence, while the electromotive forces in the other two sections are in the same direction as in the former case. The reversals mentioned are indicated by the arrows on Fig. 4. Sections 1 and 4 will now be in series, and sections 2 and 3 in series. Sections 1 and 4, however, will now be in parallel with sections 2 and 3. All of the electrical conditions described in connection with Fig. 3 will now be reproduced, but on account of the changed electrical relations of the sections all of the current now passes to the igniter B, and none at all to the igniter A, even if the conductor connecting A to the points x and y is not interrupted. This is because the drop between the points b and y is the same as the drop between the points b and x, and no difference of potential exists between the points

x and y, to which the igniter A is connected. By such an arrangement of circuits, the igniters may remain permanently connected to the generating windings of the source of electrical energy, and no distributer is needed to control the passage of the current. Further all the generating elements or windings are simultaneously energized to generate current, and each cooperates with all the rest at each instant of ignition. Obviously the igniters A and B will be located in different engine cylinders.

Figs. 5, 6, 7, and 8 show a magneto embodying the principle illustrated in Figs. 3 and 4. This magneto has semicircular magnets M bent in the form of a semicircle, and assembled with their like poles adjacent, so as to form a complete circle. The magnets M are fastened to pole pieces of soft iron N and S, each of which has two polar projections n—n and s—s respectively. The polepieces N, S and the magnets M form a rotatable unit. The armature E is made of soft iron and is approximately ring-shaped as shown. This armature has four polar projections p and between these polar projections are placed the sections 1, 2, 3, and 4 all wound in the same direction around the ring. These four sections constitute the generating windings, and are all numbered to correspond with the sections shown on Figs. 3 and 4; and are connected in the same manner to igniters A and B. T is a timer having two sets of insulated contacts, one pair of contacts serving to shortcircuit the igniter A and the other pair to shortcircuit the igniter B. The interrupter lever carrying the movable contacts is indicated by L and this lever is actuated by a cam c.

As shown on Figs. 5 and 6, the sections 1 and 2 are in parallel with sections 3 and 4. When the magnets rotate from the position shown on Fig. 5 to the position shown on Fig. 6, they pass through the point of maximum induction and the lines of magnetic force are reversed through the iron portions of the armature E in the same way as in the well known shuttle wound armature commonly used on ignition magnetos when it passes through its mid position between the permanent magnets. This reversal is indicated by arrows. The result is a sudden change of the lines of force through the sections, giving rise to a high voltage. At this moment the timer cam operates the lever L breaking the short circuit around the igniters, and producing a spark at the igniter A. No spark, however, is produced at B, although the short circuit is broken around the igniter B at the same time, because, as explained above, there is no electromotive force at this time in the conductors for connecting the igniter B with the midpoint of the wires connecting sections 1 and 2 and 3 and 4. When the magnets and polepieces N and S have rotated through 90 degrees the next ignition period is reached. Sections 1 and 4 are now in parallel with sections 2 and 3, and the conditions are the same as described in connection with Fig. 4. This condition is illustrated on Figs. 7 and 8. When the magnets rotate from the position shown on Fig. 7 to that shown on Fig. 8, the lines of force are reversed through the armature and the sections thereon, producing a maximum voltage the same as before, and when the timer is operated, the spark is produced at the igniter B. At this time the igniter A is inactive.

By the above construction a spark takes place four times for each revolution, twice at A and twice at B. This makes it possible to rotate the magnets at half the speed of the ordinary bipolar shuttle wound machine, wherein only two sparks per revolution can be obtained. This means the saving of a great deal of wear, which is no inconsiderable object.

Obviously I might employ a separate timer lever for the igniter A and a separate timer lever for the igniter B, operating each separate lever by turns. The timer, however, in no wise distributes the flow of current to the igniters, since that object is obtained solely by the arrangement of windings and their relation to the magnetic field in the manner shown. The function of the timer is simply to fix the exact instant when the spark is to pass at one igniter or the other, and not by any means to determine the particular igniter at which the spark is to be produced.

Obviously by using a sufficient number of turns, and sufficiently strong magnets, even the timer could be dispensed with, so that the magneto would operate without either a timer or distributer to supply current to the igniters in the manner shown. Under such circumstances the polar projections of the magnets and the armature would have to be given an especial shape, so that the reversal of the lines of force would take place through the sections with great suddenness at each instant when a spark is required.

Fig. 9 shows a side view of the magnets, and the inside polepieces. The polepieces N and S are fastened at one end to a disk F which has a hub H to receive a driving shaft I. To the other end of the polepieces N and S is secured a cam ring R which has four cam projections to operate the timer lever L. Fig. 10 is a side view of the armature, which is fastened at the right to the ring r, which is bolted or fastened in any other way to the support K. This support also carries the interrupter lever as shown. Support K has an aperture O shown in dotted lines therethrough, to give passage

for the armature wires, which are led out through the hollow interior of the armature E. The ring r serves as a bearing support for the ring R on the magnets, and the left end of the armature can be conveniently supported in a recess in the disk F when the parts are assembled. The operation of assembling is accomplished by simply inserting the armature E into the space between the polepieces N and S, till the ring R rests upon and surrounds the ring r.

Figs. 11 and 12 show views similar to Figs. 3 and 4, but with both primary and secondary windings. The arrows and reference characters correspond to those on Figs. 3 and 4, and a jump spark is obtained at the spark gaps B and A whenever the circuit through the conductor a', b', or through the conductor x' y' is broken. When the circuit is broken through a' b' (Fig. 12), with the sections 1 and 4 in parallel with sections 2 and 3, the sections 1 and 2 oppose each other likewise sections 3 and 4, and the current at once falls to zero, inducing a high voltage in the secondaries. This secondary voltage behaves exactly in the manner explained in regard to the Figs. 3 and 4 and produces a spark at B. When the primary circuit is broken through the conductor x' y' (Fig. 11), with sections 1 and 2 in parallel with sections 3 and 4, the operation is the same, producing a spark at A. It thus appears that the armature of my magneto, as shown on Figs. 5, 6, 7 and 8 can be wound with primary and secondary sections and made to produce a high tension current for ignition purposes, as well as with low tension sections for low tension currents.

Figs. 13, 14 and 15 illustrate a method of effecting ignition in regular sequence in the cylinders of an engine having more than two cylinders. These three views have reference to a three cylinder engine. Six sections are employed, indicated by 1′, 2′, 3′, 4′, 5′ and 6′. The points between these six sections are connected by conductors a' d', b' e' and c' f', as shown, and an igniter may be placed in each one of these three conductors. Each of the sections will be designed to have the same resistance and the same inductance, exactly as in the preceding cases. Suppose now that the same electromotive force be generated in each of the six sections by the same number of lines of force threading through them in the same instant of time. Suppose the six sections are all wound in the same direction around the ring, and the direction of the magnetic flux is such that the E. M. F.'s of the section 1′, 2′ and 3′ are in series, and those of the sections 4′, 5′ and 6′ are in series; but the first three sections are in multiple with the second three. Under such conditions current will flow only through the conductor a' d', and produce a spark at A′. No current will flow through the other two conductors. The reason for this is plain. The section 6′ is subjected to the full difference of potential between the points a' and c'. This difference of potential will oppose the E. M. F. in section 6′ and would be sufficient to send a current, driven by an E. M. F. equal to that in the section 6′, through this section in the opposite direction. But the section 1′ is subjected to the full difference of potential between the a' and e', and this potential difference is enough to send a current driven by an equal E. M. F. to that of the section 1′ through this section in the opposite direction. This reverse E. M. F. equal to that of a single section, neutralizes the resultant reverse E. M. F. in the section 6′, and the result is that there is no current flowing across between the points b' and e', c' and f'. By reversing the E. M. F. of the sections 1′ and 4′, causing the sections 2′, 3′ and 4′ to be in parallel with sections 5′, 6′ and 1′, as on Fig. 14, the current all passes through the conductor b' e' to the exclusion of the other two, and a spark is obtained at the igniter B. And by reversing the E. M. F. at the next ignition period in the sections 2′ and 5′, throwing sections 3′ 4′ and 5′ in parallel with sections 6′, 1′ and 2′, the current all passes over the conductor at c' f', producing a spark only at the igniter C′. For a four cylinder engine eight sections would be used and there would be four conductors leading to four igniters. This principle could also be embodied in an igniter for an engine having more than four cylinders.

It will be observed that regardless of the number of cylinders employed the sections of the generating windings constitute but a single generating source, and all the igniters may be directly connected thereto at each ignition period, the passage of the current to the proper igniter being automatically controlled without the use of a distributing circuit controller of any kind. Further, the generating elements or windings which form the electrically-conductive or generating path through the magneto are so connected to one another and to the igniters as to cause current to pass from all of the generating elements to each igniter in turn at successive instants of ignition.

In conclusion, it is to be noted that for a three cylinder engine, the windings shown on Figs. 13, 14 and 15 would be wound on a ring having six polar projections instead of four, as on Figs. 5, 6, 7, and 8, and for a four cylinder engine, the armature would have eight polar projections.

In closing it is to be observed that the embodiment of my invention set forth in Figs. 13, 14 and 15 may be wound with low tension wiring, in which case low tension igniters, preferably of the magnetic break

type will be connected at A, B and C; while if high tension effects are to be produced, primary and secondary windings will be employed after the manner set forth on Figs. 11 and 12. In the latter case the secondary sections will be located on the armature in inductive relation to the six low tension or primary sections 1′, 2′, 3′, 4′, 5′ and 6′. The same is true of the modifications described for producing ignition without a distributer in engines which have more than three cylinders.

Referring to the sources of electricity shown on the drawings, it will be observed that the magnets constitute primarily the means for creating an electromotive force in the windings; the arrangement of polepieces on the magnets and the armature constitute means for controlling the action of the magnetic field, so as to change the parallel relations of the winding sections; while the magnets and the polepieces thereon and on the armature together constitute means for generating current in such a way as to cause current to pass to a different igniter at successive instants of ignition. It is to be further observed that in all the forms of electric generating means indicated, the winding sections constitute an electrically conductive multiple path in which current is generated to supply the igniters with electric energy.

It is evident from the above description that no distributer is needed in my ignition system to cause current to pass to each ignition circuit in turn. This result is obtained by the manner in which current is generated in the source of electricity; and the actual employment of a distributer or similar circuit controller in the ignition circuits above described would not interfere with or change in any way the action of the sections which make up the generating windings of the magneto.

Having described my invention, what I claim as new and desire to secure by Letters Patent of the United States is as follows:—

1. In an ignition system for internal combustion engines, the combination of a plurality of igniters, a source of electricity for supplying current to said igniters, and conductors connecting all of the said igniters to the said source at each period of ignition, said source having means for generating current in such a way as to cause current to pass from all of its generating elements to a different igniter at each successive instant of ignition.

2. In an ignition system for internal combustion engines, the combination of a plurality of igniters, a source of electricity for supplying current to said igniters, and conductors connecting all of the said igniters to the said source at each period of ignition, said source having magnetic means for generating current in such a way as to cause current to pass from all of its generating elements to a different igniter at each successive instant of ignition.

3. The combination of a plurality of circuits, means in said circuits consuming current at recurring periods, a source of electricity for supplying current to said circuits, and conductors connecting said source to all of said circuits at each of said periods, said source having means for generating current in such a way as to cause current to pass from all of its generating elements to a different circuit at each of said periods.

4. The combination of a plurality of circuits, means in said circuits consuming current at recurring periods, a source of electricity for supplying current to said circuits, and conductors connecting said source to all of said circuits at each of said periods, said source having magnetic means for generating current in such a way as to cause current to pass from all of its generating elements to a different circuit at each of said periods.

5. In an ignition system for internal combustion engines, the combination of a plurality of igniters, a source of electricity comprising generating windings for supplying current to the said igniters, and conductors connecting all of the said igniters to the said source of electricity at each period of ignition, said source having means for generating current in such a way as to cause the current to pass from all of said windings to a different igniter at successive instants of ignition.

6. In an ignition system for internal combustion engines, the combination of a plurality of igniters, a source of electricity comprising generating windings for supplying current to said igniters, and conductors permanently connecting all of the said igniters to said source of electricity, said source having means for generating current in such a way as to cause the current to pass to a different igniter at each successive instant of ignition.

7. In an ignition system for internal combustion engines, the combination of a plurality of igniters, a source of electricity comprising a set of windings for supplying current to said igniters, and conductors connecting the said source to all of the said igniters at each period of ignition, said source having means for generating electricity in such a way as to cause the current to pass from all of said windings to a different igniter at each successive instant of ignition.

8. In an ignition system for internal combustion engines, the combination of a plurality of igniters, a source of electricity comprising a set of windings for supplying electricity to said igniters, and conductors

permanently connecting the said source to all of the said igniters, said source having means for generating electricity in such a way as to cause the current to pass from all of said windings to a different igniter at successive instants of ignition.

9. In an ignition system for internal combustion engines, the combination of a plurality of igniters, a source of electricity comprising a set of generating windings to supply current to said igniters, and means for connecting the said source to all of the said igniters at each period of ignition, said source having means for generating electricity in such a way as to cause current to pass from all of said windings to a different igniter at each successive instant of ignition.

10. In an ignition system for internal combustion engines, the combination of a plurality of igniters, a source of electricity comprising a set of generating windings for supplying current to said igniters, means for creating an electromotive force in said windings, means for controlling the action of the first-named means to put certain of said windings in parallel with the remainder of said windings, at each period of ignition and for changing the parallel relations of the said windings at successive periods of ignition and means for connecting all of the said igniters to the said source at each ignition period, whereby the current will pass to a different igniter at successive instants of ignition.

11. In an ignition system for internal combustion engines, the combination of a plurality of igniters, a source of electricity comprising a set of generating windings for supplying current to the said igniters, means for creating an electromotive force in the said windings, means for controlling the action of the first-named means to put certain of said windings in parallel with the remainder of the said windings, at each period of ignition and for changing the parallel relations of the said windings at successive periods of ignition and means for connecting all of the said igniters directly and permanently to the said source, whereby the current will pass to a different igniter at successive instants of ignition.

12. In an ignition system for internal combustion engines, the combination of a plurality of igniters, generating windings for supplying current to the said igniters, said windings being closed on themselves, means for connecting all of the igniters directly and permanently to the said windings, said means joining the opposite terminals of the individual igniters to diametrically opposite points located at equidistant intervals in the closed circuit of said windings, means for creating electromotive forces in the generating windings, means for controlling the action of the creating means to put the electromotive forces in the halves of the generating windings bounded by said diametrically opposite points in parallel at each period of ignition and for shifting the terminal points of said halves at successive periods of ignition, whereby all the current passes to a different igniter at successive instants of ignition.

13. In an ignition system for internal combustion engines, the combination of a plurality of igniters, generating windings for supplying current to the said igniters, said windings being closed on themselves, means for electrically connecting all of the said igniters simultaneously to the said windings, said means connecting the opposite terminals of the individual igniters to diametrically opposite points at equidistant intervals in the closed circuit of the said windings, means for creating electromotive forces in the generating windings, means for controlling the action of the creating means to put the electromotive forces in the halves of the generating windings bounded by said diametrically opposite points in parallel at each period of ignition and for shifting the terminal points of said halves at successive periods of ignition, whereby all the current passes to a different igniter at successive instants of ignition.

14. In an ignition system for internal combustion engines, the combination of a plurality of igniters, generating windings comprising a set of sections for supplying current to the said igniters, said windings being closed on themselves, means for connecting all of the said igniters directly and permanently to the said windings, said means joining the opposite terminals of the individual igniters to diametrically opposite points located at equidistant intervals in the closed circuit of said windings, means for creating electromotive forces in the generating windings, means for controlling the action of the creating means to put the electromotive forces in the halves of the generating windings bounded by said diametrically opposite points in parallel at each period of ignition and for shifting the terminal points of said halves at successive periods of ignition, whereby all the current passes to a different igniter at successive instants of ignition.

15. In an ignition system for internal combustion engines, the combination of a plurality of igniters, generating windings comprising a set of sections for supplying current to the said igniters, said windings being closed on themselves, means for connecting all of the said igniters simultaneously to the said windings, said means connecting the opposite terminals of the individual igniters to diametrically opposite points located at equidistant points in the

closed circuit of the said windings, means for creating electromotive forces in the generating windings, means for controlling the action of the creating means to put the electromotive forces in the halves of the generating windings bounded by said diametrically opposite points in parallel at each period of ignition and for shifting the terminal points of said halves at successive periods of ignition, whereby all of the current passes to a different igniter at successive instants of ignition.

16. In an ignition system for internal combustion engines, the combination of a plurality of igniters, generating windings for supplying current to said igniters, said windings being closed on themselves, means for permanently and directly connecting all of the said igniters to the said generating windings, said means joining the opposite terminals of the individual igniters to diametrically opposite points located at equidistant intervals in the circuit of said windings, magnetic means for creating electromotive forces in the generating windings, means for controlling the action of the creating means to put the electromotive forces in the halves of the generating windings bounded by said diametrically opposite points in parallel at each period of ignition and for shifting the terminal points of said halves at successive periods of ignition, whereby all the current passes to a different igniter at successive instants of ignition.

17. In an ignition system for internal combustion engines, the combination of a plurality of igniters, generating windings for supplying current to the said igniters, said windings being closed on themselves, means for electrically connecting all of the said igniters to the said windings simultaneously, said means joining the opposite terminals of the individual igniters to diametrically opposite points located at equidistant intervals in the closed circuit of the said windings, means for creating electromotive forces in the said windings, means for controlling the action of the creating means to put the electromotive forces in the halves of the generating windings bounded by said diametrically opposite points in parallel at periods corresponding to the instants of ignition and for shifting the terminal points of said halves at successive periods of ignition, whereby all the current passes to a different igniter at successive instants of ignition.

18. In an ignition system for internal combustion engines, the combination of a plurality of igniters, and a source of electricity having generating elements, said source embodying controlling means for enabling all of said generating elements to supply current to one igniter to the exclusion of another, while both the said igniters are in circuit with said source.

19. The combination of a plurality of circuits, means in each of said circuits for consuming current at recurring periods, and a source of electricity having generating elements to be connected to said circuits, said source embodying controlling means for enabling all of said generating elements to supply current to the consuming means of one circuit to the exclusion of the consuming means for another circuit while both of said consuming means are in circuit with said source.

20. In an ignition system for internal combustion engines, the combination of a plurality of igniters, and a source of electricity having generating elements, said source also having magnetic controlling means for enabling all of said generating elements to supply current to one igniter to the exclusion of another while both the said igniters are in circuit with said source.

21. The combination of a plurality of circuits, means in each of said circuits for consuming current at recurring periods, and a source of electricity having generating elements to be connected to said circuits, said source also having magnetic controlling means for enabling all of said generating elements to supply current to the consuming means of one circuit to the exclusion of the consuming means for another circuit while both of said consuming means are in circuit with said source.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

WILLIAM F. NICKEL.

Witnesses:
C. W. FAIRBANK,
ISAAC B. OWENS.