E. S. LINCOLN.

MAGNETO CIRCUIT CONTROLLER.

APPLICATION FILED JAN. 27, 1910.

1,015,328.

Patented Jan. 23, 1912.

2 SHEETS—SHEET 1.

Fig. 1.

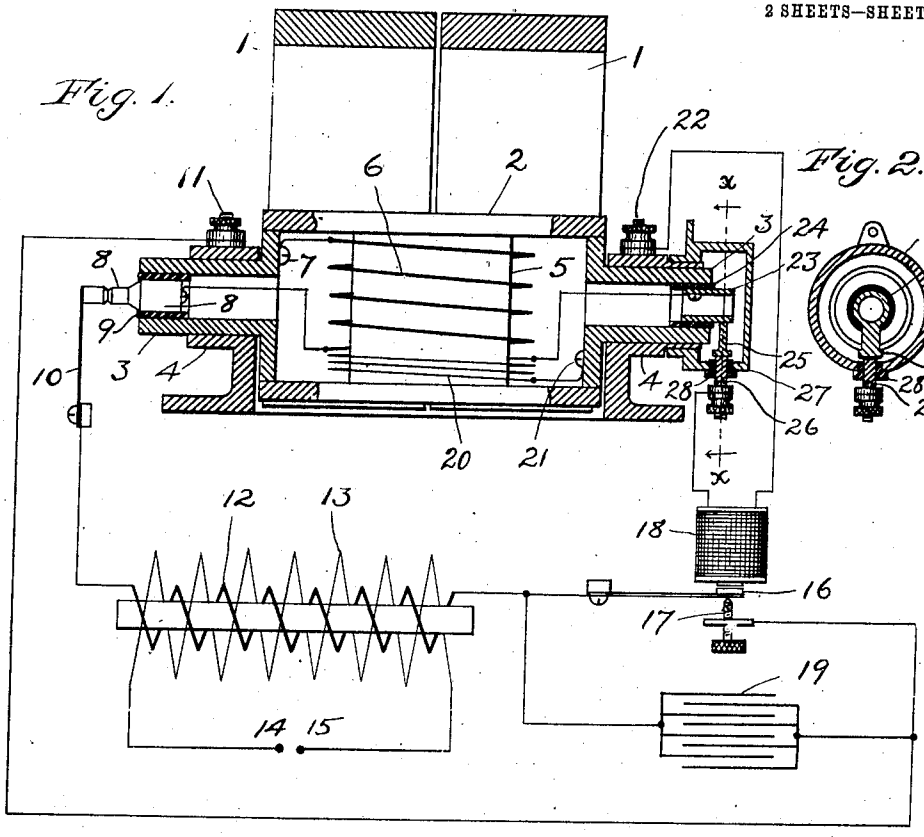

Fig. 2.

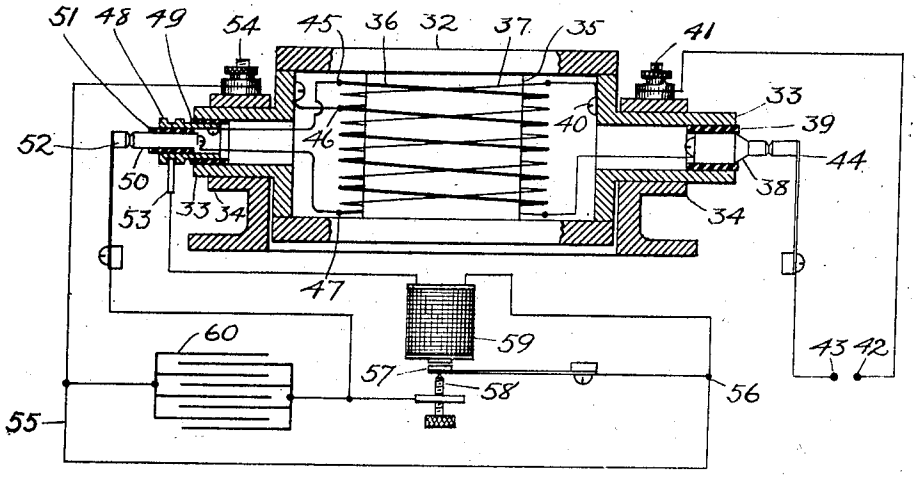

Fig. 3.

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2 SHEETS—SHEET 2.

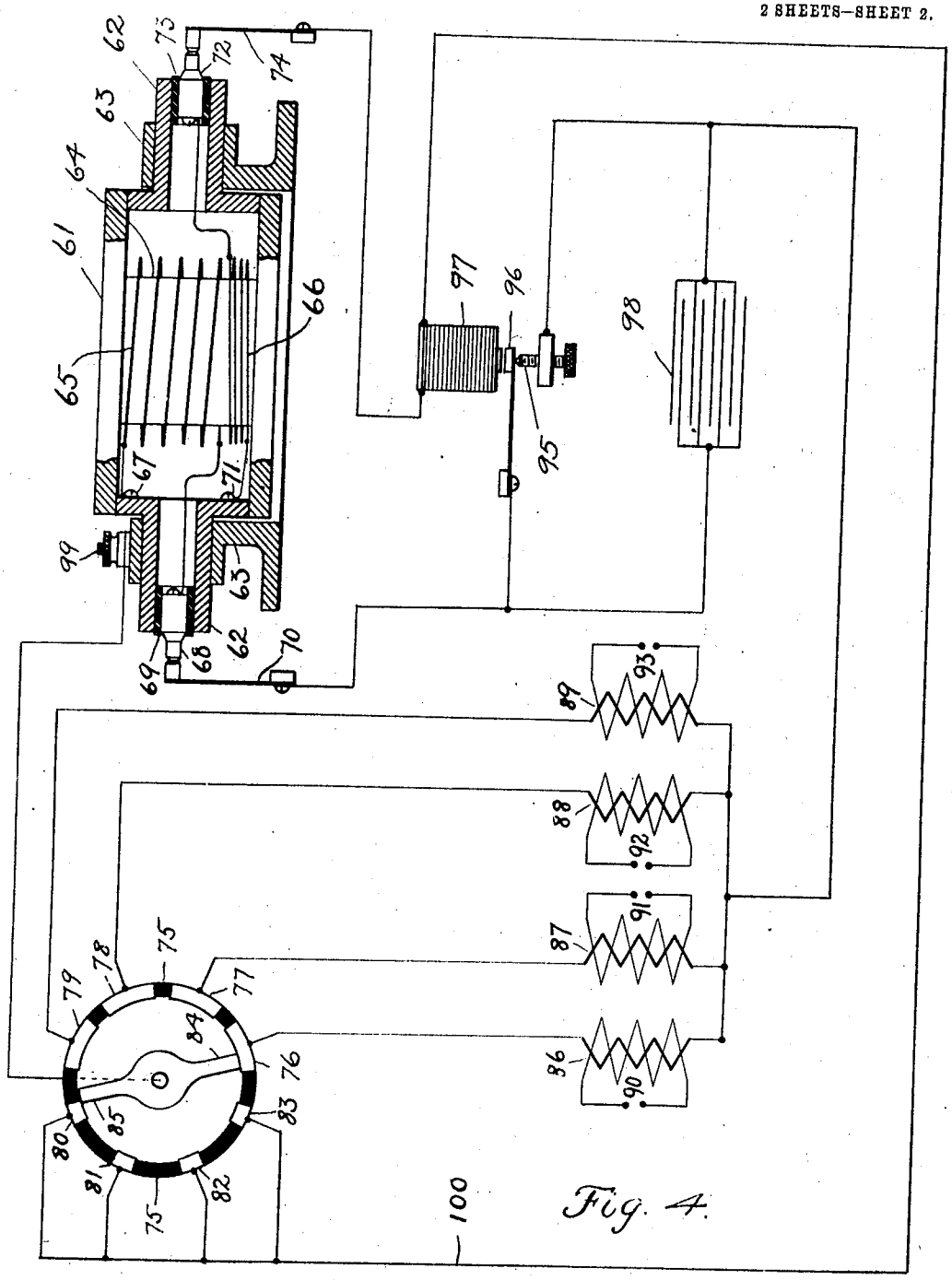

Fig. 4.

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UNITED STATES PATENT OFFICE.

EDWIN S. LINCOLN, OF BROOKLINE, MASSACHUSETTS, ASSIGNOR TO ELECTRIC GOODS MANUFACTURING COMPANY, A CORPORATION OF MAINE.

MAGNETO-CIRCUIT CONTROLLER.

1,015,328. Specification of Letters Patent. Patented Jan. 23, 1912.

Application filed January 27, 1910. Serial No. 540,415.

To all whom it may concern:

Be it known that I, EDWIN S. LINCOLN, citizen of the United States, residing at Brookline, in the county of Norfolk and State of Massachusetts, have invented certain new and useful Improvements in Magneto-Circuit Controllers, of which the following is a specification.

My invention relates to ignition systems adapted to generate high tension electric current for the purpose of energizing the ignition devices of engines or motors of the internal combustion type, and thereby to produce a spark at such devices for the purpose of firing a charge of combustible in the cylinders of such engines.

More especially my invention has reference to ignition systems in which is employed a source of electricity, preferably a magneto electric generator having a revoluble armature carrying a generating winding, in which electric current is generated as a result of the rotation of the armature; the fluctuations in the flow of the current generated in the generating windings being utilized to energize inductive means which are in operative connection with the ignition devices. Such fluctuations are commonly most effectively secured by interrupting the flow of current produced in the generating windings at a time when such flow is approaching its maximum, the sudden cessation of current flow operating to render operative the said inductive means with which such windings are connected. For the purpose of effecting the interruption of the flow of current in the energizing winding, it has been customary to intercalate in the circuit in which said winding is included, a circuit breaker embodying two relatively movable contacts, normally in electrical engagement with each other, which are caused to separate at the desired instant, and so open the circuit which is energized by the generating winding. In many cases said circuit breaker is electrically operated by a magnet which is arranged, when magnetized by the current flowing through the same, to attract one of said movable contacts, and, by causing it to separate from the other contact with which it is normally in engagement, to interrupt the continuity of the energizing circuit. It has heretofore been the usual practice to connect the winding of said magnet in series with the generating winding, so that the flow of the current generated in the generating winding, through the magnet winding, produces the magnetism therein which causes the operation of the circuit breaker. An objection to this practice is founded in the consideration that when the generator winding and the magnet winding are thus connected in series, the presence of the numerous convolutions of wire, comprised in said magnet winding ordinarily has the effect of introducing into the circuit in which the generating winding and the primary winding of the induction coil are included, a reaction producing element which operates to retard the rapidity of the fluctuations of the current in the said primary winding, and so materially decreases the electrical efficiency of the current inducing means.

The object of my invention, therefore, is to construct an ignition system of the type described, in which the circuit in which is included the generating winding by which the inductive means is energized is electrically distinct from the circuit in which is included the magnet winding by which the circuit breaker intercalated in such generating winding is actuated, so that the fluctuations of current in such generating winding will not be retarded by being obliged to traverse said magnet windings. To attain this object I have devised the novel form of magneto electric generator, and have associated the same in operative relation with cooperating electrical apparatus as hereinafter more particularly and fully described in the specification, illustrated in the drawings accompanying the same, and designated in the claims.

In the drawings,—Figure 1 shows, partly in section and partly in diagram, one preferred embodiment of my invention. Fig. 2 is a view taken on the plane X—X, Fig. 1. Fig. 3 shows, partly in diagram and partly in section, a modification of my invention. Fig. 4 is a view partly in section and partly in diagram showing my invention adapted for use in connection with multi-cylindered motors.

Referring to said Fig. 1, at 1, 1, are the magnets, preferably of the permanent type and of the horse shoe or U form, commonly employed in magneto electric generators and adapted to produce a magnetic field. In the magnetic field produced by such

magnets, is located the armature 2, which is rotatably mounted by the journals 3, 3, in the bearings 4, 4. Said armature 2, which may be of any approved type, comprises a core portion 5 on which are coiled current generating windings, comprising an energizing winding 6, which is adapted to generate the current by which the inductive means is energized, and an auxiliary winding 20 adapted to generate the current for operating the circuit breaker. One terminal of said energizing winding is electrically connected to said armature by being grounded on the same at 7, while the other terminal is in connection with a conducting plug 8, mounted in the end of the preferably hollow armature journal 3, and suitably insulated therefrom as by the bushing 9. A wiper 10 is preferably resiliently held in engagement with one end of the plug 8 as shown. At 11 is a binding post, mounted for example, on the bearing 4; said binding post being in grounded connection with said terminal 7 of the energizing windings through the armature journal 3 and the bearing 4 which is in contact therewith. At 12, is represented the primary winding of an induction coil, or the like, with which is associated in an inductive relation the secondary winding 13, of which the terminals are electrically connected to the spark points 14 and 15, preferably contained in a spark plug of any approved construction and located in usual manner in the cylinder of an engine or motor not shown in the drawings. The wiper 10 is electrically connected to one terminal of said primary winding 12, the other terminal of the same being in electrical connection with the binding post 11 through a circuit which includes separable contacts embodied in a movable vibrator 16 and an adjustable contact screw 17 which is normally resiliently held in engagement therewith; both separable contacts forming a part of a circuit breaker which is actuated by an electromagnet 18. Thus said primary winding 12 of the induction coil is normally electrically connected in series with the energizing winding 6 carried by the armature, and current generated in said winding 6 will flow through the said primary winding 12 so long as the vibrator 16 remains in engagement with the contact screw 17. A condenser 19 is preferably connected in shunt around the vibrator 16 and the contact screw 17 as shown. The current by which said electromagnet 18 is energized when it is desired to operate the circuit breaker is supplied from an auxiliary winding 20, which is wound upon the revoluble armature 2 adjacent the said energizing winding 6, and which is electrically connected with said electromagnet 18 as will hereinafter appear. By the rotation of the armature 2, current will be generated in the auxiliary winding which is utilized to energize the electromagnet 18 at the moment when its operation is desired. One terminal of said auxiliary winding 20 is grounded on the armature at 21 and is thereby in electric connection with the armature bearing 4 and the binding post 22 which is preferably mounted thereon as shown. The other terminal of the auxiliary winding is led to a conducting sleeve 23, which may be carried in the open end of the armature journal 3 and separated therefrom by the insulating bushing 24. Said sleeve 23 carries a contact arm 25, adapted to engage, as the armature revolves, in certain of its positions, with a contact member 26, carried on a casing 27, which may be mounted upon the end of the bearing 4 and has a capacity for angular adjustment with reference thereto. Said contact member 26 is insulated from said casing 27 in any approved manner, as by an insulating bushing 28, and its outer end preferably terminates in a binding nut as shown. From binding post 22 a conductor leads to one terminal of the magnet 18, the other terminal of said magnet being electrically connected with said contact member 26. It is thus evident that when said contact arm 25 and contact member 26 are in engagement, the winding of the magnet 18 will be in series with the auxiliary winding 20. Hence the current which will be generated in said auxiliary winding 20, as a result of the rotation of the armature, will flow through the winding of said electromagnet 18 and will magnetize the same, attracting the vibrator 16 toward the magnet and separating the same from the contact screw 17; thus opening the circuit in which is included the energizing winding 6 and the primary winding 12 of the induction coil. In practice I so adjust the relative positions of said contact arm 25 of the contact member 26 that the said contact arm 25 will come in engagement with the contact member 26 at a moment when the flow of current in the energizing winding is approaching its maximum. At such time the engagement of the contact arm 25 and contact member 26 will close the circuit from the auxiliary winding through the electromagnet and will energize the latter, causing it to actuate the vibrator 16 and to render the circuit breaker operative to open the circuit in which is included the energizing winding 6, and the primary winding of the induction coil. The resulting interruption to the flow of current in the primary winding will operate to induce high tension current in the secondary winding in the usual manner, which will produce an electric discharge between the spark points 14 and 15. Should it be desired to advance or to retard the spark this result may be secured by angularly rotating the casing 26 by means of a suitable connection, not

shown which is adapted to engage a lever arm 28. In this way the moment of the engagement of the contact arm 25 with the contact member 26, may be delayed or hastened, with a corresponding variation in the moment of the energization of the circuit breaker magnet and of the spark production. In practice, I calculate the current generating capacity of the auxiliary winding and the number of convolutions included in the magnet winding so that said auxiliary winding will, in all its positions within the limits of the capacity of adjustment of said casing 26, generate sufficient current to render said circuit breaker operative in any of such positions.

In Fig. 3 is illustrated an embodiment of my invention in which the same is shown as applied to a magneto electrical generator of the high tension type, in which is employed a revoluble armature on which are associated in an inductive relation a primary winding and a secondary winding; and in which a high tension current, adapted to energize the ignition devices, is induced in said secondary winding by the operation, at the desired instant, of a circuit breaker intercalated in the circuit of the primary winding. In said embodiment is also illustrated a modified system of winding the revoluble armature, so that the energizing winding and the auxiliary winding are integral or continuous, although provided with such electrical connections and said auxiliary windings and the particular circuits to which they are designed to supply electrical energy. In said Fig. 3 is further illustrated a circuit breaker embodying slight modifications in the manner of causing the operation of the same and differing slightly from that shown in Figs. 2 and 3 in such mode of operation. Referring to said Fig. 3, 32 represents an armature which is revolubly mounted in a magnetic field, but situated and constructed preferably substantially like that illustrated in Fig. 1. Said armature is mounted by means of journals 33 in the bearings 34, and embodies a core 35 on which are carried the generating windings 36 and the secondary windings 37 superimposed thereon in an inductive relation. One of the terminals of the secondary winding, is connected to a plug 38 mounted in the end of journal 33 and insulated therefrom, as by the insulating bushing 39, while the other terminal of said secondary winding is grounded on the armature at 40, and is thus in electrical connection with a binding post 41, which is preferably mounted upon the armature bearing 34 as shown. At 42 and 43 are represented spark points which are preferably comprised in a spark plug of any approved construction, located in an engine cylinder, not shown in the drawing. Spark point 42 is connected to the binding post 41 while spark point 43 is in engagement with plug 38 preferably by means of a wiper 44 which is resiliently held in contiguous contact with the exposed outer end of said plug. The generating windings, wound in an inductive relation to the said secondary winding, are divided into two groups; that group between the terminal of the same numbered 45 and an intermediate convolution, for example 46 constituting the auxiliary winding, and that group between convolution 46 and terminal 47, comprising the energizing winding. The terminal 45, of the auxiliary winding is connected to a conducting sleeve 48 which is mounted in the end of the armature bearing and suitably insulated therefrom as by the insulating bushing 49. Preferably the said sleeve 48 is adapted to carry a plug 50 from which it is insulated, preferably by the bushing 51; said plug 50 being in connection with the terminal 47 of the primary winding, as shown. A wiper 52 is adapted to engage the plug 50 on its exposed end. A brush 53 is also provided, which, in the embodiment of my invention now being described, continuously contacts with an exposed portion of the surface of said conducting sleeve. At 54 is a binding post, mounted on the armature bearing, as shown. It is therefore, evident that the generating windings of the armature core is thus divided into two groups, which although mechanically continuous, are electrically distinct. Such groups are the auxiliary winding, having its terminal 45 in electrical connection with the brush 53 and its other terminal 46 in electrical connection with said binding post 54, through the armature bearing and the armature journal, and an energizing winding constituted by the convolutions of the generating windings which are located between the terminals 46 and 47, the terminal 46 being in electrical connection with the binding post 54 in the manner just above indicated, and its terminal 47 being in electrical connection with the wiper 52. From the binding post 54, a conductor 55 carries the circuit to a point 56 where it divides, one branch of the circuit returning to wiper 52 through a circuit breaker which includes a movable contact carried by the vibrator 57, and a stationary contact, normally engaged by said movable contact, and carried in the tip of the adjustable contact screw 58. Beyond said point 56 the other branch of said circuit leads through the winding of an electromagnet 59, which is designed to actuate the movable vibrator 57 which forms a part of said circuit breaker, and back to the brush 53. As a result of the construction and connections above described it is apparent that the circuit through the energizing winding is normally closed through the movable vibrator 57 and

the contact screw 58, while the circuit through the auxiliary winding is closed through the electromagnet 59. Preferably a condenser 60 is connected in shunt around the separable contacts of the circuit breaker, as shown in Fig. 3.

The operation of the embodiment of the invention just described, will be as follows. As the armature 32 rotates in the magnetic field produced by the permanent magnets, an electric current will be caused to flow through the energizing winding of the said armature; the intensity of its flow rising to a maximum and then dying away, according to the position occupied by the said armature relative to the magnetic field. The current so produced will flow through the circuit in which the separable contacts comprised in vibrator 57 and contact screw 58 of the circuit breaker are included. Simultaneously with the production of the current in the energizing winding, current will be generated in the auxiliary winding, such current also approaching its maximum flow as the armature approaches a certain angular position relative to the magnetic field. In practice the number of convolutions in said electromagnet and the strength of the current flow in the auxiliary winding are so interrelated that when the flow of current in the energizing winding is approaching its maximum, the flow of current from said auxiliary winding to the electromagnet which is in series therewith will magnetize the said magnet 59 sufficiently to attract the armature 57 and thereby to cause the separation of the same from the contact screw 58. In consequence the circuit through the energizing winding will be opened and the flow of current therethrough suddenly interrupted. As a result of the sudden interruption in the flow of the current in said energizing winding, high tension current will be induced in the secondary winding which is inductively associated on the magneto armature with the energizing winding, and in consequence an electric discharge between the spark points 42 and 43 will be produced.

When it is desired to control the instant of the spark production more accurately than is possible with a circuit breaker having the mode of operation just hereinbefore described in connection with Fig. 3, a timing device comprising a rotating contact arm and an angularly shiftable contact member adapted to engage said arm, constructed substantially as above described in connection with Figs. 1 and 2, may be employed. Such timing device may be readily applied to the embodiment of my invention shown in Fig. 3 by any person skilled in the art to which my invention pertains in view of the description of the same hereinbefore contained, and it will not be necessary for me to described the construction of the same in further detail.

In Fig. 4 is illustrated the preferred manner of applying my invention for the purpose of energizing the ignition system of motors having more than one cylinder. In such figure is shown a magneto embodying my invention, combined with a distributing and timing device, hereinafter called a distributer-timer, adapted to electrically connect the said magneto successively in operative relation with the ignition systems of different engine cylinders and when so connected to render said magneto effective to energize the same. Referring to said Fig. 4, 61 represents an armature revolubly mounted in a magnetic field situated and constructed preferably substantially like that shown in Fig. 1. Said armature is mounted by means of journals 62 in the bearings 63, and embodies a core portion 64, on which are coiled current generating winding, comprising an energizing winding 65, and an auxiliary winding 66. One terminal of said energizing winding is grounded on the armature at 67, while the other terminal is in connection with a conducting plug 68, mounted in the left hand armature journal 62, as shown in said Fig. 4, and suitably insulated therefrom as by the bushing 69. A wiper 70 is resiliently held in engagement with the plug 68 as shown. In a similar manner one terminal of the auxiliary winding is grounded on the armature at 71 and the other terminal is conducted to a plug 72 preferably mounted in the right hand armature journal 62 and insulated therefrom by the bushing 73; a wiper 74 being also resiliently held in engagement wherewith as shown. As in Fig. 1, a binding post 99, mounted for example, on the left hand bearing 63, is in electrical connection both with the terminal 67 of the energizing winding, and with the terminal 71 of the auxiliary winding through the armature journal 62 and the bearing 63 which is in contact therewith. In operative relation with the magneto is combined a distributer timer adapted to electrically connect said magneto to the igniting devices of the desired cylinder and contemporaneously with such connection to effect the actuation of the devices by which said magneto is rendered operative to produce a spark at such ignition devices. In general said distributer timer embodies a rotating member carrying contact making arms, hereinafter called timer arms, and a stationary member or casing carrying a plurality of insulated contact blocks with which said timer arms are adapted to engage, and in consequence of such engagement to establish the electrical connections as hereinafter more particularly set forth. In said Fig. 4 is shown a distributer timer as preferably constructed for use in combination with a magneto for the

purpose of energizing the ignition systems of a four cycle motor having four cylinders. As appears in said figure the distributer timer comprises a stationary member or casing 75, preferably if insulating material and carrying eight contact blocks 76, 77, 78, 79, 80, 81, 82, and 83 as shown. Such contact blocks are two kinds, the distributer contacts 76, 77, 78, and 79, and the timer contacts 80, 81, 82, and 83; the distributer contacts being disposed at substantially equal angular intervals of approximately 45° over one half of the circumference of the casing 75, while the timer contacts are disposed over the other half of said circumference at intervals of substantially 45° in positions preferably approximately diametrically opposite to the distributer contacts. The rotating member of the distributer timer is formed with two preferably diametrically opposite timer arms 84 and 85, and revolves about a central bearing which is preferably substantially concentric with the circumference on which the bearing surfaces of the distributer timer contacts are disposed, so that as said rotating member revolves each of the timer arms carried thereby in turn successively engages with each of the distributer contact blocks and with each of the timer contact blocks. Said rotating member is preferably positively driven so as to rotate at a definite relative speed with reference to the armature. Preferably said rotating member is gear driven from said armature and in the modification of my invention now under description is assumed to rotate once in every four revolutions of the armature, it being further assumed that the magneto armature is driven at one half the speed as that of the motor. At 86, 87, 88, and 89 are represented induction coils which are adapted respectively to energize spark points 90, 91, 92, and 93, preferably carried by spark plugs located in the different cylinders of the engine and connected with the secondary windings of said induction coils by appropriate electrical conductors. The distributer contact 76 is electrically connected with one terminal of the primary winding of the induction coil 86, the other terminal thereof being electrically connected to a conductor 94. In a similar manner the distributer contact 77 is electrically connected to said conductor 94 through the primary wind of the induction coil 87 and the distributer contacts 78 and 79 are in electrical connection with said conductor 94 through the induction coils 88 and 89, respectively. Said conductor 94 leads to the wiper 70 through separable contacts, of which one is carried upon a contact screw 95 and the other upon a movable armature 96 forming a part of an electrically actuated circuit breaker which is actuated by an electromagnet 97. Preferably a condenser 98 is connected in shunt around said separable contacts. The binding post 99 is electrically connected with the rotating member of the distributer-timer and is therefore in electrical communication with each of said timer arms 84 and 85. It is thus apparent that as the rotating member of the timer arm revolves, the energizing winding 65 will be placed successively in series with each one of the induction coils. The timer contacts 80, 81, 82, and 83 are preferably collectively electrically connected to a conductor 100 which leads through the winding of the electromagnet 97 to the wiper 74. It is therefore apparent that when either of the timer arms engages with any one of the timer contacts, the auxiliary winding 66 on the armature will be placed in series with the electromagnet 98. Inasmuch as the timer contacts and the distributer contacts are arranged in pairs, of which each member occupies approximately diametrically opposite positions, the two timer arms will contemporaneously engage the timer contact and the distributer contact comprising one pair. Furthermore each pair of contacts will become engaged in succession as the rotating member revolves, each pair being so engaged twice during each complete revolution of said rotating member. Preferably the distributer contacts have a contact surface extending over a greater arc than that of the timer contacts, and the same are so located with respect to the timer contacts that one timer arm of the rotating member engages the same slightly before the other timer arm engages the timer contact, which is paired with the same.

The embodiment of my invention just hereinbefore described, operates in the following manner: As the motor rotates the armature is revolubly driven thereby, and such revolution will produce an alternating electric current in the generating windings; such current flowing first in one direction during one-half of a revolution of the armature, and in the reversed direction during the other half of such revolution and in either case attaining its maximum intensity of flow as the generating windings carried on the armature reach a definite angular position with reference to the magnetic field in which the armature rotates. As the alternating current flow so produced approaches its maximum in one direction, the angular position of the rotating member of the timer relative to the magneto armature is so adjusted that the timer arm 84, for example, engages the distributer contact 76. Such engagement will place the energizing winding 65 in series with primary winding of the induction coil 86 and the current produced in said energizing winding will flow through said coil and energize the same. Following such energization of the induc-

tion coil 86 the other timer arm 85 will engage the timer contact 80; the moment of such engagement corresponding to the instant when it is desired to produce a spark at the spark points 90 to which induction coil 86 is connected. In consequence the auxiliary winding 66 will be connected in series with the winding of the electromagnet 97 by which the circuit breaker is actuated. The flow of the current generated in said auxiliary winding as the armature rotates, will magnetize the said electromagnet and in consequence will cause the sudden separation of the contacts carried on the movable armature 96 and the contact screw 95, thus suddenly opening the circuit in which is comprised the energizing winding and the primary winding of the induction coil. As a result of the sudden opening of the circuit just mentioned, high tension current will be induced in the secondary winding of the induction coil and an electric discharge at the spark points 90 will be produced which will explode the charge of combustible in the motor cylinder in which said spark points are located. The continued rotation of the armature through approximately one half of a revolution will bring it into a position in which a current, generated in the energizing winding in consequence of such rotation and flowing in a reversed direction to that just hereinbefore mentioned, will approach its maximum intensity of flow. As the armature approaches such position of maximum flow, the timer arm 84, assuming the same to rotate in an anti-clockwise direction, will have rotated approximately 45° and will engage the distributer contact 77, thereby causing the induction coil 87 to become energized by such flow of current. Immediately after such energization of the induction coil 87, the timer arm 85 will engage the timer contact 81, again completing the circuit through the electromagnet 97 and causing the actuation of the circuit breaker in a manner analogous to that just hereinbefore described, and thereby producing electric discharge at the spark points 91. Thus the alternating flows of current produced in the generating windings during each half revolution of the armature is utilized to produce an electric discharge in turn at spark points 90 and 91. In like manner the spark producing function of my invention will be repeated twice during the ensuing revolution of the armature, and electric discharges will take place, first, at spark points 92 by reason of the contemporaneous engagement of timer arms 84 and 85, respectively, with distributer contact 78, and the timer contact 81, and second, at spark point 93 by reason of the contemporaneous engagement of said timer arms respectively, with the distributer contact 79, and the timer contact 82. During the next ensuing two revolutions of the magneto armature, the timer arms of the rotating member of the distributer timer, although occupying positions diametrically opposite to those in which they have just been described will again engage in succession with the timer contacts 80, 81, 82, and 83, and contemporaneously with such engagement will also engage with distributer contacts 76, 77, 78, and 79, respectively, and in consequence the electric discharges at the spark points 90, 91, 92, and 93 will be repeated.

If desired, means may be provided for angularly rotating stationary member of the distributer timer within predetermined limits and thereby to hasten or delay the time of engagement of the rotating timer arms with the distributer and timer contacts. In consequence the spark may be advanced or retarded as desired within the limits of adjustment. Moreover the advance or retardation of the spark may be also secured by providing means whereby the timer contacts alone are angularly movable, the distributer contacts remaining substantially fixed, the change of position in such timer contacts operating to vary the instant when the circuit breaker is actuated and the inductive means rendered operative to produce a spark.

The changes required in order to apply the modifications just hereinabove mentioned to the embodiments of my invention described can be easily effected by any one skilled in the art and I do not deem it necessary to describe the same in further detail.

It will be observed that in any of the embodiments of my invention hereinbefore described the reactance which is offered by the winding of the magnet by which the circuit breaker is actuated, is not included in the circuit through which flows the current, which energizes the inductive means employed to produce the high tension current. Hence the fluctuations of said energizing current are not subjected to the retarding influences of said reactance and the electric activity of the said inductive means is in consequence, considerably greater than would be the case were such magnet winding connected in series with the circuit by which the inductive means is energized. The use of my invention, therefore contributes to materially increase the efficiency of the ignition system as a whole, besides supplying a simple and easily controllable manner of regulating the instant of spark production.

While I have described my invention more particularly as applied in connection with an induction coil of the common type having a primary and a secondary winding, the principle of my invention may be readily applied by any one conversant with the art to any other form of current inducing means

in which the variations of the current flow in an energizing circuit, as caused by instrumentalities adapted to control such current flow, said instrumentalities including an electric circuit for actuating the same, are utilized to induce an electric current of high potential in said coil.

I claim—

1. In combination with a current inducing means including an energizing circuit, instrumentalities for controlling the flow of current in said energizing circuit, said instrumentalities including an electric circuit for actuating the same; an electric generator having current generating windings, one portion of said windings being electrically connected in energizing relation with said energizing circuit, and another portion of said windings being connected in energizing relation with said actuating electric circuit.

2. In combination with an induction coil, an electric circuit for energizing said coil, and a circuit interrupting device intercalated in said energizing circuit, said device including a magnetizing circuit for actuating the same; an electric generator having current generating windings, one portion of said windings being electrically connected in energizing relation with said energizing circuit, and another portion of said windings being electrically connected in energizing relation with said magnetizing circuit.

3. In combination, an induction coil having a primary winding, an electric generator having revoluble current generating windings grouped into a plurality of electrically distinct portions, an energizing circuit connecting one portion of said current generating windings in energizing relation with said primary winding, a circuit interrupter intercalated in said energizing circuit, said circuit interrupter including an electromagnet for actuating the same, and electric conductors connecting another portion of said current generating windings in energizing relation with said electromagnet.

4. In combination with spark points, an induction coil for producing a high tension discharge at said spark points, said induction coil including a primary winding, an electric generator having revoluble generating windings, and comprising an energizing winding and an auxiliary winding, an electric circuit connecting said energizing winding in energizing relation with said primary winding, a circuit interrupter adapted to control the electrical continuity of said circuit, said circuit interrupter including an electromagnet for actuating the same, and an electric circuit connecting said auxiliary winding in energizing relation with said electromagnet.

5. In combination with spark points, an induction coil for producing a high tension discharge at said spark points, said induction coil including a primary winding, an electric generator having revoluble generating windings, and comprising an energizing winding and an auxiliary winding, an electric circuit connecting said energizing winding in energizing relation with said primary winding, a circuit interrupter adapted to control the electrical continuity of said circuit, said circuit interrupter including an electromagnet for actuating the same, a discontinuous electric circuit adapted to connect said auxiliary winding in energizing relation with said electromagnet, and a timing device closing said last mentioned circuit at the moment of discharge production.

In testimony whereof I affix my signature in presence of two witnesses.

EDWIN S. LINCOLN.

Witnesses:
NATHAN B. DAY,
CHAS. F. RANDALL.