G. W. WACKER.

MAGNETO.

APPLICATION FILED DEC. 23, 1915.

1,224,247. Patented May 1, 1917.

Fig. 1.

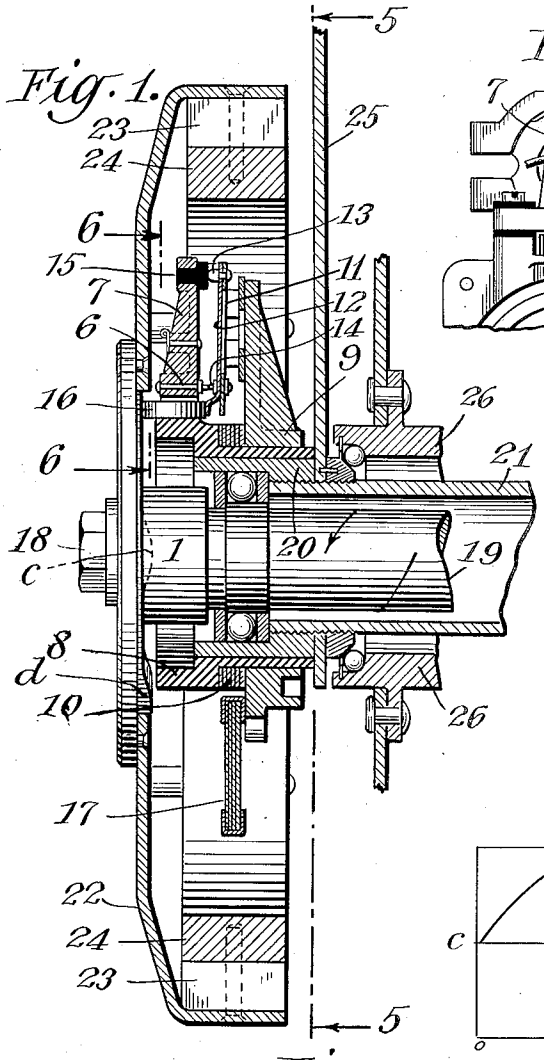


Fig. 6.

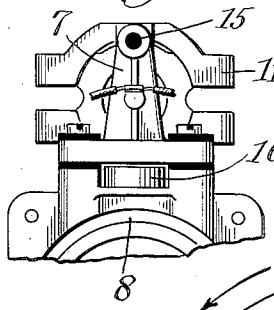


Fig. 2.

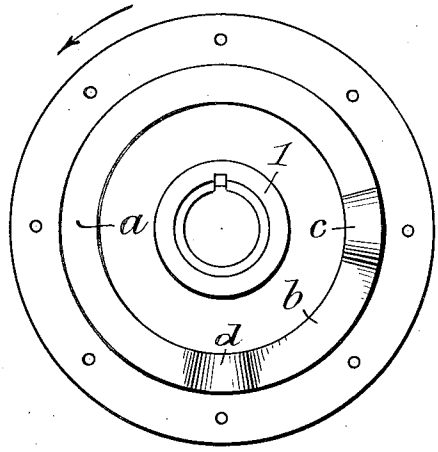


Fig. 3.

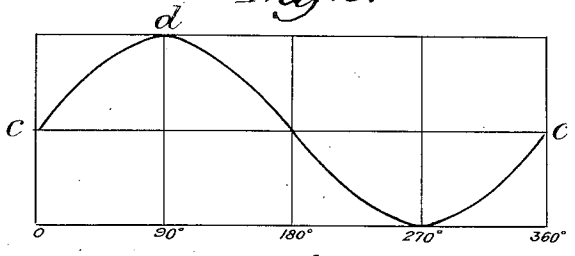


Fig. 4.

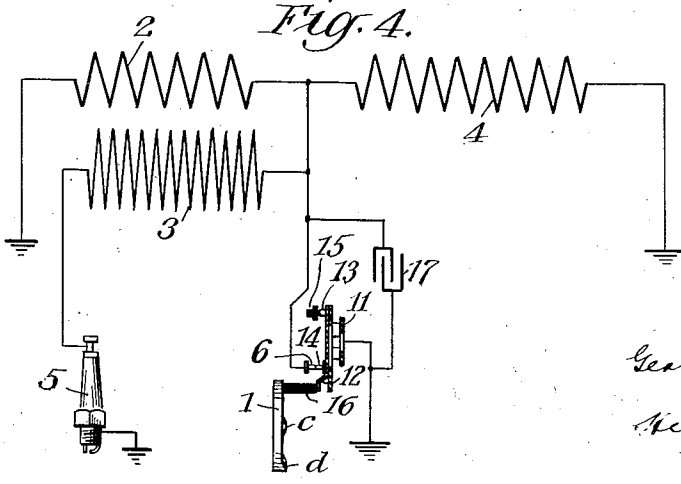
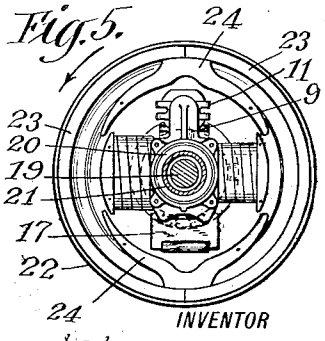


Fig. 5.



INVENTOR

George W. Wacker

BY

Henry D. Williams

ATTORNEY

UNITED STATES PATENT OFFICE.

GEORGE W. WACKER, OF RUTHERFORD, NEW JERSEY, ASSIGNOR TO AUTO-PED COMPANY OF AMERICA, A CORPORATION OF DELAWARE.

MAGNETO.

1,224,247. Specification of Letters Patent. Patented May 1, 1917.

Application filed December 23, 1915. Serial No. 68,446.

To all whom it may concern:

Be it known that I, GEORGE W. WACKER, a citizen of the United States, residing at Rutherford, in the county of Bergen and State of New Jersey, have invented certain new and useful Improvements in Magnetos, of which the following is a specification, reference being had therein to the accompanying drawings forming part thereof.

My invention relates to magnetos such as are employed for ignition purposes in connection with the internal combustion engines of self-propelled vehicles. My invention relates more particularly to the means for periodically making and breaking the short circuit of a short circuited primary coil. Other features of construction embodied in the same magneto which embodies my present invention and in part illustrated in the accompanying drawings form the subject of three other applications for patent filed by me on even date herewith, of which application Serial Number 68,443 relates more particularly to the armature construction, application Serial Number 68,444 to the construction of the interrupter or circuit breaker, and application Serial Number 68,445 to means for making electrical connection of the high tension coil to an outside conductor.

In regard to my present invention it is first to be noted that heretofore magnetos have been operated in two different ways as to the control of the circuits. According to one way, known as the open circuit system, the circuit of the short circuited primary coil is maintained normally open, being thus open during the greater part of a complete rotation and being closed only long enough to produce sufficient current flow to result in a spark from the spark coil when the closed circuit of the primary coil is broken, the circuit-controlling or circuit-making and circuit-breaking devices being constructed to operate in this way. According to the other way of operation, known as the closed circuit system, the short circuit of the primary coil is kept closed at all times excepting when broken substantially at periods or points of maximum current flow in order to produce an ignition current in the secondary coil or spark coil. In both systems of operation commonly the circuit is closed automatically by a spring and is opened or broken by means of a raised cam face or cam projection at the desired points of relative rotation of the relatively rotating parts of the magneto, for example, of its armature and its field magnet.

The normally open circuit system operates well electrically but there are mechanical difficulties and objections. For example, the extended raised cam surface, which is employed for both breaking the circuit and for maintaining it in the open condition, by reason of its pressure upon the spring-pressed cam roller or corresponding part results in excessive wear of such cam roller and the parts with which it coöperates. The construction of circuit-controlling means employed in the closed circuit system is substantially free from these mechanical defects but electrical difficulties are present. For example, particularly at high speed, what perhaps may not inaptly be termed the residue of current from a preceding electrical impulse seems to have a tendency to persist and to partially overlap upon the next succeeding current impulse in the opposite direction which it is desired to utilize for producing the next succeeding spark, with the result that an effective spark-producing current impulse will not be produced. However, whatever the explanation may be, this above electrical disturbance of the magneto circuits exists and must be reckoned with. In cases where the short circuit of the primary coil is broken at each succeeding period or time of substantially maximum current flow, for producing a spark at each such period of maximum current, the above mentioned objectionable electrical disturbance is not present. However, when a magneto is employed for producing a lesser number of sparks than that of which it is capable as determined by the successive peaks or rises of alternating current impulses, then the objectionable overlapping and interfering effects of any unused current pulsation or impulse of which the circuit has not been broken, is marked. For example, when a bipolar magneto, this being the common form, is employed for ignition purposes in connection with an internal combustion engine having only a single cylinder and the magneto is driven or rotated at engine speed, such, for example, as by reason of having its rotative parts mounted upon and rotative with the crank shaft of the engine, then in such an instance two opposite cur-

rent impulses or current peaks, will be produced at each rotation of the rotative parts of the magneto and of the engine shaft, and each of these current impulses is capable of producing a spark, but only one of these pulsating current impulses is required for effecting the desired ignition in the cylinder of the engine. In such a case, in operating with a circuit-controlling construction for producing an ignition spark under the normally closed circuit system, it has been found that the unused current impulse seriously interferes with the production of an effective ignition spark at the single time at which the circuit is broken.

It is an important object of my present invention to provide a construction operating on the normally closed circuit principle or system which will be substantially free from the above mentioned electrical difficulties and objections. I have discovered that if the short circuit of the primary coil or energizing coil be broken at a point of comparatively low and non-spark-producing current and in advance of the point at which the succeeding or following spark-producing current impulse has its circuit broken for producing a spark, that such next or following spark-producing current impulse will be stronger and will result in the production of an effective ignition spark. This improved result, so far as I am able to ascertain, apparently is due to the dissipation of left over or residual current and likewise of the residual magnetism, by reason of which the circuits are cleared and are enabled to start anew without interference to build up a strong spark-producing current impulse. I have found this advantageous result to be particularly marked in the case of a bipolar magneto such as above mentioned in which only one of the two alternating current impulses is employed for spark-producing purposes. Other more particular objects and advantages of my invention will hereinafter appear.

My invention includes circuit-controlling means adapted or so constructed as to clear the magneto circuit of objectionable electrical and magnetic effects or influences in advance of the production of a spark-producing electrical impulse in such circuit. My invention more particularly includes features of construction and combinations of parts as will appear from the following description.

I shall now describe the ignition magneto embodying the circuit-controlling means of my invention illustrated in the accompanying drawings and shall thereafter point out my invention in claims.

Figure 1 is a central vertical axial section of a complete magneto embodying my invention, some of the parts appearing in elevation.

Fig. 2 is a side or face elevation as viewed from the right in Fig. 1 of the field magnet hub having formed thereon a circuit-controlling cam.

Fig. 3 is a diagram illustrating the successive alternating current impulses and the points relatively thereto at which the circuit of the primary coil is successively broken.

Fig. 4 is a diagram of the circuits of the magneto.

Fig. 5 is a reduced vertical section on a plane indicated by the line 5—5 of Fig. 1 as viewed from the right and shows the complete magneto in side elevation.

Fig. 6 is a partial vertical section on a plane indicated by the line 6—6 of Fig. 1 as viewed from the left.

In carrying out my present invention a rotative field magnet support or hub 1 is provided upon its inner side with an annular circuit-controlling or circuit-making and circuit-breaking cam. This cam has an extended depressed cam face or surface *a* located in a single plane and which, in the construction shown, extends nearly three-quarters of the way around, which is to say, is nearly two hundred and seventy degrees in arcuate or circumferential length. The annular cam on the hub 1 is provided with another similar but shorter depressed cam surface *b* located in the same plane as the face *a* and which, in the construction shown, is almost ninety degrees or nearly one-fourth of the cam circumference in length. The depressed cam surfaces *a* and *b* are separated from each other at their adjacent ends by two similar rounded cam projections *c* and *d* which in the construction illustrated in the drawings are shown as spaced apart one-fourth of the circumference of the annular cam, being spaced ninety degrees apart from their middle or highest points, this spacing, of course, corresponding to a quarter rotation of the rotative magnet-carrying hub 1.

The magnet-carrying magneto hub 1 rotates in a counter-clockwise direction as seen in Figs. 2 and 5 and as viewed from the right in Fig. 1, so that the first cam projection *c* travels in a circular path ninety degrees or one-fourth of a rotation in advance of the second cam projection *d*. The first cam projection *c* is a circuit-clearing circuit-breaking cam projection and the second cam projection *d* is a spark-producing circuit-breaking cam projection. The timing is so arranged, as is particularly illustrated in Fig. 3 and as is there indicated by the letters *c* and *d*, that the first or circuit-clearing cam projection *c*, traveling ninety degrees in advance of the second or spark-producing cam projection *d*, will operate to break the circuit at a point midway between the peaks or points of maximum flow of the two oppo-

sitely flowing current impulses, or at a point where substantially no current is flowing. The second or spark-producing cam projection *d*, following ninety degrees behind the first or circuit-clearing cam projection *c*, will operate to break the circuit substantially at the maximum of the first current impulse after the breaking of the circuit by the advance cam projection *c*.

It is to be noted in this connection that each time the circuit is broken it will be immediately closed and that the spark-producing current impulse which is interrupted by the second cam projection *d* is produced during the time that the circuit is permitted to be closed by the shorter depressed cam surface *b*. After the spark-producing breaking of the circuit by the second cam projection *d* the circuit is permitted to remain closed throughout the travel of the extended depressed cam surface *a* during which time, as is illustrated in the diagram in Fig. 3, a second opposite current impulse is developed which rises to its maximum and then gradually subsides substantially up to the point where the circuit is again to be broken by the circuit-clearing advancing cam projection *c*.

The magneto illustrated in the drawings it is to be understood is bipolar, not only by reason of the diagrammatic indication in Fig. 3, but also as is shown in the other figures of the drawings illustrating the construction, particularly Fig. 5. In Figs. 1 and 5 the rotative position of the cam-carrying hub 1 relatively to the other parts of the magneto corresponds to that indicated by two hundred and seventy degrees in the diagram of Fig. 3, this being a maximum point of an unused alternating current impulse, the objectionable effects of which are dissipated by the advancing circuit-clearing cam projection *d*, such dissipation occurring at the indication O (or 360°) in Fig. 3 and, as will readily be understood, just prior to the building up or rise of current which is terminated by the second cam projection *d* which breaks the circuit at 90° for producing an ignition spark, as is also indicated in Fig. 3.

The other parts of the circuit-controlling mechanism which are coöperative with the annular cam having the cam surfaces *a*, *b*, *c* and *d* formed on the rotative magnet-carrying hub 1, may be of any suitable construction, and these parts of the circuit-controller or circuit-breaker which are illustrated in the accompanying drawings, more particularly form the subject of my hereinbefore mentioned patent application Serial Number 68,444, and such parts are herein described together with other parts of the magneto only to a sufficient extent for the understanding of my present invention. Also the circuit arrangement or combination of coils diagrammatically illustrated in Fig. 4 of the drawings as included in the magneto which embodies my present invention is more particularly set forth and claimed in my hereinbefore mentioned patent application Serial Number 68,443. In this construction primary and secondary coils, respectively, 2 and 3 are provided which correspond respectively with the usual primary and secondary coils commonly employed in magneto construction, and there is also provided a separate additional reinforcing coil 4 for the primary coil 2, the reinforcing coil 4 being so arranged and connected as to act in harmony with and reinforce the inductive effect of the primary coil 2. In the wiring diagram illustrated in Fig. 4 the primary coil 2 and the secondary high tension or spark-producing coil 3 are shown as connected in multiple in a short circuit which is normally closed through the circuit controller or circuit breaker, and the supplemental reinforcing coil 4 is shown as connected in a short circuit through the circuit breaker in multiple relation with the primary coil 2 and the secondary coil 3, but when the circuit breaker or circuit controller is excluded, as when the circuit is broken, then the reinforcing coil 4 will be connected in series with the primary coil 2 and will also be in series with the secondary high tension coil 3, but the primary coil 2 and the secondary coil 3 will be in multiple relation with each other relatively to the reinforcing coil 4. The circuits are shown as of the grounded type, and one end of the winding of the high tension coil 3 is shown as connected to a usual spark plug 5.

The other parts of the circuit breaker which are coöperative with the circuit breaking cam of the hub 1 will now be described. In the construction illustrated one end of the winding of each of the three coils 2, 3 and 4 is electrically connected to a stationary contact terminal or contact point 6, shown as a stud, which is carried by a connector piece or contact post 7 which is mounted upon but insulated from the other parts of an armature frame, as most clearly appears in Fig. 6 of the drawings. The contact post 7 is mounted upon and insulated from a main frame part or armature hub 8 over a reduced portion of which fits a second frame part or collar plate 9 which clamps in place a laminated armature core 10.

The collar plate 9 has an upward projection or extension, as appears in Fig. 1, and a sheet metal circuit-closing or contact-making push spring 11 is mounted upon this frame extension. The sheet metal circuit-closing or contact-making spring 11 carries a contact-breaking lever bar 12 which is shown as secured at its upper end to the

spring 11 by means of a fulcrum pin 13 and as similarly secured near its lower end by means of a short stud 14 which forms a movable contact terminal or contact point coöperative with the stationary contact point or contact stud 6. The fulcrum pin 13 at the upper end of the lever bar 12 rests upon and is adapted to rock upon a fulcrum heel or bearing 15 of insulating material, such as hard rubber, shown as supported by the connector piece or contact post 7.

Normally or when unrestrained the circuit-closing spring 11 will press the movable contact stud 14 into circuit-making engagement with the adjacent end of the stationary contact stud 6, as appears in Fig. 1 of the drawings, and the short circuit of the magneto coil will thereby be closed through the armature frame which forms a grounded connection, as indicated in Fig. 4. The lower projecting end of the circuit-breaking lever bar 12 is shown as off-set away from the circuit-closing spring 11 and this projecting offset end of the lever bar 12 is coöperative with a cam roller 16 of suitable insulating material, such as hard fiber.

The cam roller 16 is shown as loosely contained in a slot in the armature frame shown, as appears in Figs. 1 and 6, as formed between the base of the contact post 7 and the adjacent face of the armature hub 8. It is to be noted as appears in Fig. 1, that the cam roller 16 projects from its containing slot at both sides of the contact post 7 and of the adjacent part of the armature hub 8. At one side the cam roller 16 is engageable with the adjacent projecting end of the lever bar 12 and at the other side the cam roller 16 is adapted to be engaged by the hereinbefore described annular cam formed upon the rotative field magnet hub 1. The smooth depressed cam surfaces *a* and *b*, which are in the same plane, as hereinbefore noted, do not press upon the projecting cam roller 16 but preferably permit the cam roller to have a certain amount of play and looseness, thereby permitting the circuit-closing spring 11 to maintain the closed circuit condition. However, the rounded cam projections *c* and *d* successively strike against or engage the cam roller 16 and force it back in its containing slot, thereby imparting circuit-breaking movement to the lever bar 12 against the tension of the circuit-closing spring 11. These cam projections *c* and *d* only break the circuit momentarily, permitting it to be immediately again closed by the circuit-closing spring 11.

As hereinbefore described, the first or circuit-clearing cam projection *c* rids the circuit of disturbing currents and leaves it free for the production of the succeeding spark-producing current impulse, the circuit of which is broken by the second or spark-producing cam projection *d* at the proper point of current flow to produce the most effective spark, as hereinbefore described. Because of the fact that the circuit-breaking cam roller 16 is loose within its containing slot at all times excepting when momentarily engaged by these cam projections *c* and *d* the wear upon this cam roller and upon the adjacent end of the lever bar 12 and upon other coöperative parts is very slight and is much less than it would be were the circuit maintained in a normally open condition by an extended projecting cam surface such as has hereinbefore commonly been the practice. Also in this connection it is to be noted that the advance breaking of the circuit at a non-sparking point by the circuit-clearing cam projection *c* produces improved electrical effectiveness comparable to that produced by a construction providing for operation under the normally open circuit system.

It is to be noted and is to be understood that the circuit-breaking cam projections *c* and *d* do not necessarily need to be relatively located exactly at the positions shown in the drawings. The first or circuit-clearing cam projection *c* could be shifted circumferentially somewhat relatively to the spark-producing cam projection *d* and good results still be secured. However, the circuit-clearing cam projection *c* should be so located as to avoid the production of a spark as that would be objectionable, in that it would unnecessarily deteriorate the spark plug 5 and also might sometimes effect pre-ignition. The best results so far have been secured by the location of the first or circuit-clearing cam projection *c* and the second or spark-producing cam projection *d* ninety degrees or one-fourth of a rotation apart, as illustrated in the drawings. It is to be understood of course, that the rotative cam-carrying hub 1 must be properly timed with relation to the magneto armature, which, in the construction illustrated in the drawings, is stationary. A condenser 17 is shown as connected across the contact terminals 6 and 14 of the circuit-breaker in the usual way as is well understood in the art.

In the magneto construction embodying my invention illustrated in the drawings, the cam-carrying hub 1 is also the hub of the fly wheel of the engine and is shown as removably held, by means of a tap bolt 18, upon the outer end of the engine crank shaft 19. This outer end of the crank shaft 19 is shown as journaled, by means of ball bearings, in a bearing ring or collar 20 which is screw-threaded over the adjacent outer end of a stationary sleeve 21. The armature hub 8 is fixed upon the stationary collar 20 so that the magneto armature is stationary while the field is rotative, being carried by the fly wheel hub 1. In the construction of magneto illustrated in the

drawings, a combined fly wheel shell and magnet carrier 22, preferably of non-magnetic material, such as brass, is fixed upon the cam-carrying hub 1 and has a peripheral flange or rim, as appears in the drawings. The field magnet of the magneto is shown as comprising two semi-circular permanent magnets 23 which have their like poles in contact and which fit within the peripheral flange or rim of the fly wheel shell 22 and are carried thereby. These semi-circular magnets 23 are provided at their joined ends with curved oppositely arranged polar extensions or poleshoes 24, as most clearly appears in Fig. 5.

It will now be readily understood that the magnets 23 and their pole shoes 24 provide two opposite magnet poles and also that the straight or bar-like armature core 10 is similarly bipolar. In this construction, as will be clear from an inspection of the drawings, particularly Fig. 5, there will be two alternating current impulses for each rotation of the rotative field, and one of these current impulses will have its maximum strength substantially in the relative position of the rotative parts appearing in Fig. 5 of the drawings, and this maximum current impulse is that which is indicated in Fig. 3 as occurring at 270° of rotation, this being the unused current impulse whose after effects are dissipated by the advancing circuit-clearing cam projection *c* at a point ninety degrees in advance of the breaking of the circuit at substantially the point of maximum current strength of the next succeeding current impulse by the following spark-producing cam projection *d* which, as hereinbefore noted, breaks the circuit at the point indicated in Fig. 3 at 90°.

In the construction illustrated in the drawings a plate-like stationary frame part 25 of the self-propelled vehicle is shown as held in place on the stationary sleeve 21 by the stationary armature-carrying bearing collar or ring 20. Also a ground wheel of the vehicle has a hub 26 shown as journaled upon the sleeve 21.

It is obvious that various modifications may be made in the construction illustrated in the drawings and above particularly described within the principle and scope of my invention.

I claim:

1. A magneto having, in combination, a short circuited primary coil, a secondary spark coil in inductive relation with the primary coil, means for producing alternating current in the short circuit of the primary coil, and means for breaking such short circuit at a non-sparking time in relation to the current therein and also for subsequently breaking such short circuit at a spark-producing time in relation to such current.

2. A magneto having, in combination, an armature including a short circuited primary coil and a secondary coil, a field magnet, the field magnet and the armature being mounted for relative rotation, and means operated by the relative rotation of the field and armature for successively breaking such short circuit at non-sparking and at spark-producing points in such rotation.

3. A magneto having, in combination, two relatively rotary parts, a short circuited primary coil, a secondary spark coil in inductive relation with the primary coil, and means operated by such relative rotation for successively breaking such short circuit at a non-sparking and at a spark-producing point in such rotation.

4. A magneto, having, in combination, two relatively rotary parts, a short circuited primary coil, a secondary spark coil in inductive relation with the primary coil, and means operated by such relative rotation for successively breaking such short circuit at a non-sparking point preceding a spark-producing point and again at the next succeeding spark-producing point.

5. A magneto having, in combination, two relatively rotary parts, a short circuited primary coil, a secondary spark coil in inductive relation with the primary coil, and means operated by such relative rotation for breaking such short circuit successively substantially at points of minimum and of maximum current flow.

6. A magneto having, in combination, an automatically acting circuit-closing circuit closer, and circuit-breaking means for operating the circuit closer to break the circuit, such means including a cam for thus operating the circuit closer to break the circuit at a time of substantially maximum flow of current for producing a spark and at a preceding time of less flow of current for clearing the circuit.

7. A magneto, having in combination, a spring-pressed circuit closer, and circuit-breaking means coöperative with such circuit closer, such means including a cam having a spark-producing circuit-breaking cam projection and also having a circuit-clearing circuit-breaking cam projection.

8. A magneto having, in combination, a primary coil included in a normally closed circuit, a secondary spark-producing coil in inductive relation with the primary coil, and means for alternately breaking the circuit of the primary coil at a point to clear the circuit and at another point to produce a spark at successive alternate breakings of the circuit.

9. A bipolar magneto having, in combination, a primary coil included in a normally closed circuit, a secondary spark-producing coil in inductive relation with the primary coil, spark-producing circuit-break-

ing means operative to break the circuit of the primary coil at a bipolar point substantially when the flow of current is greatest, and circuit-clearing circuit-breaking means operative to break the same circuit after the subsidence of maximum current flow in the opposite direction corresponding to the other bipolar point.

10. A magneto having, in combination, a primary coil included in a normally closed circuit, a secondary spark-producing coil in inductive relation with the primary coil, spark-producing circuit-breaking means operative to break the circuit of the primary coil at alternate points of substantially maximum current flow, and circuit clearing circuit-breaking means operative to break the same circuit at other alternate points after the subsidence of maximum current flow.

In testimony whereof I have affixed my signature.

GEORGE W. WACKER.