April 15, 1924. 1,490,171

I. E. HENDRICKSON

MAGNETO

Filed Sept. 30, 1921 4 Sheets-Sheet 1

Fig. 1.

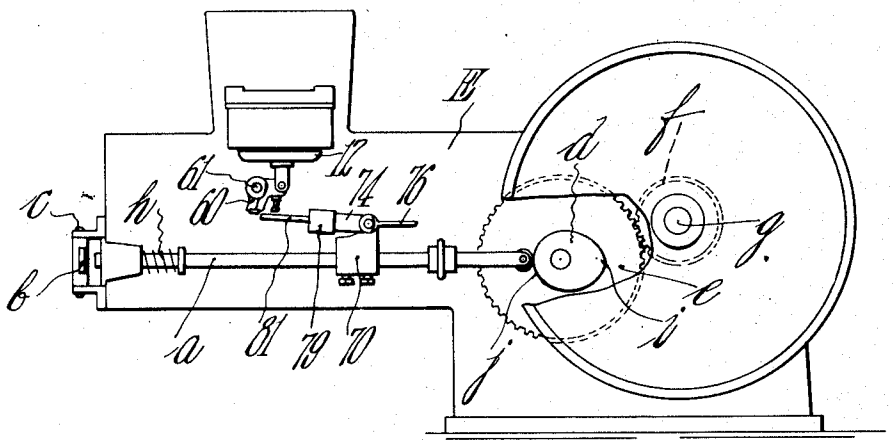
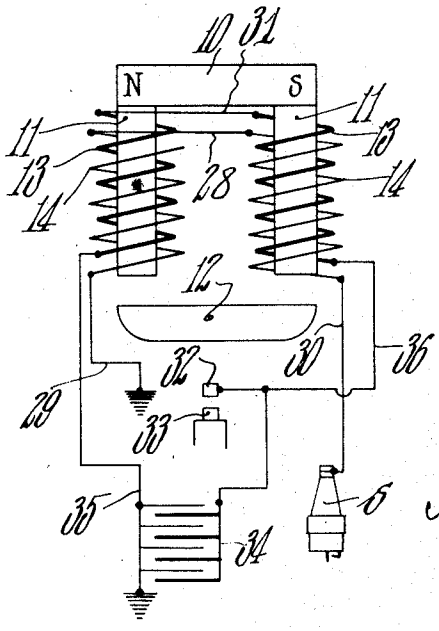


Fig. 6.



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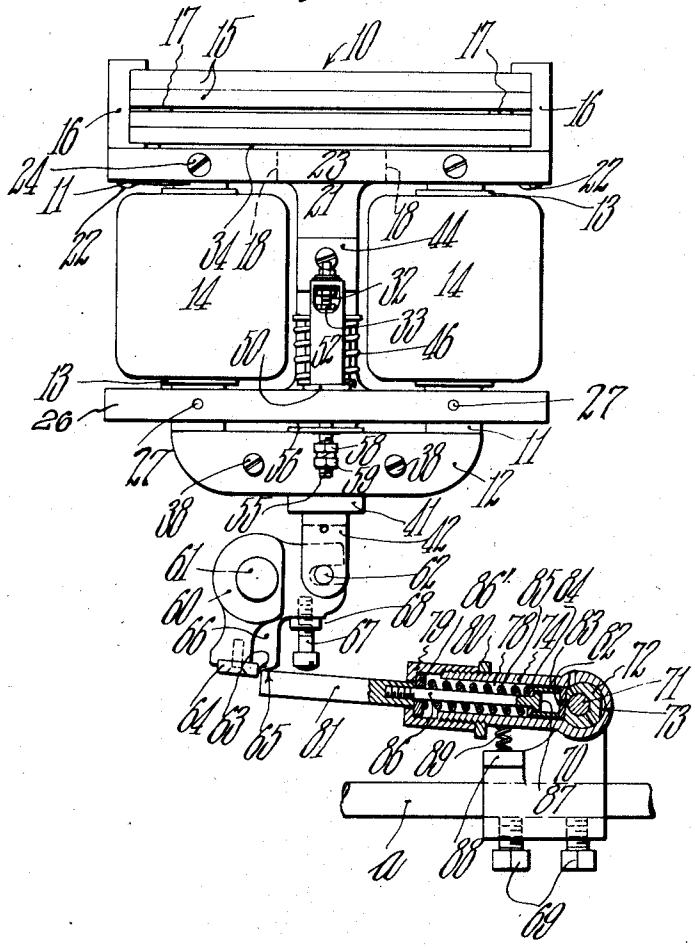
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Fig. 2.



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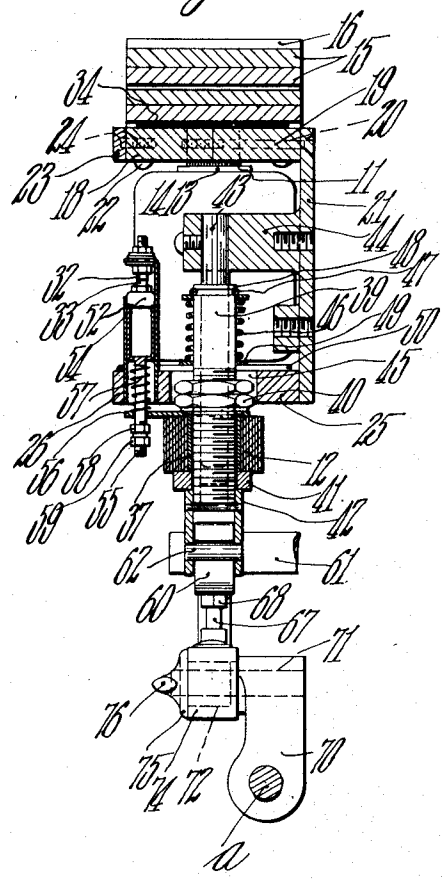
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MAGNETO

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Fig. 3.



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Fig. 4.

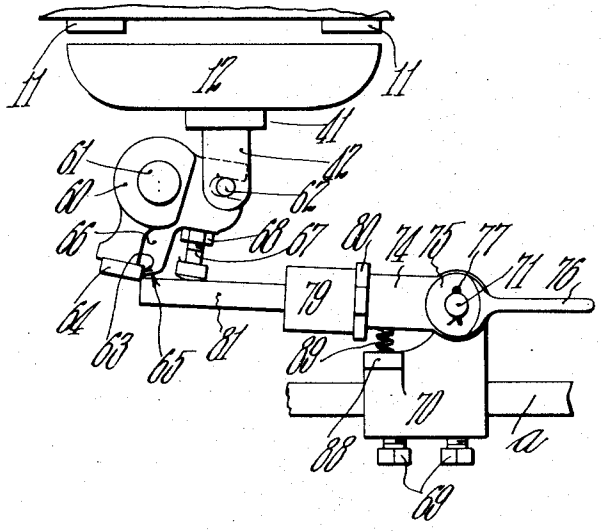
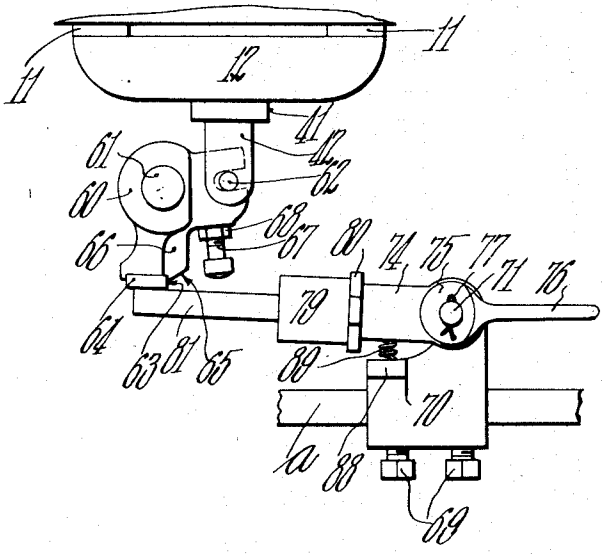


Fig. 5.



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Patented Apr. 15, 1924. 1,490,171

UNITED STATES PATENT OFFICE.

IRA E. HENDRICKSON, OF SPRINGFIELD, MASSACHUSETTS, ASSIGNOR TO WICO ELECTRIC CO., A CORPORATION OF MASSACHUSETTS.

MAGNETO.

Application filed September 30, 1921. Serial No. 504,334.

To all whom it may concern:

Be it known that I, IRA E. HENDRICKSON, a citizen of the United States, residing at Springfield, in the county of Hampden and State of Massachusetts, have invented new and useful Improvements in Magnetos, of which the following is a specification.

This invention relates to improvements in magnetos and is especially directed to magnetos of the type wherein a reciprocating armature moves into and out of engagement with magnetic poles to vary the flux in a magnetic circuit and by such variations to cause the generation of electricity in a suitable winding.

The invention is particularly concerned with mechanism for actuating the armature in a novel manner. Heretofore, it has been thought essential, in magnetos of the type described, to apply to the armature very suddenly, if not practically instantaneously, a relatively high initial force to dislodge the armature from its poles and overcome the opposing force due to magnetic attraction. Hence, the use of the hammer which, when suddenly released, is driven toward the armature and, after acquiring considerable momentum, engages the latter with an impact which sets the armature suddenly in motion at high speed. Such actuation of the armature was considered necessary in order to provide for a rapid change in flux in the generating windings. Other prior art magnetos, of the type under consideration, while dispensing with the hammer, have nevertheless retained the sudden and practically instantaneous release of the armature to allow the sudden application of a considerable initial driving force.

This invention is concerned, broadly, with improvements in magnetos of the type in which an armature is moved into and out of contact with magnetic poles and a driving mechanism is provided to build up on the armature, while held to its poles, a differential of force to disengage it therefrom. This differential, by reason of its infinitesimal initial value, is not capable of moving the armature away from its poles at high speed, but, as soon as the least air gap is established between the armature and its poles, the differential is increased considerably and continues to increase very rapidly until within a very short time it becomes effective to rapidly move the armature. This increase in the differential is due to the rapid weakening of the resistance to armature movement, which resistance includes as a principal element the force of magnetic attraction.

This invention has for an object to provide a magneto, of the general type defined, in which the armature flight is effected in the above manner and the armature, once it is deposited on the cores, is held thereto by magnetic attraction, the force of the latter being then superior to that of the driving means by which it is subsequently moved in the other direction,—together with means periodically operable to progressively oppose the force of magnetic attraction until the driving means becomes effective to move the armature.

According to this feature of the invention, the armature may be drawn toward its cores by any suitable means and will remain there until the magnetic hold on the armature is broken, after which the driving means, being then superior to the weakened force of magnetic attraction, will drive the armature away from the cores at rapidly increasing speed in the manner above outlined.

The invention has for another object to provide a magneto of the general character defined, wherein the armature tends at all times to remain on its cores and mechanism, which is periodically rendered effective and, when rendered effective, operates entirely independent of the engine, is provided to move the armature through one complete cycle, leaving only the preliminary operation of rendering such mechanism effective or the starting of the cycle dependent on engine operation, whereby the armature cannot be started from its poles without completing its flight and returning thereto. The magneto therefore can never, under any ordinary conditions of operation, be left with an open magnetic current.

The invention also has for an object to provide mechanism, operating in the general manner above outlined, for actuating a reciprocating armature type of magneto from the push rod or other reciprocable part of an internal combustion engine.

Other objects and advantages will appear in the following description and in the illustrative embodiment of the invention in the accompanying drawings, in which:

Fig. 1 is a small scale elevation view showing the mounting of the magneto on an internal combustion engine;

Fig. 2 is an enlarged elevational view of the magneto and its actuating mechanism;

Fig. 3 is a cross sectional view thereof;

Figs. 4 and 5 are fragmentary elevational views showing the actuating mechanism in other positions; and

Fig. 6 is a diagrammatical view of the electrical connections of the magneto.

In these drawings, there is shown, in full detail, an embodiment of the invention incorporating many desirable features relating to the particular construction and arrangement of various parts, which, although important and preferred, are not essential as far as the broader aspects of the invention, heretofore outlined are concerned. As to each of the latter, the showing is to be taken merely as an illustrative example of one of many suitable types of magnetos, in which they may be embodied.

The magneto is of the type in which an armature is moved into and out of contact with magnetic poles to vary the reluctance of a magnetic circuit, and, by such variations, cause the production of an electromotive force in a generating winding. It includes a source of magnetic flux 10, conducting members for the flux such as cores 11 and an armature 12 to form a magnetic circuit the reluctance of which may be varied by movement of the armature, and a suitable winding preferably including both primary and secondary coils 13 and 14 respectively.

The source of magnetic flux, in this particular instance, comprises a series of permanent bar-magnets 15 arranged in superposed relation and grouped into a unit for convenient assembly in the general manner disclosed in U. S. Letters Patent No. 1,335,119 granted March 30, 1920 on an invention of T. G. Louis. That is, the ends of like polarity of all magnets are received within substantially U-shaped clips 16, to which they are firmly held, as by shims or wedges 17. The clips 16, although of magnetic material, are not hard, as are the magnets 15, and are readily drilled to receive the attaching devices, later to be described. Various other means may be employed for securing the magnets in place and the clips are given merely as an illustration of one of many suitable means.

A magnetic pole-piece is provided for each pole of the magnetic source and each of these pole-pieces is made up of two rectangular blocks 18 and 19. The two blocks for each pole piece, as shown in Fig. 3, are arranged side by side and are recessed to receive between them the upper end of a core 11. The latter, as indicated in Fig. 3, is built up of laminations which are drawn together by, and held to, the mating pair of blocks by a single screw 20 (Fig. 3). The latter passes through a back frame 21, through the block 19 and core 11 and threads into the block 18. The screw 20 serves to draw the blocks together, thereby clamping the laminations of core 11 and also securing these parts to the back frame 21. The clips 16, above described, are secured to their respective pole-pieces by screws 22 which pass upwardly through the latter and thread into the lower part of the clips, there being two screws for each clip, as indicated in Fig. 3. The two pole-pieces may be further tied together by a bar 23, of non-magnetic material, which connects the spaced blocks 18 and is secured thereto by screws 24.

The two cores 11 extend downwardly from their pole-pieces in parallel relation and terminate at a short distance below the lower edge of frame 21. Near their lower ends, the laminations of the cores are clamped together and connected to the frame 21 in a manner similar to that above described except that two members 25 and 26, of non-magnetic material, suffice for both cores. Two screws 27 (Fig. 2) passing through frame 21, member 25 and the cores 11, thread into member 26 and serve to draw the members together and hold them to the frame.

Upon each core 11 and between the points at which it is clamped, are provided two coils 13 and 14 arranged one upon the other. The inner coils 13 are provided for a choking function, either to retard the building up, or the diminution of, magnetic flux in cores 11. The outer coils 14 constitute the generating winding. The electrical connections of these coils are shown in Fig. 6. The coils 14 are usually, although not necessarily, connected in series, as by a wire 28 joining one terminal of each coil. The other terminals of the generating winding, constituted by the connected coils, are the service terminals. Customarily, one terminal is grounded, as by a wire 29 to the frame of the magneto and the other extends to the ignition system, as indicated by the wire 30 extending to a spark-plug *s*.

The two coils 13 are also usually, although not necessarily, connected in series, as by a wire 31 joining one terminal of each coil. The other terminals of the choke-winding, afforded by the connected coils 13, are connected to relatively movable breaker-points 32 and 33 and a condenser 34 is bridged across these terminals in the usual manner. Usually, as shown, one terminal of one coil 13 is grounded, as by a wire 35, to the frame of the machine, whereby to conveniently connect with the movable breaker-point 33, which, as will appear is in constant metallic connection with the frame, and one side of the condenser 34

is similarly grounded. The corresponding terminal of the other coil 13 is connected, as by a wire 36, to the stationary breaker-point 32 and the other side of the condenser 34. The latter is conveniently located beneath the magnets 15 and between the clips 16, where it is supported by resting upon the blocks 18 and 19 (Figs. 2 and 3.)

The magnetic circuit will be readily understood from Fig. 6. The poles of the magnetic source, extended by the cores 11 to admit the windings 13 and 14, are periodically connected and disconnected by the armature 12, thereby providing for a magnetic circuit of alternately low and high reluctance through the windings.

The armature 12, as best shown in Fig. 3, may be made up of laminations in the usual manner, although this is not necessarily essential. The armature is fixed to a sleeve 37 and the laminations are spread apart at the center of the armature to permit the sleeve to pass therethrough. Bolts 38 (Fig. 2) located on opposite sides of sleeve 37, pass through the armature and serve to clamp the laminations thereof together as well as to bind them to the sleeve. A guide sleeve 39, the lower portion of which is threaded, passes freely through sleeve 37 and is adjustably secured to armature 12 by being clamped between a nut 40 located on one side of the armature and a spacing washer 41 which is located on the other side of the armature and in abutment with a fork 42 threaded upon the lower end of the guide sleeve 39. The latter is slidably mounted on a guide rod 43 fixed to a lug 44 on frame 21 and disposed centrally between and in parallel relation with cores 11, the members 25 and 26 being suitably recessed to receive the sleeve 39 and nuts 40 as indicated at 45 in Fig. 3. A spring 46, coiled about sleeve 39 acts between a seat 47, suitably fixed thereon as by a split spring ring 48, and a seat 49 which rests upon a hair pin shaped member 50, straddling sleeve 39 and bridging the recess 45.

The breaker points 32 and 33 form part of a unitary interrupter mechanism which is contained in a cylindrical casing 52, driven into an opening in the member 25 and thereby stationarily held to the magneto frame. At its upper end, the casing 52 carries the stationary breaker point 32 which is adjustably mounted therein and suitably insulated therefrom. The movable breaker point 33 is fixed to the upper end of a relatively long cylinder 54 which closely fits in, and is guided by the casing 52. Fixed to and depending from the cylinder 54 is an actuating rod 55 which extends below casing 52 and passes loosely through one end of a plate 56, the other end of which encircles the sleeve 37 of the armature 12 and is clamped thereagainst by nuts 40. Encircling rod 55 and disposed between plate 56 and the base of cylinder 54 is a coil spring 57 and mounted upon the rod and disposed below the plate is an abutment 58, preferably taking the form of a nut threaded upon the rod to facilitate adjustment and a second nut 59 being provided to lock nut 58 in adjusted position. When armature 12 is held to its cores, spring 57 presses point 33 tightly against point 32. Spring 57 is at such time considerably compressed so that it will hold the points 32 and 33 in engagement even while the armature moves away from its poles, the opening or separation of these points being effected only when plate 56 engages the abutment 58 and thereby pulls the point 33 downwardly. The time of opening of the points may be varied (by adjusting abutment 58) but is preferably near the end of the downward flight of the armature. The points 32 and 33 again close shortly after the armature starts its return movement. The closing of these points during the return movement is desirable because the choking winding is thereby effective to prevent any sudden change of flux which would cause an occasional "upthrow" spark.

The means for overpowering the magnetic hold on armature 12 or "tripping" it to start it from its cores and the driving mechanism for thereafter moving it rapidly away from its cores are independent from the magneto assembly described and are carried by some reciprocable part of the engine E (Fig. 1) such as the push rod *a*. The latter is utilized to operate the exhaust valve of the engine through the intermediary of a rocker arm *b* pivoted at *c*. Rod *a* is operated by a cam *d*, driven by a gear *e*, which in turn is driven by a gear *f* carried by the crankshaft *g* of engine E. A spring *h* urges rod *a* against cam *d*. The engine as shown, is of the four cycle type and cam *d* is arranged to rotate at one half the crankshaft speed. The relative positions of the parts shown in Fig. 1 is that which obtains at the beginning of the compression stroke. The high point of cam *d* is shown at *i* and, when this portion of the cam engages rod *a* (after substantially two strokes of the engine and near the end of the firing stroke) the rocker arm *b* will have been engaged and moved sufficiently to open the exhaust valve. Intermediate the high and low points of cam *d*, there is a rise *j*, which moves rod *a* during the compression stroke sufficiently so as to cause the operation of the magneto at the beginning of the firing stroke by means to be described. The exact time of operation of the magneto can be controlled and varied by such means. The movement of rod *a* effected by the rise *j*, is not sufficient to oper-

ate the rocker arm *b*, there being sufficient clearance between these elements for this purpose.

The magneto frame 21 is stationarily mounted on the engine adjacent and above the push rod *a*. Below the armature an oscillatable lever 60 is pivoted intermediate its ends at 61 to the engine frame and one arm of this lever is adapted to fit between the arms of fork 42 and is itself forked to straddle a pin 62 which extends between the arms of fork 42. The other arm of lever 60 has a shoulder 63, preferably constituted by the end face of a hardened latch block 64 suitably secured to the arm. The base of shoulder 63 is defined by the lower face 65 of a web 66 on lever 60 and such face is disposed at an obtuse angle to the shoulder 63. Adjustably mounted in the first named arm of lever 60 and depending therefrom, is a screw 67, which may be held in adjusted position by a lock nut 68. The screw 67 is located beyond the web 66 and its lower end is disposed at or about the level of the adjacent end of surface 65.

Secured to the push rod *a*, preferably for longitudinal adjustment thereon, as by the set screws 69, is a bracket 70, in one side face of which is fixed a stud 71 which projects horizontally outward from the bracket and at right angles to the axis of rod *a*. Rotatably mounted on stud 71 is an eccentric 72 which has two or more recessed or flattened portions 73 in its periphery. A casing 74 has a cylindrical opening therethrough at one end to receive the eccentric 72, which opening is closed at one end by the adjacent face of bracket 70 and at the other by a circular flange 75 of larger diameter than the eccentric. To such flange is fixed a lever 76, whereby the eccentric may be turned, and a pin 77 is passed through stud 71 outside flange 75 to hold the latter, the eccentric and casing 74 against substantial axial displacement thereon. The casing 74 constitutes a trip finger and controls the time when armature 12 is dislodged from its poles, such time being variable by turning the eccentric 72, which is releasably held in its various positions of adjustment by means to be described.

The casing 74 has a longitudinally disposed cylindrical opening 78 which extends from one end to, and intersects at right angles with, the opening in which eccentric 72 is seated. Such opening is closed at its outer end by a removable cap 79 threaded upon the outer cylindrical end of casing 74 and thereby adapted for longitudinal adjustment relatively thereto, such cap being held in its various positions of adjustment by a lock nut 80. Cap 79 is provided with a square opening therein to slidably receive a bar 81 of square cross section and the outer end of this bar is adapted as a latch to periodically engage the latch block 64. Its outer end is preferably hardened to insure long life and, after wear, the worn face of bar 81 may be turned ninety degrees, either by turning cap 79 or by removing the bar from the cap and reinserting it in a new position therein, whereby an additional wearing surface may be presented to the latch block. Other additional wearing surfaces may be presented by similar adjustments of bar 81.

Loosely mounted in the inner end of opening 78 is a disc 82 which closes such end of the opening and bears against the periphery of eccentric 72 and, when engaged with the flattened portions 73 thereof, acts to hold the eccentric in adjusted position. Also loosely mounted in opening 78 with one end in abutment with disc 82 is a sleeve 83 and similarly mounted in the opening in abutment with the other end of this sleeve is a washer 84 having an opening of less diameter than that of the sleeve. The washer 84 forms a seat for a spring 85 which constitutes a resilient driving means for moving armature 12 in its downward flight after it has been started by the trip finger on casing 74. Spring 85 acts on the latch bar 81 against a washer 86′ mounted on an extension of the bar and resting against the shoulder afforded by the intersection of such bar and shoulder. This extension takes the form of a rod 86, threaded into the inner end of bar 81 and extending inwardly through spring 85 and washer 84 and having a head 87 against which the washer at times may bear. This head is normally spaced from disc 82 and the distance of separation defines the limit of movement of bar 81 and the degree of compression of spring 85. Such limit and degree of compression are variable by adjustment of cap 79.

It is to be particularly noted that although the driving spring is interposed between a part movable with and at the same speed as rod *a*, such as the disc 82 forming the inner end of the trip finger casing 74, and the latch bar 81, the latter and the trip finger may be brought into direct contacting engagement on compression of the drive spring 85. The latter, even when stressed to the maximum limit permitted, is of itself insufficient to overpower the force of magnetic attraction which normally holds armature 12 to its poles. The trip finger 74 therefor is also permitted to act on the latch bar 81, after stressing of the drive spring 85, and independently of the latter so that a relatively slow acting force is transmitted from the push rod *a* through contacting parts directly to the armature to dislodge the latter from its poles. After a very slight dislodgment of the armature, the force of magnetic attraction is so diminished that the driving spring 85 can function and it

rapidly expands and moves bar 81 ahead at high speed and at a speed considerably in excess of rod 81.

The trip finger 74 is, as will be readily apparent from the foregoing description, pivotally supported at one end from bracket 70 and for supporting its other end, in such position that the latch bar 81 may engage the latch block 64, a ledge 88 is provided on the bracket, which ledge projects from the latter and underlies the finger 74. Between the latter and this ledge a spring 89 is interposed which yieldingly supports the finger in such position that the upper outer corner of the bar 81 will strike some part of the surface 65 on lever 60 and allow the bar, as it continues to move, to be cammed downwardly by said surface and thereby directed properly against the shoulder 63 of the latch block 64.

The operation of the magneto operating mechanism will next be described. The normal position of the armature and its connected parts is shown in Fig. 3 and assuming that these parts are so positioned and that the push rod is moving to the left on the compression stroke of the engine, the latch bar 81 will eventually engage surface 65 and be directed, as just described, into engagement with the latch block 64. The exact time of engagement may be controlled by adjustment of bracket 70 on rod *a* or by movement of eccentric 72. The latter is releasably held by the means described in two positions one of which is the normal running position and the other a retarded position for starting, the latter being illustrated. After engagement of bar 81 and block 64, the former continues to move but the latter does not move until the head 87 abuts disc 82 for, as has been pointed out, the driving spring 85 is insufficient even when fully stressed to overcome the force of magnetic attraction which holds the armature on its poles. Meanwhile the driving spring is being stressed properly to perform the function later required of it. On abutment of head 87 with disc 82 a direct force from the push rod *a* is transmitted through solid contacting elements to the latch block 64 and thus to armature 12 and this force acting at push rod speed pulls the armature away from its poles a very short and hardly measurable distance. This force overcomes that due to magnetic attraction and starts the armature from its poles or trips it, but the rate of armature movement during this exceedingly short step of movement is relatively slow. However, immediately that an air gap is created between the armature and its poles, even though this gap be exceedingly small, the force of magnetic attraction on the armature is greatly diminished and inferior to that of the stressed driving spring 85. Accordingly, immediately that the finger 74 through the contacting latch bar 81 has tripped the armature, the driving spring relieves its stress by expanding and drives the armature with considerable rapidity away from its poles. During this latter movement the breaker points 32 and 33 open, having been hitherto closed to retard any sudden change in magnetic flux in the magnetic circuit during the starting of the armature from its poles. The relative position of the parts which then obtain, is shown in Fig. 4 and it is to be noted that the lever 60, in its downward swing, forces the head of screw 67 against the latch bar 81 and forces it downwardly out of engagement with block 64, the spring 89 yielding to permit this movement. Immediately that this disengagement occurs, the spring 46 lifts armature 12 and returns it to its poles or sufficiently close to the poles so that it may be drawn thereto by magnetic attraction. Thereafter, the push rod *a*, which during the flight of the armature described has moved only a very short and hardly measurable distance, continues its movement, as indicated in Fig. 5, for the purpose of opening the exhaust valve, eventually returning to its extreme right hand position, in which it dwells until the succeeding compression stroke.

A most important and novel feature of the arrangement described is that the armature cannot under any ordinary conditions of engine operation remain off its poles. It is normally held there by magnetic attraction to insure a normally closed magnetic circuit, the advantages of which, as far as they concern retentivity of flux in the magnetic source are well understood. To trip the armature means that the driving spring must first be stressed and then, as soon as the tripping occurs, the armature is forced rapidly away from its poles independent of the operation of the engine and likewise returns independently. Suppose that the engine should stop just after the latch bar 81 had contacted with the disc 82 of the trip finger 74, the armature would be tripped and the driving spring 85 and return spring 46 would cause a complete cycle of operation of the armature. Aside from the advantage mentioned, this feature of the invention is especially advantageous in that it reduces to a minimum the possibility of dirt, grease, or other foreign substances lodging between the armature and its poles to interfere with the desired close contact between these elements. The armature and poles are purposely not enclosed in order that their operation may be visible at all times. Consequently, if the armature remained separated from its poles for any substantial length of time, the desired intimate magnetic contact between the armature and its poles might be impaired and the reluctance of the magnetic circuit considerably

increased, with resulting decrease in efficiency of the magneto. Furthermore, as has been pointed out the choking winding is closed on the upstroke of the armature to prevent an upthrow spark and, aside from the function, the closed choking winding opposes any change in flux in the magnetic circuit and therefore tends temporarily to decrease the force of the pull on the armature which would otherwise cause the armature to be seated with a sharp noise. Thus, the closed choking winding is desired to insure that the armature will be seated as quietly as possible. However, having this condition of a closed choking winding, a relatively long time interval of contact between the armature and poles is essential to permit the flux to build up to a maximum in the non-closed magnetic circuit and such a time interval is afforded by the arrangement whereby the armature remains on its poles for the major part of the time.

As contrasted with prior art magnetos of this general type, the disengagement of the armature is not accomplished by the sudden application of a substantial initial force. On the contrary, by a movement of the push rod *a*, a force is built up relatively gradually to oppose that holding the armature to its poles and when this opposing force just overbalances the holding force, the armature commences to move but at a relatively gradually slow rate (being that of a push rod *a*) during the first infinitesimal step because the differential of force effective to move the armature is at first infinitesimal. A very slight movement of the armature very greatly diminishes the holding force and in consequence the differential of force increases and a rapid movement of the armature results and at the optimum point in such movement the breaker points 32 and 33 are opened, allowing a rapid change of flux through the generating windings to produce the spark.

In conclusion, it may be pointed out that the necessary speed of the armature is really obtained by fully utilizing the factor of the rapidly diminishing force of magnetic pull by the creation and the increase of an air gap. This factor may be termed "magnetic retraction" as distinguished from "magnetic attraction" and is the factor relied upon here to obtain armature speed, as distinguished from the hammer blow or the substantial, and instantaneously applied, initial force heretofore used to produce an initial high speed. Inasmuch as the flux can be held by the choke-coils for an interval sufficient to accelerate the armature to the desired speed, initial speed becomes unnecessary.

Although the invention has been described herein with considerable particularity in order to make clear to those skilled in the art a preferred means of making use of it, it is to be understood that the invention is not limited to the details illustrated and described except as they are included in the following claims.

What I claim is:

1. In combination with an internal combustion engine, a magneto of the type wherein an armature is moved into and out of contact with magnetic poles, mechanism operable independently of the operation of the engine when rendered effective to move the armature away from its poles a certain distance and then reseat it on its poles, and means controlled by the operation of the engine periodically to render said mechanism effective.

2. In a combination with an internal combustion engine, a magneto of the type wherein an armature is moved into and out of contact with magnetic poles, mechanism operable independently of the operation of the engine when rendered effective to move the armature through a complete cycle of movement, and means controlled by the operation of the engine to periodically render said mechanism effective, whereby the armature is prevented from stopping in any position wherein it is separated from its poles.

3. In combination with an internal combustion engine, a magneto of the type wherein an armature is moved into and out of contact with magnetic poles, means controlled by the operation of the engine to start the armature on its flight away from its poles, and means independent of the operation of the engine to complete the flight of the armature and return it to its poles.

4. In combination with an internal combustion engine, a magneto of the type wherein an armature is moved into and out of contact with magnetic poles, resilient means tending at all times to hold the armature to its poles, means effective by the operation of the engine to periodically start the armature from its poles, and means operable independently of engine operation after the armature has been started to complete the flight thereof away from the poles and release it for return movement by said resilient means and independently of the operation of said engine.

5. In a magneto, wherein the armature is held in contact with its poles by magnetic attraction, means for moving the armature away from its poles and thereafter returning it thereto, said means being ineffective while the armature remains in contact with its poles, and means periodically operable to break the magnetic hold on the armature sufficiently to render the first named means effective.

6. In a magneto, adapted for operation by an internal combustion engine and where-

in the armature is held in contact with its poles by magnetic attraction, means for moving the armature away from its poles and returning it thereto independently of engine operation, said means being ineffective until the contact of the armature and poles is broken, and means controlled by engine operation to periodically break said contact and allow said means to act.

7. In a magneto, of the type wherein an armature moves into and out of engagement with magnetic poles to vary the reluctance of a magnetic circuit and a generating winding is associated with said circuit in which winding currents may be induced by the variation of flux in said circuit; a choke winding associated with said circuit and arranged in a circuit which may be opened and closed, mechanism operable independent of engine operation when rendered effective to move the armature away from its poles a certain distance and then reseat it thereon, means controlled by operation of the engine to periodically render such mechanism effective, and means for opening said choke winding circuit after the armature has been separated from its poles on its flight away from the latter and closing such circuit before the armature reaches its poles on its flight toward the latter.

8. In a magneto, of the type wherein an armature moves into and out of engagement with magnetic poles to vary the reluctance of a magnetic circuit and a generating winding is associated with said circuit in which winding currents may be induced by the variation of flux in said circuit; a choke windind associated with said circuit and arranged in a circuit which may be opened and closed, means controlled by the operation of the engine to start the armature on its flight away from its poles, means operable independently of engine operation to complete the flight of the armature away from its poles and then return it thereto, and means for opening said choke winding circuit after the armature has been separated from its poles on its flight away from the latter and closing such circuit before the armature reaches its poles on its flight toward the latter.

9. In a magneto, of the type wherein a reciprocable armature is moved into and out of contact with magnetic poles, a rocker arm connected to reciprocate the armature, means tending at all times to move the armature toward its poles, and means reciprocable in a path nonparallel to that of the armature and periodically operable to engage said rocker arm and move the armature away from its poles and to release the rocker arm after the armature has travelled a predetermined distance.

10. In a magneto, of the type wherein a reciprocable armature is moved into and out of contact with magnetic poles, a rocker arm connected to reciprocate the armature, means tending at all times to move the armature toward its poles, a member periodically engageable with said rocker arm, resilient driving means, a reciprocable device adapted for operation by an engine to move said member through the intermediary of the resilient driving means, said device and member being movable into contact after said resilient driving means has been stressed and before the rocker arm is moved by said member.

11. In combination, a magneto adapted to be stationarily mounted on an internal combustion engine, said magneto being of the type wherein an armature is moved into and out of contact with magnetic poles, and including an armature normally held by magnetic attraction to its poles, and means for returning it toward the latter when removed therefrom; a rocker arm connected to reciprocate the armature, and mechanism to periodically engage the rocker arm and move the armature away from its poles and then release it for the return movement, said mechanism including two relatively movable parts, one of which is adapted for connection to a moving part of the engine and the other of which is adapted to engage said rocker arm, and elastic means stressed by the relative movement of said parts when the last named part engages said rocker arm.

12. In combination, a magneto adapted to be stationarily mounted on an internal combustion engine, said magneto being of the type wherein an armature is moved into and out of contact with magnetic poles, and including an armature normally held by magnetic attraction to its poles, and means for returning it toward the latter when removed therefrom; and mechanism adapted for connection to a reciprocable part of the engine and arranged to periodically move the armature away from its poles and then release it for the return movement, said mechanism including means for transmitting from said part to the armature a relatively slow acting force to overpower that of magnetic attraction and start the armature away from its poles, and resilient means exerting less force than the maximum force of magnetic attraction on the armature for driving the latter at a greater speed away from its poles after it has been started by the last named means.

13. In combination, a magneto adapted to be stationarily mounted on an internal combustion engine, said magneto being of the type wherein an armature is moved into and out of contact with magnetic poles, and including an armature normally held by magnetic attraction to its poles, and means for returning it toward the latter when removed therefrom; and mechanism adapted

for connection to a reciprocable part of the engine and arranged to periodically move the armature away from its poles and then release it for the return movement, said mechanism including means for transmitting from said part to the armature a relatively slow acting force to overpower that of magnetic attraction and start the armature away from its poles, and resilient means stressed by the action of the last named means but to a degree insufficient to overpower the magnetic attraction on the armature and arranged to drive the armature away from its poles after it has been started by the last named means and independently of and at a higher speed than that of the last named means.

14. In combination, a magneto adapted to be stationarily mounted on an internal combustion engine, said magneto being of the type wherein an armature is moved into and out of contact with magnetic poles, and including an armature normally held by magnetic attraction to its poles, and means for returning it toward the latter when removed therefrom; and mechanism adapted for connection to a reciprocable part of the engine and arranged to periodically move the armature away from its poles and then release it for the return movement, said mechanism including a member for attachment to said part, a second member mounted for limited sliding movement relatively to the first member and arranged to engage the armature, resilient means tending to hold said members at one limit of said movement and adapted to be stressed prior to movement of the armature to permit the members to move to the other limit of their movement, said members having parts which are movable into contact by the stressing of the spring so that a force from said part of the engine may be transmitted through the contacting members, to move the armature.

15. In combination, a magneto adapted to be stationarily mounted on an internal combustion engine, said magneto being of the type wherein an armature is moved into and out of contact with magnetic poles, and including an armature normally held by magnetic attraction to its poles, and means for returning it toward the latter when removed therefrom; and mechanism adapted for connection to a reciprocable part of the engine and arranged to periodically move the armature away from its poles and then release it for the return movement, a casing adapted at one end for attachment to said part, an armature actuating bar slidably mounted in the casing and projecting from the opposite end thereof, a spring tending to project the bar from the casing, means for limiting the extent of projection of said bar from the casing, said bar adapted when moved into the casing to abut the first named end of the latter after the spring has been stressed to a predetermined degree.

16. Armature actuating mechanism, comprising a member adapted for attachment at one end to a reciprocable part of an internal combustion engine, a second member slidably connected to the first member and projecting beyond the other end thereof, a spring tending to project the second from the first member, means for limiting the extent of said projecting movement, and means comprising interengageable parts of said members to abut after said spring has been stressed to a predetermined degree on inward movement of the second member.

17. Armature actuating mechanism, comprising a member adapted for attachment at one end to a reciprocable part of an internal combustion engine, a second member slidably connected to the first member and projecting beyond the other end thereof, a spring tending to project the second from the first member, means for limiting the extent of said projecting movement, and means comprising interengageable parts of said members to abut after said spring has been stressed to a predetermined degree on inward movement of the second member, and adjustable means for moving the first member relatively to said part.

18. Armature actuating mechanism, comprising a casing provided at one end with a seat for an eccentric, an eccentric mounted in said seat, a bracket rotatably supporting said eccentric and adapted for connection to a reciprocable part of an internal combustion engine, an armature actuating bar slidable in the casing and projecting from the opposite end thereof, said bar having parts adapted to abut opposite ends of the casing to limit its sliding movement, and a spring normally holding said bar in its outer position.

19. Armature actuating mechanism, comprising a casing provided at one end with a seat for an eccentric, an eccentric mounted in said seat and having recessed portions in its periphery, a bracket rotatably supporting said eccentric and adapted for connection to a reciprocable part of an internal combustion engine, an armature actuating bar slidable in the casing and projecting from the opposite end thereof, said bar having a part engageable with the second named end of the casing to limit its inward movement, a spring tending to hold the bar in its outer position, a detent to engage in any one of the recessed portions in the eccentric and hold it in adjusted position, a seat for said spring and connected with said detent, and an opening provided in said seat to permit said bar to abut the detent and limit its inward movement.

20. Armature actuating mechanism, comprising, a casing open at one end and adapt-

ed for attachment at the other end to a reciprocable part of an internal combustion engine, a removable closure for said open end having a polygonal opening, an armature actuating bar of polygonal cross-section slidable in said opening, a spring tending to force said bar outwardly from the casing, and means for limiting the movement of said bar in each direction.

21. In combination with an internal combustion engine, a magneto stationarily mounted thereon and of the type wherein an armature is moved into and out of contact with magnetic poles, resilient means tending at all times to move the armature toward its poles so that it may normally be held thereon by magnetic attraction, an oscillatable lever associated with the armature for moving it away from its poles when swung in one direction, a member movable with a reciprocable part of the engine, a bar slidably carried by said member and adapted to periodically engage said lever and swing it in said direction, resilient means connecting said bar and member, said bar and member being movable into contact and said resilient means being stressed to a predetermined degree prior to movement of the lever by the bar, said resilient means thereafter relieving its stress by driving the lever after it has been started by the bar, and means for disengaging the bar and lever after the latter has been swung a predetermined distance in said direction.

22. In combination with an internal combustion engine, a magneto stationarily mounted thereon and of the type wherein an armature is moved into and out of contact with magnetic poles, resilient means tending at all times to move the armature towards its poles so that it may normally be held thereon by magnetic attraction, an oscillatable lever associated with the armature for moving it away from its poles when swung in one direction, a member movable with a reciprocable part of the engine, a bar carried by said member and adapted to periodically engage said lever, resilient means connecting the bar and member and through which the latter moves the bar into engagement with the lever, said resilient means being stressed after such engagement without moving the lever, said bar after stressing of said resilient means being moved directly by said member independent of said resilient means to start the lever in motion and the stressed resilient means arranged to move the lever after it has been started.

23. In a magneto, of the type wherein a reciprocable armature is moved into and out of contact with magnetic poles and means are provided for returning the armature toward its poles when removed therefrom, mechanism operable from a moving part of an engine for moving the armature away from its poles and subsequently releasing it for the return movement, said mechanism operating to effect the initial stage of armature movement by a non-elastic transmission from said moving part and including previously stressed elastic means effective at the end of said initial stage of movement to complete the movement at a much higher speed than that of said part.

In testimony whereof I have affixed my signature.

IRA E. HENDRICKSON.