

Nov. 19, 1929.

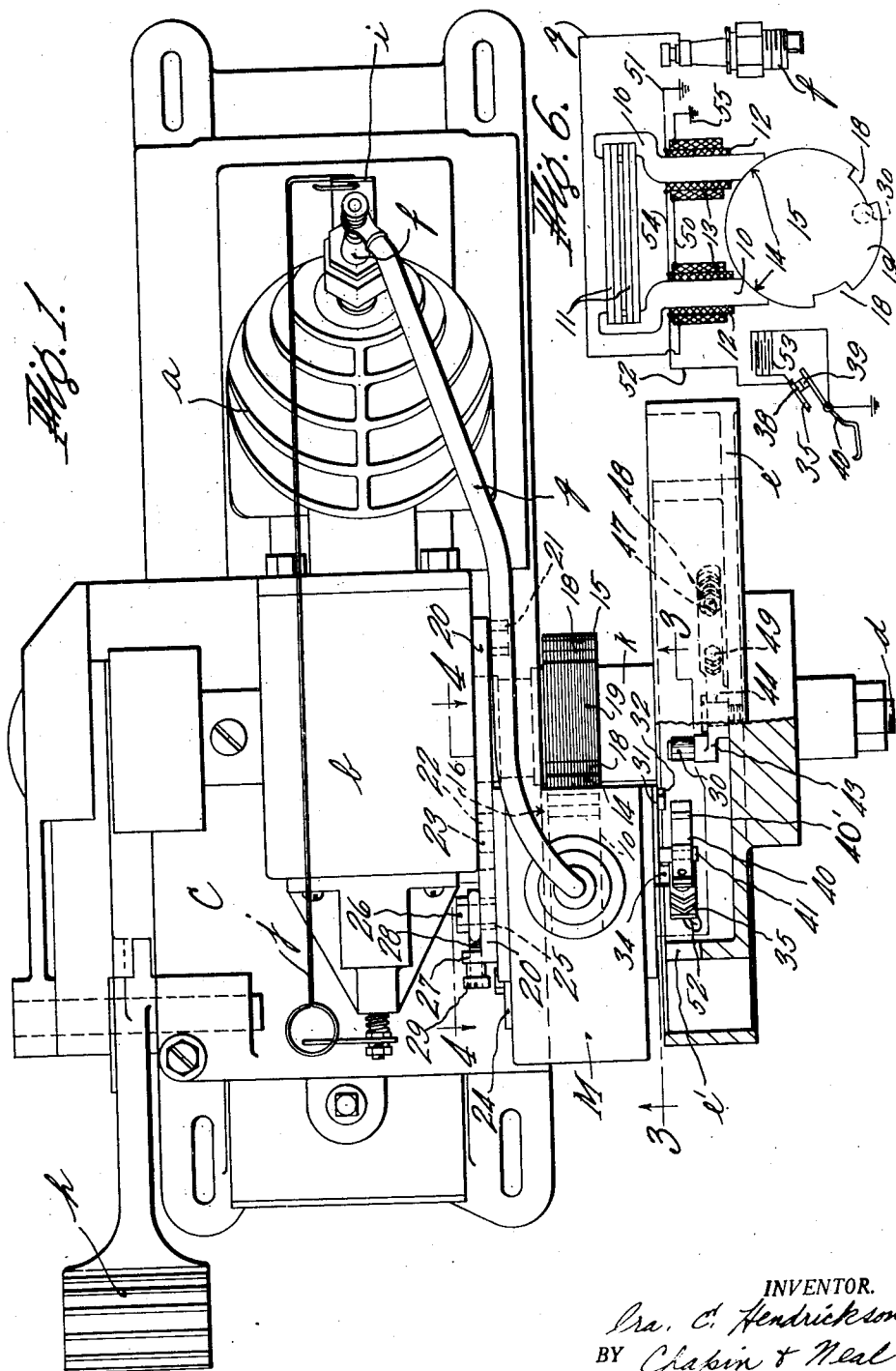
I. E. HENDRICKSON

1,736,441

MAGNETO

Filed Aug. 31, 1928

3 Sheets-Sheet 1



INVENTOR.

Ira. C. Hendrickson

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ATTORNEYS.

Nov. 19, 1929.

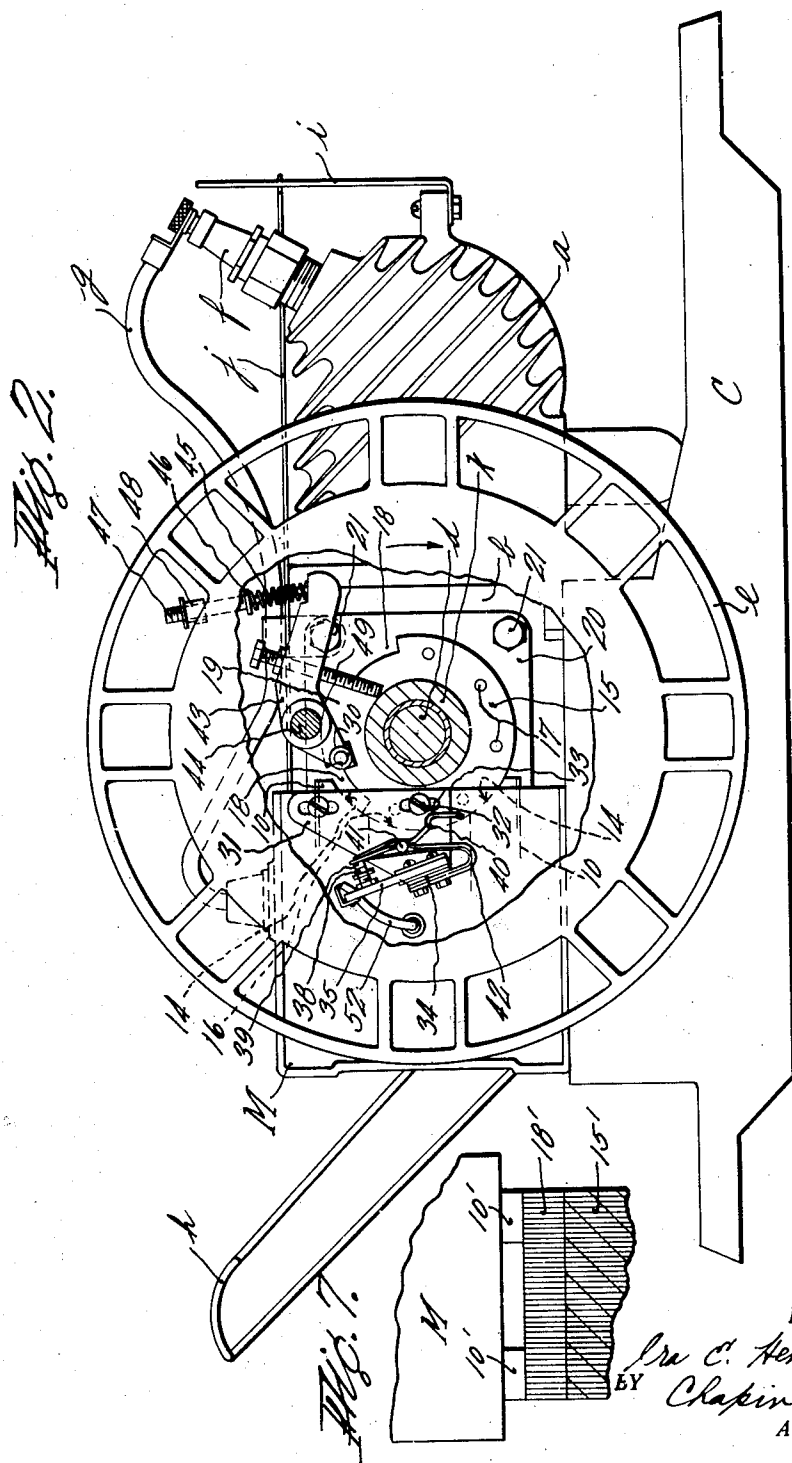
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Fig. 3.

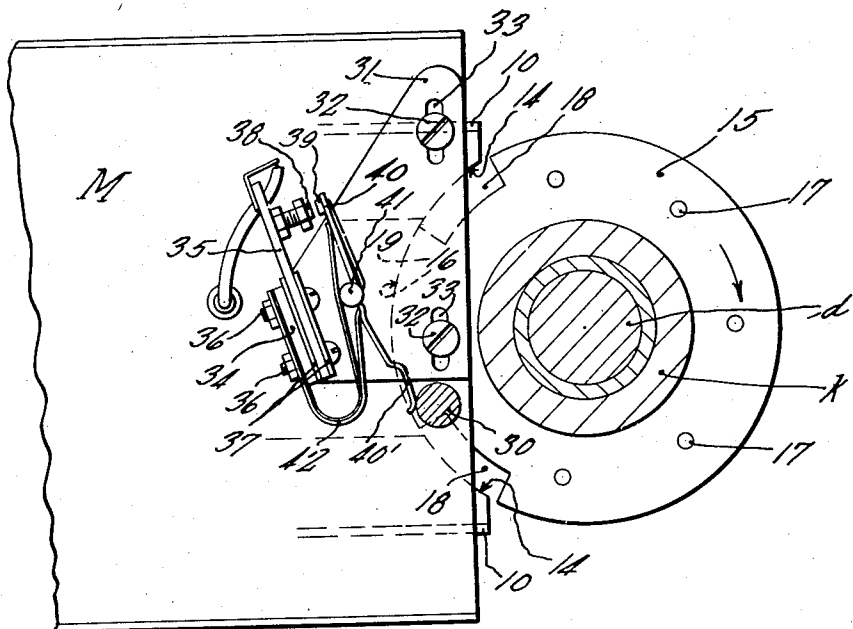


Fig. 4.

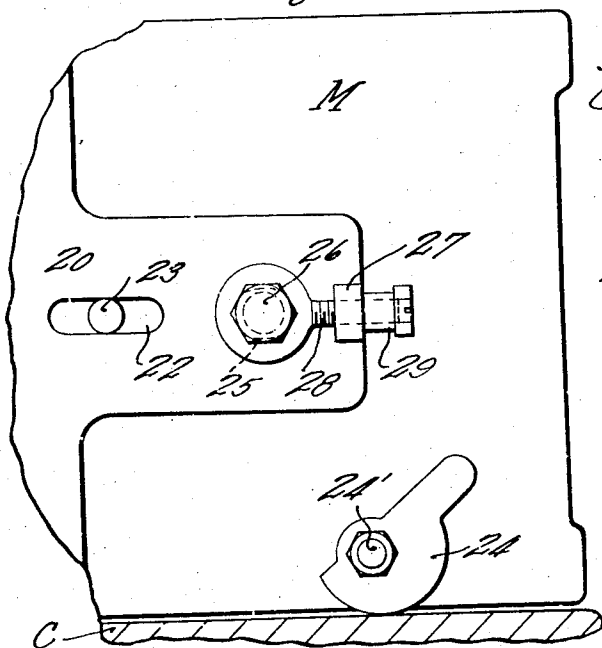
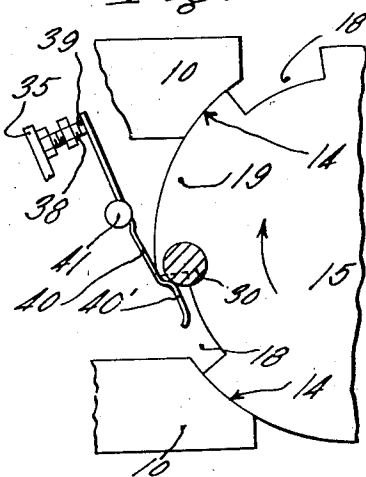


Fig. 5.



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UNITED STATES PATENT OFFICE

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MAGNETO

Application filed August 31, 1928. Serial No. 303,303.

This invention relates to an improved magneto of the type having an unwound, rotary inductor or armature,—sometimes known as the flywheel type when the flywheel is utilized as the inductor.

The prior art discloses a large number of magnetos of this type, which may for convenience be subdivided into two general classes. In one of these classes, the magnetic field elements,—except for the inductor,—and the generating coils are maintained stationary,—leaving the inductor as the only rotary element. In the other class, the magnets rotate. The only magnetos of the stated type which have had any substantial commercial success, so far as I am aware and have been able to determine, are of the second-named class and these have many disadvantages.

Contrasted with magnetos of the first class, magnetos of the second class are more expensive to manufacture. Also, their use leads to many complications. Usually they must be specially designed for each engine installation and thus “built into” the engine as distinguished from a unitary structure which can be added on to any engine without necessitating special design of engine parts. Long magnets, bent up into substantially circular form, are often used and these are expensive due to the special work in shaping them, as well as to the large amount of material involved. Such magnets have to be surrounded by non-magnetic material, which is more expensive than cast iron. For example, it is common to make the flywheel of aluminum. It is also common to house the magnets, as well as all other parts of the magneto in the flywheel. This practice makes the magneto relatively inaccessible,—difficult to install and difficult to remove when servicing is required. Also, it is not feasible in magnetos of the second class to reduce the clearance between the pole pieces and the inductor to such low limits as is practical in magnetos of the first class and, therefore, the former are less efficient than the latter, other factors being equal.

That there are so many disadvantages to magnetos of the second class has led me to di-

rect my invention entirely to magnetos of the first class, and I seek by the utilization of a less amount of material in a less expensive way to produce better results. In this field, however, there are many troubles to be overcome. The prior art abounds in examples of magnetos of this class, but it is, I believe, a fact that no one of such magnetos has ever met with any substantial degree of commercial success. Something has been lacking in each instance which prevented a commercially successful solution of the problem. At intervals over a long period of years attempts have been made to solve this problem, but no one heretofore has happened to secure just the right combination of elements to admit of results which would bring full commercial success.

My invention is directed to, and has for its general object, the provision of a magneto of the first-named class which satisfies the exacting demands of commercial service. Various good features individually disclosed in the prior art have been retained and other bad features eliminated, and the result is a novel arrangement of elements cooperating in an improved way to produce successful results.

More particularly, I set forth the objects of my invention by stating conditions which I deem necessary to assure successful results in a magneto of the stated type and class. The magnets, cores, and coils should be stationary and assembled as one compact, unitary structure, which can be applied to any engine in a conveniently accessible location and without substantial alterations in the latter. This unit, which should include two magnetic pole pieces, should preferably be mounted for convenient adjustment toward or away from the rotary inductor in order to adjust the clearance between the rotor and pole pieces and, for efficient utilization of the magnetic flux, such clearance should be exceedingly small and as near physical contact as possible. For proper adjustment and maintenance of such clearance, it is essential that both pole pieces should lie on the same side of the engine crankshaft. Due to the lack of actual contact between the arma-

ture and pole pieces, it is essential that the magneto have both primary and secondary coils,—otherwise, the spark produced will be too feeble to satisfy the requirements. The inductor, for maximum efficiency, must provide for a sharp and double break in the magnetic circuit and, so far as is practical, must at other times hold the magnetic circuit closed. A simple form of breaker point mechanism should preferably be used to control the primary circuit, which requires one opening and closing for each cycle of operation of the magneto. These breaker points should normally hold the primary circuit closed and should preferably open at substantially the time when the double break in the magnetic circuit occurs to allow the spark to be produced on breaking, rather than on making, of the magnetic circuit. The breaker points should close shortly thereafter. Preferably, the inductor should be so arranged as to move into position to at least partially complete the magnetic circuit before the breaker points close so that a substantial building up of flux occurs under the favorable condition of an open circuited primary winding. The inductor should hold the magnetic circuit closed as long as possible to hold such flux as has been built up, during the instant that the breaker points are open, and also to allow time for additional building up of the flux, if and when necessary, under the slower and less favorable condition of a closed circuited primary winding.

So far as I am aware there has been no magneto heretofore which will satisfy all these conditions and therein I believe is the reason for the failure of magnetos of this class to attain commercial success.

Perhaps the closest approach to a satisfactory solution of the problem is disclosed in the Clark Patent No. 1,486,229, dated March 11, 1924, which states many of the difficulties encountered in magnetos of this type and offers as a solution a special quick-opening and quick-closing breaker-point mechanism. Such mechanism leads to complications which I desire to avoid. As distinguished from the Clark patent, I have provided a different type of inductor, which enables me to dispense with the necessity of using his special breaker point mechanism and enables me to utilize one of ordinary construction. At the same time, by so doing, I have secured greatly improved results, in so far as spark output is concerned.

It is another object of my invention to utilize, with comparatively little modification, a magneto of a standard and efficient type, which has met with substantial commercial success, when used with a reciprocating and contacting armature. Such magnetos have for some time been produced in large quantities and are available at low cost. By a

slight change in the shape of the polar faces and a change in the breaker point mechanism, this magneto is suitable for use with a rotary inductor. I need, then, to provide merely a simple mounting to support the magneto unit from the engine and to place a rotary inductor on the crank shaft or other suitable rotary part of the engine, in order to equip any engine with a satisfactory rotary inductor type magneto and this can be done at a cost far lower than that of magnetos of the second-named class, as above defined.

Other objects and advantages will appear from the following description and will be pointed out in the appended claims.

The invention will be disclosed with reference to the accompanying drawings, in which—

Fig. 1 is a plan view, with parts broken away, showing a magneto, embodying my invention, applied to an internal combustion engine;

Fig. 2 is a side elevation view thereof,—a part of the flywheel being broken away to reveal the magneto;

Figs. 3 and 4 are fragmentary sectional views taken on the lines 3—3 and 4—4, respectively, of Fig. 1;

Fig. 5 is a diagrammatical view taken similarly to Fig. 3 but showing a different relative positioning of parts;

Fig. 6 is a diagrammatical view illustrative of the magnetic and electrical circuits of the magneto; and

Fig. 7 is a fragmentary longitudinal sectional view illustrative of a modification.

Referring to Figs. 1 and 2, the invention has been illustrated as applied to a standard type of small internal combustion engine. Such engine, in so far as a description of it is necessary to an understanding of this invention, includes a single cylinder *a*, bolted to a crank case *b*, mounted on a suitable bed plate *c*. The crankshaft is indicated at *d* and carries a flywheel *e* of usual form and material. A spark plug *f* is connected by a high tension cable *g* to the magneto unit *M*. The pedal *h* is part of the usual mechanism for cranking the engine. To stop the engine, a flexible, metallic arm *i*, secured to cylinder *a* and thereby grounded, is arranged to be flexed and drawn into contact with the terminal of the spark plug *f* by pulling on the wire *j*. The particular engine shown is of the two cycle type. Accordingly, for this particular engine, the magneto is required to produce one spark per revolution. This engine, of course, is merely illustrative of one of many suitable types with which my magneto may be used and other installations may require a different number of sparks per revolution.

The magneto unit *M* may be of any suitable type embodying a magnetic source and a pair of cores with primary and secondary coils

thereon. Such parts are shown conventionally in Fig. 6, wherein two cores 10, connected one to each polar extremity of a bank of permanent magnets 11, carry primary and secondary coils 12 and 13, respectively, and terminate with polar faces 14 arranged to be engaged by an unwound rotary inductor 15. The unit M, except for the change in shape of the polar faces and a different form of inductor and breaker point mechanism is, or may be, like the magneto disclosed in Brown and Louis Patent No. 1,557,976, dated October 20, 1925, to which reference is made for a more complete disclosure. The parts described are all housed in a casing, as shown in the last named patent, forming a small compact unit easily handled and readily applied to any engine. The standard type of magneto shown in such patent may be used by removing the breaker point mechanism and substituting another later to be described, and by milling or otherwise shaping the lower ends of cores 10, and any intervening part, to conform to the curvature of the inductor. In Figs. 2 and 3 the cores 10 are indicated in part only but sufficiently to show the polar faces 14 and the recess 16 which permits the inductor 15 to rotate in close proximity to such faces.

The inductor 15 is simply a cylindrical body of magnetic material which is built up of circular laminations suitably held together, as by rivets 17, and which is substantially equal in length to the thickness of cores 10. This body is suitably fixed to turn with crankshaft *d*, as by being driven on to the hub *k* of flywheel *e*. The inductor, for the particular engine shown, is provided with two non-magnetic portions 18 which are so spaced as to simultaneously register with the two polar faces of cores 10, as shown in Fig. 3. These portions 18, as shown, are formed by notching the periphery of the inductor, but the prior art shows that notches filled with some metallic and non-magnetic material are equivalents for the purpose. The notches, or non-magnetic portions 18, are preferably a little wider than the polar faces 14 with which they cooperate. Otherwise, the optimum break in the magnetic circuit would not be obtained. The preferred length of each notch 18, relative to that of its polar face, has been shown in Fig. 3, and this has been found to yield the best magnetic break. Notches of any greater length add nothing to the effectiveness of the magnetic break and are bad because they interfere with the building up of flux and lessen the dwell period during which the magnetic circuit is closed, as will appear in greater detail hereinafter.

The effort in the present case has been to cut away as little of the periphery of the inductor as is practical and restrict the length of the non-magnetic portions 18 to the minimum necessary for the proper and most effi-

cient performance of their function. The intervening part 19 is most important and without it successful results could not be obtained because this part, not only adds to the dwell period in which the magnetic circuit is closed, but also enables a substantial part, and it is believed, the larger part of the flux to be built up under the most favorable condition; i. e., before the breaker points close, as will appear in more detail hereinafter. Another important feature is that the notches 18 are spaced apart by an angle less than 180 degrees and therefore both notches lie on one side of the shaft as distinguished from a diametrically opposed relationship of such notches, which would render most difficult the adjustment and maintenance of the clearance between the inductor and polar faces within the small limits sought for in this case.

For the maximum efficiency the polar faces 14 should contact with the inductor and, while it is not feasible to obtain the intimate and actual contact of the inductor with these polar faces, which can be obtained in a magneto of the reciprocating armature type, the object here is to approach that condition as closely as is feasible. To this end, both polar faces 14 are located on the same side of the shaft and provisions are made whereby the unit M may be thrust bodily and in a radial direction to simultaneously carry both polar faces into exceedingly close proximity to the inductor with only what may be termed "rubbing" clearance. Any suitable means may be provided for this purpose.

As shown in Figs. 1 and 2, a plate 20 is suitably secured as by bolts 21 to one side of the crankcase *b* of the engine to serve as a support for the magneto unit M. In plate 20, there is a slot 22 (Figs. 1 and 4) which is disposed horizontally and substantially radially with respect to crankshaft *d*. A stud 23, fixed to the magneto unit M, projects into this slot and closely fits the same. This arrangement allows the magneto unit M to be moved radially in or out with respect to inductor 15 and also to be tilted up or down as may be necessary to bring the polar faces 14 into proper relation with the inductor and with equal clearance. A cam 24 (Fig. 4), foliocrumed at 24' on the unit M, bears on bed plate *c*, and provides a means for tilting the unit M. The plate 20 also has a second slot, marked 25 through which a cap screw 26 passes. Slot 25 is wide enough to allow enough up or down play of stud 26 therein to enable the vertical adjustment of the unit M by cam 24 to be effected, and is long enough to permit the radial movement described. The outer end of plate 20 has an outwardly turned lug 27 in which the shank of an eyebolt 28 is slidable. The stud 26 passes through the eye of eyebolt 28 as well as through slot 25 and threads into the frame of the magneto unit M. Stud 26 serves to clamp such unit

in adjusted position. A nut 29 threaded on the outer end of the shank of eyebolt 28, serves as a means for drawing the magneto unit M away from the inductors, when stud 26 is loosened. With stud 26 loosened, the unit M is thrust inwardly until magnetic attraction draws the polar faces into contact with the inductor and cam 24 is adjusted to hold the magneto at the proper elevation. The nut 29 is then turned to pull the unit M outwardly just enough to create the very small clearance above described. The means described for effecting the radial and vertical adjustments of unit M are merely illustrative of one of various suitable means which may be used for the stated purposes.

For convenience, I have mounted the breaker point mechanism on the outside of the magneto but in such a manner that it is sheltered by the flywheel, as will be clear from Fig. 1. This location of such mechanism simplifies the character of the means used for controlling its operation, such means being carried by the flywheel *e*, or any other suitable rotary part, and herein taking the form of a roll 30. The breaker point mechanism is mounted on a plate 31, held to unit M by screws 32, which pass through slots 33 in the plate, whereby the mechanism may be bodily shifted to effect changes in the timing of the opening of the breaker points, by causing roll 30 to open them earlier or later in the revolution of crankshaft *d*, accordingly as plate 31 is moved down or up from the position shown in Fig. 3. Plate 31 has an outwardly turned part 34 to which a conducting arm 35 is secured by bolts 36. Arm 35 is suitably insulated from part 34, as indicated at 37, and carries the fixed, but adjustable, breaker point 38. The cooperating breaker point 39 is carried by one end of a lever 40, which is pivotally supported at a point intermediate its ends by a stud 41 secured to plate 31. A spring 42 tends to normally hold points 38 and 39 in contact. The other end of lever 40 is suitably shaped for engagement by roll 30 and preferably, as shown, has a tail 40', whereby roll 30 will hold the points 38 and 39 open for a short interval. In some cases this tail may be dispensed with, especially where the installation permits time enough for the flux to build up against a closed circuited primary winding.

In this particular case, it is desired to control the speed of the engine by cutting out the ignition after the engine reaches a certain speed. For this purpose roll 30 is carried by one end of a lever 43, fulcrumed at a point intermediate its ends on a stud 44, secured to flywheel *e*. The other end of the lever is relatively heavy and is adapted to be thrown outwardly by centrifugal force but is normally restrained by a spring 45. The latter is interposed between the outer end of the lever and an adjustable abutment 46 carried

by a screw 47, threaded into flywheel *e*. A lock nut 48 holds screw 47 in adjusted position. When the engine exceeds the speed, predetermined by adjustment of screw 47, arm 43 will be moved against the force exerted by spring 45 and roll 30 will be moved inwardly so as not to engage the breaker-point lever 40. A screw 49, threaded into lever 43, engages the hub *k* and limits the outward movement of roll 30.

The electrical connections are shown diagrammatically in Fig. 6 and are essentially as disclosed in the Brown & Louis patent, above identified. For example, the primary coils 12 are or may be connected in series by a wire 54 and one terminal of the primary winding is grounded as at 51. The other terminal of such winding is connected by a wire 52 to arm 35 and thus to the fixed breaker point 38. Breaker point 39 is grounded. A condenser 53 is bridged across the breaker points in the usual manner. The secondary coils are, or may be, connected in series by a wire 50 and one terminal of the secondary winding is grounded, as at 55. The other terminal of the secondary winding is connected by wire *g* to spark plug *f*.

The preferred operation of the magneto will next be described with particular reference to Figs. 2, 3, and 5. Assuming that the flux has been built up in the magnetic circuit to the desired intensity, the rotor 15, revolving in the direction of the arrow, will eventually come into the position shown in Fig. 3 and cause an effective and double break in the magnetic circuit. Both notches 18 then register with their respective polar faces 14 and there is a substantial air gap between the upper edge of each radial wall of each notch and the adjacent end edges of the polar faces 14. As set forth above, the notches are made just enough longer than the polar faces to afford gaps, such as have just been alluded to, and secure maximum effectiveness of the magnetic break. The proportions shown in Fig. 3 are those which have been found to yield the best results. At substantially the same time that this double break occurs, roll 30 engages lever 40 and causes a quick separation of the breaker 38 and 39 and an opening of the primary circuit, which has theretofore been maintained closed for the purpose of holding the flux in the magnetic circuit. On the substantially simultaneous opening of both the magnetic and the primary circuits, a very rapid decrease of flux occurs and an E. M. F. is generated in the secondary, resulting in a spark at plug *f*. The flux change, utilized for the production of the spark, is that which occurs on the breaking rather than the making of the magnetic circuit and this is important because a more rapid and more effective change of flux occurs under the former condition than under the latter.

Having described the production of the spark, the next and a most important consideration is the building up of the flux in the magnetic circuit in readiness for the production of another spark. The lever 40 preferably has its tail piece 40' so constructed that the breaker points 38 and 39 are held separated for a short interval. This interval is preferably such as to allow the rotor 15 to move from the position shown in Fig. 3 to that shown in Fig. 5. In Fig. 5, the breaker points have just closed and in Fig. 3 they have just opened. As will be evident from Fig. 5, this interval is long enough to allow a closing of the magnetic circuit by the rotor and, in consequence, a building up of a substantial amount of flux occurs under the most favorable condition of an open circuited primary winding. Such winding does not then oppose and restrain the building up of flux and I believe that the greater part of the flux is built up during the time while the breaker points are open. While full coverage of the polar faces 14 by the inductor is not obtained, there is enough to permit the action described and my experiments indicate that results are not materially improved by delaying the closing of the breaker points beyond the time indicated. This is probably due to the fact that the completion of the building up of flux can be accomplished against the restraining influence of the short circuited primary because of the time available by the long period in which the rotor holds the magnetic circuit closed. By keeping such circuit closed as long as possible, the flux built up, while the breaker points are open, is retained and time allowed for further building up of flux, if and when the same is necessary.

There are two positions of the rotor wherein the magnetic circuit is broken in part,—one when the leading notch 18 comes into registration with the lower polar-face 14 and the other when the trailing notch 18 is similarly positioned with respect to the upper polar face. There will undoubtedly be a loss in flux at each of these two positions but such losses are kept at a minimum because the primary circuit is then closed and tends to oppose change in flux. However, the much greater intervals, when the magnetic circuit is closed, permit rebuilding up of flux to an extent to adequately compensate for such losses. It is possible to arrange the magneto, as shown at M' in Fig. 7, so that a single notch 18' in a somewhat wider inductor 15' will cause a double break in the magnetic circuit by coming under both cores 10' at the same time. This arrangement avoids ensuing losses, such as above described. However, a different disposition of the magneto on the engine is required and one which would not in many cases, admit of the compact arrangement herein shown, where the magneto fits nicely into the space between the crankcase and the fly-

wheel and does not project materially beyond the periphery of the latter. It will be understood that the unit M' is like the unit M except that the breaker point mechanism would need to be mounted on one of the ends faces rather than on the side face, as heretofore described.

It will be understood that the feature relating to the centrifugal arrangement for cutting out the magneto to control engine speed may be used or not, as occasion requires, and this feature is not essential in so far as the real invention is concerned.

It has been stated that the part 19 of the rotor is most important. But for this part, it would not be feasible to close the magnetic circuit before the breaker points close and thus all of the flux would have to be built up against the restraining influence of a short circuited primary winding. That is one reason why one long notch, extending from the leading end of the leading notch to the trailing end of the other notch, would not be practical at all. The other, and a most important reason for the part 19 is that it adds to the length of the period during which the magnetic circuit is closed. The effort here is to do away with as little of the periphery of the inductor as is practical, and thereby secure as long a period as is practical for the closed condition of the magnetic circuit. The present arrangement affords time for the building up of flux against a short circuited primary winding and also holds the flux that has been built up. Although a great deal of flux is built up, while the breaker points are open, as was the case in the Clark patent above referred to, much better results are obtained here, which clearly indicates the value of keeping the magnetic circuit normally closed rather than open. Also the improved results are obtained with a simple form of breaker point mechanism without going to the special provisions of the Clark patent and the complications, which as a practical matter, often arise from the use of the device therein shown.

The magneto can be operated satisfactorily in other than the exact manner described and the described operation is to be taken as illustrative of what I now believe to be the best and preferred operation, rather than in any limiting sense. The magneto installation is not so critical or sensitive that extreme care and exactitude in the adjustments of the relative positions of the parts is necessary. For example, a spark will be produced if the breaker points open earlier and before the magnetic circuit has been completely broken. The building up of flux while the breaker points are open is most desirable, important, and preferred, but it is not necessarily essential in all cases and particularly in those cases where there is a long dwell period during which the magnetic circuit is closed. In

the latter case, there may be time enough for all the flux to build up against the restraining influence of the closed circuited primary winding. However, if the inductor should have additional notches to produce more sparks per revolution, then the feature of building up flux while the breaker points are open would probably be essential for successful results.

A most important feature of the invention is that both polar faces lie on the same side of the crankshaft so that by one adjustment both such faces may be moved into closely adjacent relation with the inductor. A minimum clearance between the inductor and polar faces is essential for maximum efficiency and if the polar faces were diametrically opposite such small clearances as are here used would not be feasible because the crankshaft, in many cases, does not run true enough to permit. In applying the magneto to an engine, which has been in use for some time, the wear in the bearings might be enough to defeat the use of the rubbing clearance, herein desired, unless the polar faces were both located on the same side of the shaft. Also, of course, the cores would have to be independently adjustable, if located in diametrically opposed relation and this is seldom feasible.

As distinguished from the flywheel magnetos, now found in the market, the present magneto can be made up separately from the engine and requires no special design of engine parts. In fact, a standard type of magneto, already available and of proved efficiency, can be utilized with but little modification. This one compact unit may be furnished to the engine manufacturer, with a supporting bracket therefor and the inductor, and the magneto installation can be effected without requiring any special skill. The necessity of designing the magneto to suit the engine is eliminated and an equipment is provided which is applicable to most engines without substantial change therein. It follows that the magneto can be produced at much less cost. Also, it is to be noted that the magneto can be removed by removing the one screw 26 and the complete outfit, except for the inductor (which does not require servicing) is available and accessible for servicing. The flywheel *e* has a recess, indicated at *e'* in Fig. 1, which, when turned so as to be opposite the breaker-point mechanism permits passage of the latter when the magneto unit *M* is removed. Such unit, containing all parts on which service can ever be required, may be removed and shipped back to the factory for repairs and another unit put in place to allow continued operation. One does not have to dismantle any part of the engine to get at the magneto.

The invention is characterized over magnetos in which the magnets rotate, in that a

less amount of material, handled in a less expensive way, is productive of better results. As to that type of magneto in which the inductor rotates and the magnets are stationary, this invention points out the particular elements and arrangement thereof, which yield commercially successful results and render this type suitable where heretofore it has been unsuitable.

The invention has been disclosed herein, in an embodiment at present preferred, for illustrative purposes, but the scope of the invention is defined by the appended claims rather than by the foregoing description.

What I claim is:

1. A magneto, comprising, a stationary unit having a source of magnetic flux, a pair of cores connected one to each polar extremity of said source, and primary and secondary windings on said cores; cooperating and relatively movable breaker points, a primary circuit including said primary winding and breaker points and arranged to be opened and closed by the separation or engagement of said points, a rotary inductor movable in close proximity to the polar faces of said cores to maintain a normally closed magnetic circuit and arranged periodically to break such circuit substantially simultaneously at both polar faces, both said polar faces being located on the same side of the axis of revolution of said inductor, and means for separating said breaker points at substantially the same time that the magnetic circuit is broken at both said polar faces.

2. A magneto, comprising, a stationary unit having a source of magnetic flux, a pair of cores connected one to each polar extremity of said source, and primary and secondary windings on said cores; cooperating and relatively movable breaker points, a primary circuit including said primary winding and breaker points and arranged to be opened and closed by the separation or engagement of said points, a rotary inductor movable in close proximity to the polar faces of said cores to maintain a normally closed magnetic circuit and arranged periodically to break such circuit substantially simultaneously at both polar faces, both said polar faces being located on the same side of the axis of revolution of said inductor, and means for separating said breaker points at substantially the same time that the magnetic circuit is broken at both said polar faces and for holding them open until the inductor again closes such circuit.

3. A magneto, comprising, a stationary unit having a source of magnetic flux, a pair of cores connected one to each polar extremity of said source, and primary and secondary windings on said cores; cooperating and relatively movable breaker points, a primary circuit including said primary winding and breaker points and arranged to be opened and

closed by the separation or engagement of said points, a rotary inductor movable in close proximity to the polar faces of said cores to maintain a normally closed magnetic circuit and arranged periodically to break such circuit substantially simultaneously at both polar faces, both said polar faces being located on the same side of the axis of revolution of said inductor, means for separating said breaker points at substantially the same time that the magnetic circuit is broken at both said polar faces, and means for moving said unit to simultaneously move both said polar faces toward and away from said inductor.

4. A magneto, comprising, a stationary unit having a source of magnetic flux, a pair of cores connected one to each polar extremity of said source, and primary and secondary windings on said cores; cooperating and relatively movable breaker points, a primary circuit including said primary winding and breaker points and arranged to be opened and closed by the separation or engagement of said points, a rotary inductor movable in close proximity to the polar faces of said cores to maintain a normally closed magnetic circuit and arranged periodically to break such circuit substantially simultaneously at both polar faces, both said polar faces being located on the same side of the axis of revolution of said inductor, means for separating said breaker points at substantially the same time that the magnetic circuit is broken at both said polar faces and for holding them open until the inductor again closes such circuit, and means for moving said unit to simultaneously move both said polar faces toward and away from said inductor.

5. A magneto, comprising, a rotary inductor, a stationary unit having a source of magnetic flux, a pair of cores connected one to each polar extremity of said source, and primary and secondary windings on said cores; said cores having polar faces with respect to which said inductor moves in close proximity to maintain a normally closed magnetic circuit and which are located both on the same side of the axis of revolution of said inductor, said inductor having a pair of non-magnetic portions spaced apart by an angle less than 180 degrees and so as to register substantially simultaneously one with each of said polar faces and create a double break in said circuit, a normally closed electrical circuit including said primary winding, and means for opening said electrical circuit substantially at the same time that said magnetic circuit is broken.

6. A magneto, comprising, a rotary inductor, a stationary unit having a source of magnetic flux, a pair of cores connected one to each polar extremity of said source, and primary and secondary windings on said cores; said cores having polar faces with respect to

which said inductor moves in close proximity to maintain a normally closed magnetic circuit and which are located both on the same side of the axis of revolution of said inductor, said inductor having a pair of non-magnetic portions spaced apart by an angle less than 180 degrees and so as to register substantially simultaneously one with each of said polar faces and create a double break in said circuit, a normally closed electrical circuit including said primary winding, and means for opening said electrical circuit substantially at the same time that said magnetic circuit is broken and holding it open until the inductor moves far enough to again close the magnetic circuit.

7. A magneto, comprising, a rotary inductor; a stationary unit having a source of magnetic flux, a pair of cores connected one to each polar extremity of said source, and primary and secondary windings on said cores; said cores having polar faces with respect to which said inductor moves in close proximity to maintain a normally closed magnetic circuit and which are located both on the same side of the axis of revolution of said inductor, said inductor having a pair of non-magnetic portions spaced apart by an angle less than 180 degrees and so as to register substantially simultaneously one with each of said polar faces and create a double break in said circuit, a normally closed electrical circuit including said primary winding, means for opening said electrical circuit substantially at the same time that said magnetic circuit is broken, and means for adjusting said unit to simultaneously move both said polar faces toward or away from said inductor.

8. A magneto, comprising, a rotary inductor; a stationary unit having a source of magnetic flux, a pair of cores connected one to each polar extremity of said source, and primary and secondary windings on said cores; said cores having polar faces with respect to which said inductor moves in close proximity to maintain a normally closed magnetic circuit and which are located both on the same side of the axis of revolution of said inductor, said inductor having a pair of non-magnetic portions spaced apart by an angle less than 180 degrees and so as to register substantially simultaneously one with each of said polar faces and create a double break in said circuit, a normally closed electrical circuit including said primary winding, means for opening said electrical circuit substantially at the same time that said magnetic circuit is broken and holding it open until the inductor moves far enough to again close the magnetic circuit, and means for adjusting said unit to simultaneously move both said polar faces toward or away from said inductor.

9. A magneto, comprising, a rotary inductor; a stationary unit having a source of

magnetic flux, a pair of cores connected one to each polar extremity of said source, and primary and secondary windings on said cores; said cores having polar faces with respect to which the periphery of said inductor moves in close proximity to maintain a normally closed magnetic circuit, and which are located both on the same side of the axis of revolution of said inductor, said inductor having a pair of non-magnetic portions in its periphery spaced apart by an angle less than 180 degrees and so as to register substantially simultaneously one with each of said polar faces and create a double break in said circuit, a normally closed electrical circuit including said primary winding, and means for opening said electrical circuit substantially at the same time that said magnetic circuit is broken.

10. A magneto, comprising, a rotary inductor; a stationary unit having a source of magnetic flux, a pair of cores connected one to each polar extremity of said source, and primary and secondary windings on said cores; said cores having polar faces with respect to which the periphery of said inductor moves in close proximity to maintain a normally closed magnetic circuit and which are located both on the same side of the axis of revolution of said inductor, said inductor having a pair of non-magnetic portions in its periphery spaced apart by an angle less than 180 degrees and so as to register substantially simultaneously one with each of said polar faces and create a double break in said circuit, a normally closed electrical circuit including said primary winding, and means for opening said electrical circuit substantially at the same time that said magnetic circuit is broken and holding it open until the inductor moves far enough to again close the magnetic circuit.

11. A magneto, comprising, a rotary inductor; a stationary unit having a source of magnetic flux, a pair of cores connected one to each polar extremity of said source, and primary and secondary windings on said cores; said cores having polar faces with respect to which the periphery of said inductor moves in close proximity to maintain a normally closed magnetic circuit and which are located both on the same side of the axis of revolution of said inductor, said inductor having a pair of non-magnetic portions in its periphery spaced apart by an angle less than 180 degrees and so as to register substantially simultaneously one with each of said polar faces and create a double break in said circuit, a normally closed electrical circuit including said primary winding, means for opening said electrical circuit substantially at the same time that said magnetic circuit is broken and holding it open until the inductor moves far enough to again close the magnetic circuit, and means for bodily moving said

unit to simultaneously move both said polar faces toward or away from the periphery of said inductor.

12. A magneto, comprising, a rotary inductor consisting of a cylindrical body having in its periphery two notches which extend parallel with the axis of the body from one end face to the other and which are spaced apart by an angle less than 180 degrees; a stationary unit comprising a straight bar permanent magnet, cores extending one from each polar extremity of said magnet toward and terminating in closely adjacent relation to the periphery of said inductor and so spaced that when one of said notches registers with one of said cores the other registers with the other core, and primary and secondary windings on both said cores; a normally closed electrical circuit including said primary winding, and means for opening said circuit substantially at the same time that both said notches register with both said cores.

13. A magneto, comprising, a rotary inductor consisting of a cylindrical body having in its periphery two notches which extend parallel with the axis of the body from one end face to the other and which are spaced apart by an angle less than 180 degrees; a stationary unit comprising a straight bar permanent magnet, cores extending one from each polar extremity of said magnet toward and terminating in closely adjacent relation to the periphery of said inductor and so spaced that when one of said notches registers with one of said cores the other registers with the other core, and primary and secondary windings on both said cores; a normally closed electrical circuit including said primary winding, and means for opening said circuit substantially at the same time that both said notches register with both said cores and for holding it open until both cores are in part covered by peripheral portions of said inductor.

14. A magneto, comprising, a rotary inductor consisting of a cylindrical body having in its periphery two notches which extend parallel with the axis of the body from one end face to the other and which are spaced apart by an angle less than 180 degrees; a stationary unit comprising a straight bar permanent magnet, cores extending one from each polar extremity of said magnet toward and terminating in closely adjacent relation to the periphery of said inductor and so spaced that when one of said notches registers with one of said cores the other registers with the other core, and primary and secondary windings on both said cores; a normally closed electrical circuit including said primary winding, means for opening said circuit substantially at the same time that both said notches register with both said cores and for holding it open until both cores are in

part covered by peripheral portions of said inductor, and means for moving said unit in a radial direction with respect to said inductor to carry said cores toward or away from the periphery thereof.

5 In testimony whereof I have affixed my signature.

IRA E. HENDRICKSON.

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