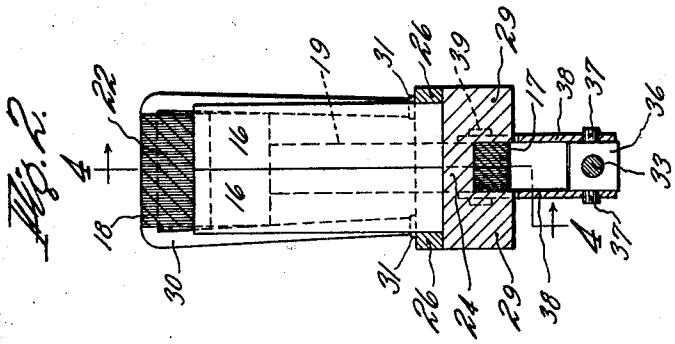
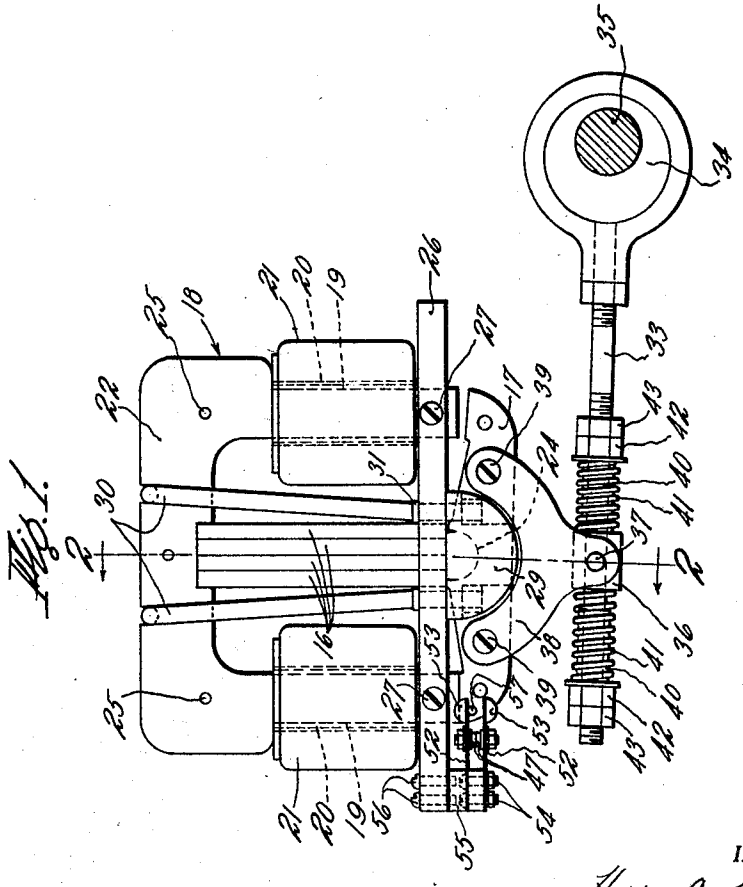
April 9, 1929. H. C. HUBBELL 1,708,095

IGNITION APPARATUS

Filed Nov. 26, 1927 3 Sheets-Sheet 1





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April 9, 1929. H. C. HUBBELL 1,708,095

IGNITION APPARATUS

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Fig. 3.

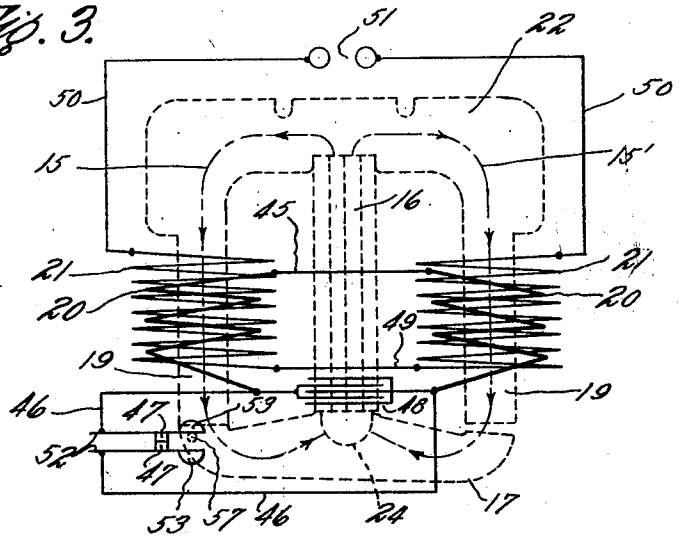


Fig. 4.

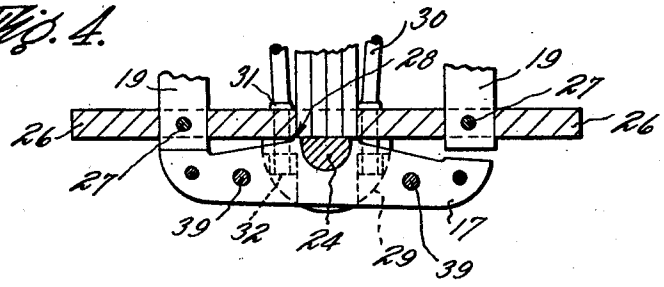


Fig. 5.

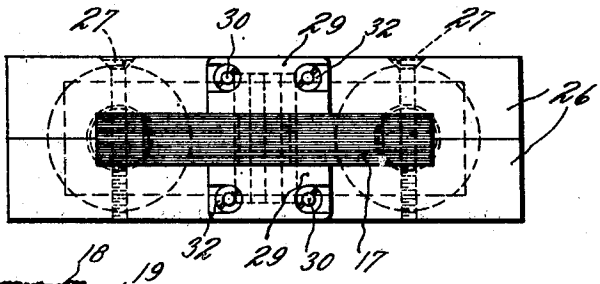
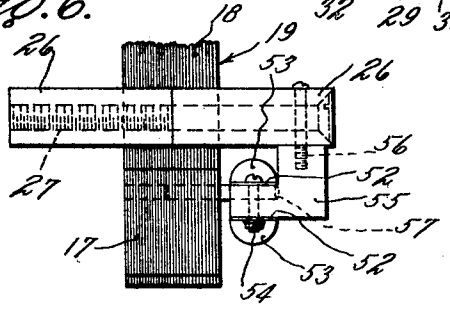


Fig. 6.



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Fig. 9.

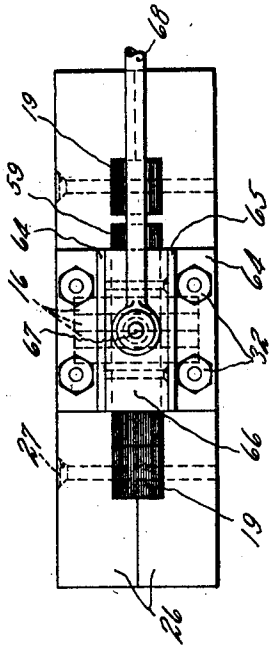


Fig. 10.

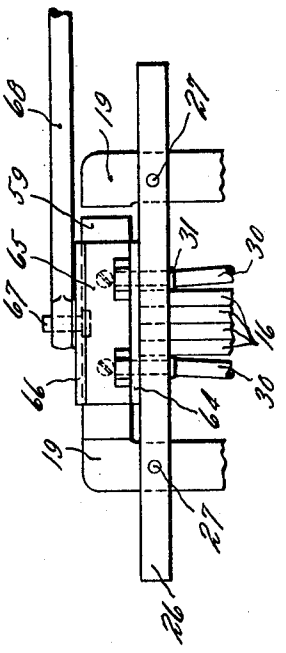


Fig. 7.

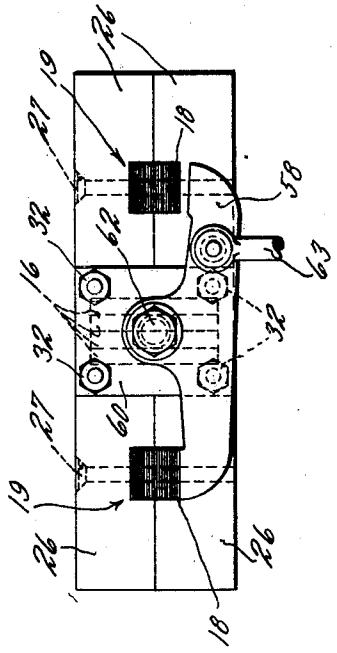
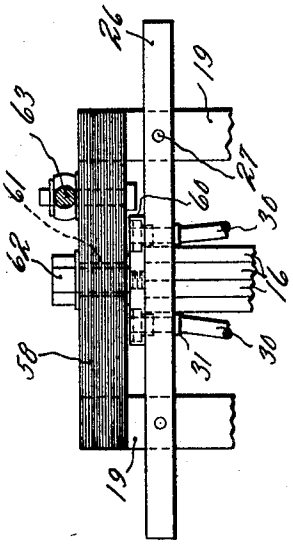


Fig. 8.



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Patented Apr. 9, 1929. 1,708,095

UNITED STATES PATENT OFFICE.

HARRY C. HUBBELL, OF WEST SPRINGFIELD, MASSACHUSETTS, ASSIGNOR TO WICO ELECTRIC COMPANY, OF WEST SPRINGFIELD, MASSACHUSETTS, A CORPORATION OF MASSACHUSETTS.

IGNITION APPARATUS.

Application filed November 26, 1927. Serial No. 235,976.

This invention relates to improvements in magnetos and, more particularly, is concerned with an improved arrangement of the members which provide the magnetic circuits therefor.

The invention is directed to magnetos of the type in which a plurality of magnetic circuits are provided. An example of one such magneto is found in U. S. Letters Patent No. 1,634,135, granted June 28, 1927, to Phelps Brown. The type of magneto, therein disclosed, is characterized by an arrangement for increasing the reluctance of one magnetic circuit, by the movement of suitable armature means, while the reluctance of the other is being decreased by such means, and vice versa; also by an arrangement whereby the electromotive forces intermittently generated by each such flux change are caused to occur simultaneously. The electromotive force generated by the making of one magnetic circuit is merged with that generated by the breaking of the other circuit, so that each unit of the machine contributes to and helps the other unit in its work. While the present invention is not limited to the above described plan of operation and may have other and more general applications, nevertheless it will be disclosed in connection with such plan as I now deem that to be the best and most efficient way of utilizing my invention.

The invention has for its object the provision of an improved arrangement of members, which afford two magnetic circuits from a source of magnetic flux together with means for increasing the reluctance of one circuit while the reluctance of the other is being decreased, characterized by an improved shifting of the lines of force from one magnetic circuit to the other and an improved efficiency in the utilization of the flux from said source.

The invention, by a more effective and more complete utilization of the flux from the source, enables material economies to be effected in the iron, copper and steel used in the magneto or, viewing the matter in another light, a better spark can be obtained with the same amount of materials if these materials are utilized according to my invention than according to prior practice.

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 front elevation of a magneto embodying the invention;

Fig. 2 is a cross sectional view taken on the line 2—2 of Fig. 1;

Fig. 3 is a diagrammatical view illustrative of the electrical and magnetic circuits;

Fig. 4 is a fragmentary sectional elevational view taken on the line 4—4 of Fig. 2;

Fig. 5 is a bottom plan view;

Fig. 6 is a fragmentary elevational view taken from the left hand end of Fig. 1 and drawn to a larger scale;

Figs. 7 and 8 are plan and fragmentary elevational views, respectively, illustrative of a modification in the mounting of the armature; and

Figs. 9 and 10 are plan and fragmentary elevational views, respectively, showing another modification in the mounting of the armature.

Referring to these drawings; the magneto is of the type in which there are two magnetic circuits (indicated by the dot-dash lines 15 and 15′ in Fig. 3) from a source of flux, such as the permanent magnets 16, and in which movable means such as the armature 17, controls these circuits in a manner such that when the reluctance of one is at a minimum the reluctance of the other is at a maximum. By preference, the armature moves into and out of physical contact with the pole pieces of the magnetic members, which provide the fixed parts of such circuits, although this is not essential for all purposes. Suitable generating windings are provided for each magnetic circuit, which windings may be utilized separately or conjointly, as desired. Preferably, although not necessarily, these windings are connected and controlled after the manner disclosed in the above identified patent. That is, the two windings are made to cooperate so that the electromotive force generated in one winding, when the magnetic circuit with which it is associated is broken, is merged with the electromotive force generated in the other winding, when its magnetic circuit is established and vice versa.

The magnetic members, referred to, are made up of a series of laminations 18 which are roughly U-shape,—the legs of the

U constituting cores 19 to receive the primary and secondary coils 20 and 21, respectively, and the cross bar portion of the U constituting a connecting yoke 22. The source of flux, herein shown as consisting of two banks of permanent magnets 16, is suitably connected at one polar extremity to yoke 22 at a point intermediate the ends of the latter. The other polar extremity of the source is connected to a pole piece 24 and the armature 17 connects this pole piece first to one and then to the other core 19. The magnets 16 are disposed between the cores 19 and in parallel relation therewith. The laminations 18 are shown as being flat, so that the cores and the source of flux all lie in a common vertical plane. This, however, is not necessarily essential although as a practical matter it is preferable. The important characteristic of the arrangement is that the magnetic path from the source of flux to both cores is such that the flux does not have to travel crosswise of the laminations. Obviously, this result can be secured even if the laminations are not flat and even though the two cores and the source of flux do not lie in the same plane.

The details of construction of the magneto are not especially important and for the most part they are purely illustrative. The laminations 18 are suitably clamped together, as by rivets 25. They are also clamped, at points adjacent the lower end of each core, between two non-magnetic members 26 by means of screws 27 (see Figs. 5 and 6). The connected members 26 serve as a frame for the magneto and they are centrally recessed to receive the magnets 16 and permit the end faces thereof to contact with the pole piece 24. The latter has a central portion of approximately semi-circular shape in longitudinal section (Fig. 4) and the armature 17 is correspondingly recessed to engage therewith. This central part of the pole piece 24 forms a fulcrum for the armature and permits it to turn through the limited arc necessary to engage first with one end then the other core 19. The armature may also be formed as shown at 28, so as to contact directly with certain of the magnets 16 at each extremity of its movement. Such abutment of the armature with the magnets might also be utilized to prevent close contact of the armature with its cores, in case such contact is not desired, or to avoid the necessity for the use of magnetic material for the fulcrum 24 of the armature. The member 24 has side wings 29 which hold the armature against lateral displacement. Two U-shaped members 30 straddle the yoke 22,—the cross bar portions of these members preferably being seated in recesses in yoke 22 and the leg portions extending downwardly to and through the frame members 26 and side wings 29. These members 30 are preferably provided with flanges 31 to abut the upper face of members 26 and their lower ends are threaded to receive nuts 32. Thus, the pole piece 24 may be drawn into close contact with the lower ends of magnets 16 and the upper ends of these magnets forced into close contact with the yoke 22. The yoke is preferably recessed, as indicated in Fig. 1 to receive the last named ends of the magnets.

The invention is not particularly concerned with the mechanism for actuating the armature and any suitable mechanism may be used for this purpose. As a matter of fact, the magneto will function if the armature is moved by hand. There are, however, many examples in the prior art of armature driving mechanisms, which will be found suitable for the work, and the particular type chosen will depend upon the results desired and the conditions encountered in the installation of the magneto on the engine.

For the purposes of illustration, I have shown an armature actuating mechanism which functions in the same general manner as that disclosed in U. S. Letters Patent No. 1,643,636, granted September 27, 1927, to Phelps Brown. The essential difference is that the mechanism is double acting and serves to operate the armature on the return as well as the forward stroke of a push rod 33. This push rod may be reciprocated in any suitable way from the engine, as by an eccentric 34 fixed to a shaft 35 of the engine. The magneto may be assumed to be fixedly supported with relation to the engine. The push rod 33 passes through a block 36, having trunnions 37, mounted to turn in plates 38, between which the block is located. These plates are clamped against opposite faces of the armature 17 by bolts 39. Encompassing the push rod and disposed one on each side of block 36 are sleeves 40 and encompassing each sleeve is a drive spring 41. Nuts 42, threaded on rod 33 and thereby axially adjustable thereon, are located one on each side of block 36 in spaced relation therewith. Each nut 42 serves as an abutment for one end of the adjacent sleeve 40 and spring 41. A lock nut 43 is provided for each nut 42.

Considering the parts as shown in Fig. 1, the eccentric 34, as it turns, will draw push rod 33 to the right and the first action will be to compress the left hand spring 41 between its abutment 42 and block 36. While this action occurs, the opposing drive spring 41 is expanding. Since the armature is held by magnetic attraction to one of the cores 19, as illustrated, no movement of it will result until the sleeve 40 engages block 36 because the drive spring 41, when fully stressed, exerts less force on the armature than the holding force due to magnetic attraction.

When, however, the sleeve 40 is forced against block 36, there is an inelastic transmission of force to the armature, which force overpowers the magnetic hold on the armature and initiates movement thereof. After the contact between the armature and the core is broken, even by a very small air gap, the magnetic attraction on the armature is so much diminished that the force of the stressed drive spring is superior to it. Consequently, the drive spring expands and moves the armature until its other end contacts with the other core 19. Subsequently, as push rod 33 moves to the left, the other drive spring will be stressed and brought into play to move the armature back into the illustrated position in a similar manner.

As an illustrative example of one suitable way of connecting the primary and secondary coils 20 and 21, reference is made to Fig. 3. The two primary windings are suitably connected, as in series by a wire 45, so that the electromotive force produced in one, by the diminution of flux in the magnetic circuit therethrough, is merged with (in this case added to) the electromotive force produced in the other coil by the increase of flux in the magnetic circuit therethrough. These two coils 20 are connected by wires 46 to a pair of breaker points 47, and a condenser 48 is bridged across these points in the usual manner. The secondary coils are connected, as in series by the wire 49, so that the electromotive forces simultaneously produced in each are added or otherwise merged. The terminals of the secondary windings are connected by wires 50 to a spark plug, represented conventionally at 51. The primary winding is normally short circuited by the closed breaker points 47 and thereby tends by its choking effect to resist change of flux in the magnetic circuits. At the proper time in the movement of the armature, these points 47 are separated, allowing flux to rapidly build up in one circuit and to rapidly die out in the other. Since the one set of breaker points controls both coils 20, the changes of flux and the consequent generation of electromotive forces in the secondary coils, are caused to occur simultaneously. Thus, one coil is made to help the other and mutually contribute to the production of the ignition spark. The operation is like that disclosed in Patent No. 1,634,135, above mentioned, to which reference is made for a more complete disclosure.

Any suitable mechanism may be provided for actuating the breaker points 47 and that shown herein is purely illustrative. As shown in Fig. 1, each breaker point is fixed to a flat spring 52 which is fixed at one end and at the other end carries a weight 53. The two fixed ends of the springs 52 are secured by bolts 54 to a block 55 of insulating material and this block, in turn, is secured by screws 56 to the frame member 26, above described. The breaker points are actuated by a pin 57 secured to armature 17 and projecting outwardly therefrom in such a position as to engage first one and then the other spring 52 as the armature is moved back and forth. As the armature is moved away from the lower end of the left hand core 19 and moved toward the lower end of the right hand core 19, the pin 57 will eventually engage the lower spring 52 and cause the points 47 to be separated. On the return movement of armature 17, the pin 57 will engage the upper spring 52 and again cause separation of the breaker points. As shown herein, pin 57 strikes one of the springs 52 at the time when the armature 17 engages with one of the cores 19. The blow delivered to spring 52 sets the weight 53 in motion and kinetic energy causes the weight to continue in motion for an interval and thereby hold the points 47 open long enough to permit the changes of flux in the magnetic circuits without the hampering influence of a closed circuit choke winding. The points become engaged again before the armature is again actuated, thereby closing the choke winding so as to retard flux changes until the armature has moved a sufficient distance to cause a material change in the reluctance of the magnetic circuits.

While the particular arrangement of the armature shown in Fig. 1 is important and advantageous, many other suitable arrangements will readily occur to those skilled in the art and the invention, in its broader aspects, is independent of the particular way in which the armature is mounted or operated. According to such broader aspects, the only important point is that some means, whether consisting of one armature or otherwise, is provided to connect the magnetic source first to one and then to the other core. The armature need not necessarily engage the lower end faces of the core, as shown in Fig. 1, and can engage the side faces thereof, as shown in connection with the armature 58 in Figs. 7 and 8 or as shown in connection with the armature 59 in Figs. 9 and 10. So also, the armature can slide instead of oscillate, if desired, and it may oscillate in a horizontal plane as well as in a vertical plane. The variations shown in Figs. 7 to 10 are intended as illustrative rather than as exclusive of the number of variations which may be made in the manner of mounting and moving the armature.

In Figs. 7 and 8, a pole piece 60 is drawn up against the magnets 16 by the members 30, 31 and 32, in the same manner as heretofore described, and a flanged bushing 61 of magnetic material is fixed in the armature. The flanged face of the bushing bears on the pole piece, and is held thereto by a stud 62, which passes through the bushing and

threads into the pole piece. A push rod 63, pivotally connected to the armature, may be actuated by any suitable means to cause the necessary movement of the armature. In this case, the armature is held in place by means other than magnetic attraction, as is the case in the form shown in Fig. 1.

In Figs. 9 and 10, a pole piece 64, held to the magnets in the same general way, is fashioned with upstanding wings 65, forming a slideway of channel-shaped cross section to receive a member 66 of similar cross section, in which the armature 59 is fixed. The member 66 is inverted with relation to the member 64, 65, and carries a stud 67 for connection to a push rod 68, by means of which the armature may be reciprocated.

In operation, the armature is intermittently moved back and forth in the described, or any other suitable manner, so that a magnetic circuit of low reluctance is provided from the source 16 through first one and then the other of the cores 19. When the reluctance of one circuit is at a minimum, the reluctance of the other is at a maximum. The building up of flux in one circuit and the dying out of flux in the other circuit is resisted by the closed circuit choking winding, comprising the primary coils 20. These coils serve to retard change of flux until the armature has moved way from the core, with which it theretofore engaged, and toward the other core a sufficient distance. At such time, the breaker points 47 are separated, thus opening the primary winding, whereupon the rapid increase of flux in one circuit and the rapid decrease of flux in the other circuit result in the generation of an electromotive force in each coil 21. The electromotive force produced in one coil 21, by the building up of flux in the magnetic circuit therethrough, is made to occur simultaneously with, and to be merged with, the electromotive force produced in the other coil 21, by the dying out of flux in the magnetic circuit through the latter and vice versa, wherefore one unit of the ignition apparatus is made to contribute to and assist the other unit in its work.

While this is the preferred operation, because it represents the best way now known to me of utilizing my invention, nevertheless it is obvious that the invention may be otherwise practiced. Since the invention in its broader aspects is directed primarily to the arrangement of the members which make up the magnetic circuits, it follows that the particular form of the electrical provisions is not essential and may be varied as desired. For example, the coils 21 need not be made to cooperate and assist each other, although obviously that is the best and most efficient way, and accordingly is disclosed and claimed herein as a preferred form.

So also, the armature, with reference to its construction, mounting and disposition relative to the fixed parts of the magnetic circuit, is not important, so far as the broader aspects of the invention are concerned, beyond furnishing a means for increasing the reluctance of one circuit and, at substantially the same time, decreasing the reluctance of the other circuit. While actual contact of the armature alternately with the cores is preferred, because the highest efficiency is obtained thereby, nevertheless actual contact can be dispensed with and the invention may still be practiced in the same general manner.

An important feature of the invention is in the disposition of the two magnetic circuits with reference to the source. By having the cores on opposite sides of the magnetic source, I have found that a materially improved spark can be obtained with the same amount of materials, i. e., copper, iron and steel, than can be obtained when these materials are utilized according to the best prior practice of which I am aware. It follows that as good a spark can be had with my arrangement with a more economical use of the materials. My arrangement is characterized by a better and more complete utilization of the flux from the magnets and by a more effective shifting of the flux from one magnet circuit to the other. As one circuit is broken, the dying out of flux therein is materially assisted by the shunting effect due to the making of the other circuit. Another factor contributing to the effective shifting of the flux from one magnetic circuit to the other is that the parts are so arranged as to avoid travel of the flux crosswise of the laminations. There is always an easy path along the laminations from all of the magnets 16 to one circuit or the other and the harder path crosswise from one lamination to another is avoided. This advantage follows from the disposition of the cores, one on one side and one on another side of the magnetic source but, as hereinbefore pointed out, this does not necessarily require that the two cores be opposite or in the same plane although, as a practical matter, that is the simplest and therefore preferable way.

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. In an ignition apparatus, a source of magnetic flux, members of magnetic material cooperating with said source to afford two magnetic circuits therefrom disposed on different sides of said source, said members including a pole piece common to both circuits and means movable relatively to the remaining parts of said circuit and cooper-

ating with said pole piece to increase the reluctance of one circuit and diminish the reluctance of the other.

2. Ignition apparatus, comprising a source of magnetic flux, means affording two magnetic circuits therefrom, said means including a pole piece of one polarity common to both said circuits, two pole pieces of the same polarity but opposite in polarity to the first named pole piece disposed in spaced relation therewith and on different sides of said source, together with means for connecting first one and then the other of the last named pole pieces to the first named pole piece.

3. In an ignition apparatus, a pair of cores, a yoke connecting one end of each, a magnet disposed between the cores and connected at one end to said yoke at a point intermediate the ends of the latter, a pole piece connected to the other end of said magnet, and armature means movable relatively to said pole piece and the other ends of said cores for alternately increasing the flux in said cores and for increasing the flux in one core and substantially at the same time diminishing the flux in the other core.

4. In an ignition apparatus, a pair of cores, a yoke connecting one end of each, a magnet disposed between the cores and connected at one end to said yoke at a point intermediate the ends of the latter, a pole piece connected to the other end of said magnet, and armature means for alternately connecting said cores at their other ends to said pole piece.

5. In an ignition apparatus, a pair of cores, a yoke connecting one end of each, a magnet disposed between the cores and connected at one end to said yoke at a point intermediate the ends of the latter, a pole piece connected to the other end of said magnet, and an armature pivoted intermediate its ends and adapted to alternately connect said cores at their other ends to said pole piece.

6. In an ignition apparatus, a pair of cores, a yoke connecting one end of each, a magnet disposed between the cores and connected at one end to said yoke at a point intermediate the ends of the latter, a pole piece connected to the other end of said magnet, and an armature fulcrumed on said pole piece and adapted to alternately connect said cores at their other ends to said pole piece.

7. In an ignition apparatus, a source of magnetic flux, members of magnetic material cooperating with said source to afford to magnetic circuits therefrom disposed on different sides of said source, said members including a pole piece common to both circuits and means movable relatively to the remaining parts of said circuit and cooperating with said pole piece to increase the reluctance of one circuit and diminsh the reluctance of the other, a generating winding associated with each magnetic circuit, controlling means to time the production of the electromotive forces in said windings one with the other so that the two intermittent electromotive forces produced in each winding during each movement of said movable means occur simultaneously, and connections between said windings whereby said electromotive forces are merged.

8. Ignition apparatus, comprising a source of magnetic flux, means affording two magnetic circuits therefrom, said means including a pole piece of one polarity common to both said circuits, two pole pieces of the same polarity but opposite in polarity to the first named pole piece disposed in spaced relation therewith and on different sides of said source, together with means for connecting first one and then the other of the last named pole pieces to the first named pole piece; a generating winding associated with each magnetic circuit, controlling means to time the production of the electromotive forces in said windings one with the other so that the two intermittent electromotive forces produced in each winding during each movement of said connecting means occur simultaneously, and connections between said windings whereby said electromotive forces are merged.

9. In an ignition apparatus, a pair of cores, a yoke connecting one end of each, a magnet disposed between the cores and connected at one end to said yoke at a point intermediate its ends, a pole piece connected to the other end of said magnet, armature means for alternately connecting said cores at their other ends to said pole piece, whereby two magnetic circuits are provided from said source one of which circuits is completed when the other is broken, a generating winding associated with each circuit; controlling means to time the production of the electromotive forces in said windings one with the other so that the two intermittent elecromotive forces produced in each winding during each movement of said armature means occur simultaneously, and connections between said windings whereby said electromotive forces are merged.

10. Ignition apparatus, comprising, a source of magnetic flux, a pole piece connected to one polar extremity thereof, two magnetic members each connected to the other polar extremity of said source and terminating with polar faces, an armature fulcrumed at a point intermediate its ends and adapted to connect said pole piece alternately to said polar faces; said armature, members and pole pieces affording two magnetic circuits from said source one of which is broken by the armature when the other is completed thereby; a generating winding

associated with each circuit, controlling means to time the production of the electromotive forces in said windings one with the other so that the two intermittent electromotive forces produced in each winding during each movement of said armature occur simultaneously, and connections between said windings whereby said electromotive forces are merged.

11. Ignition apparatus, comprising, a source of magnetic flux, a pole piece connected to one polar extremity thereof, two magnetic members each connected to the other polar extremity of said source and terminating with polar faces disposed on opposite sides of said pole piece, an armature fulcrumed at a point intermediate its ends on said pole piece and adapted to contact first with one and then with the other of the polar faces to alternately connect them to said pole piece; said armature, members and pole pieces affording two magnetic circuits from said source one of which is broken by the armature when the other is completed thereby; a generating winding associated with each circuit, controlling means to time the production of the electromotive forces in said windings one with the other so that the two intermittent electromotive forces produced in each winding during each movement of said armature occur simultaneously, and connections between said windings whereby said electromotive forces are merged.

12. In an ignition apparatus, a source of magnetic flux, means built up of laminations and connected to one polar extremity of said source, said means having two branches disposed on different sides of said source each terminating with a polar face, a pole piece connected to the other polar extremity of said source, and a single movable armature cooperating with said pole piece and with said polar faces to break the magnetic circuits from said source through said branches in alternation and to establish a magnetic circuit through one branch at substantially the time when the circuit through the other branch is broken, each circuit thus established affording a closed path from said source lengthwise of the laminations to shunt the flux from the other and then-broken circuit to accelerate the dying out of flux therein.

In testimony whereof I have affixed my signature.

HARRY C. HUBBELL.