

July 4, 1944.

K. A. HARMON ET AL

2,352,894

MAGNETO

Filed June 26, 1942

4 Sheets-Sheet 1

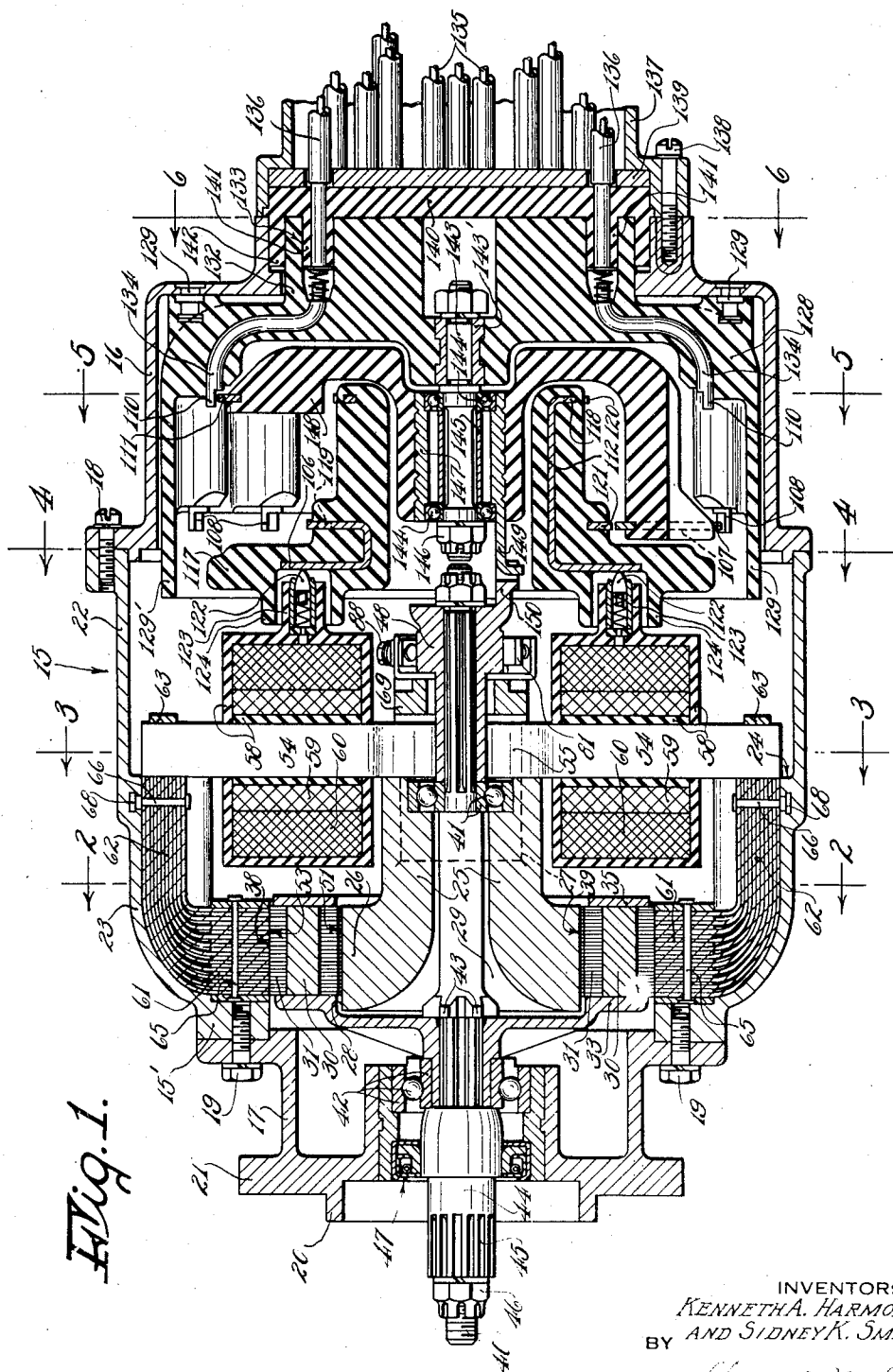


Fig. 1.

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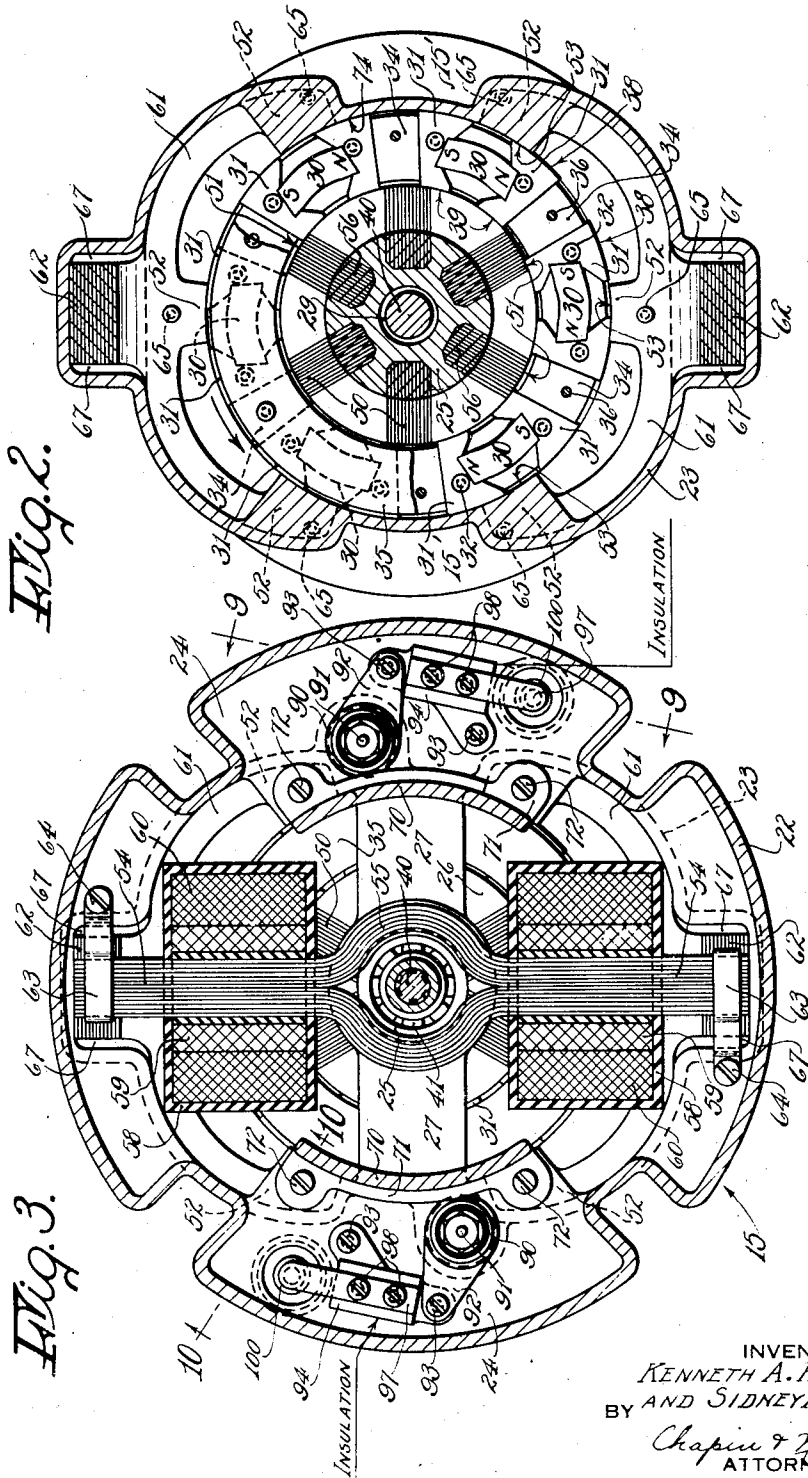
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Fig. 5.

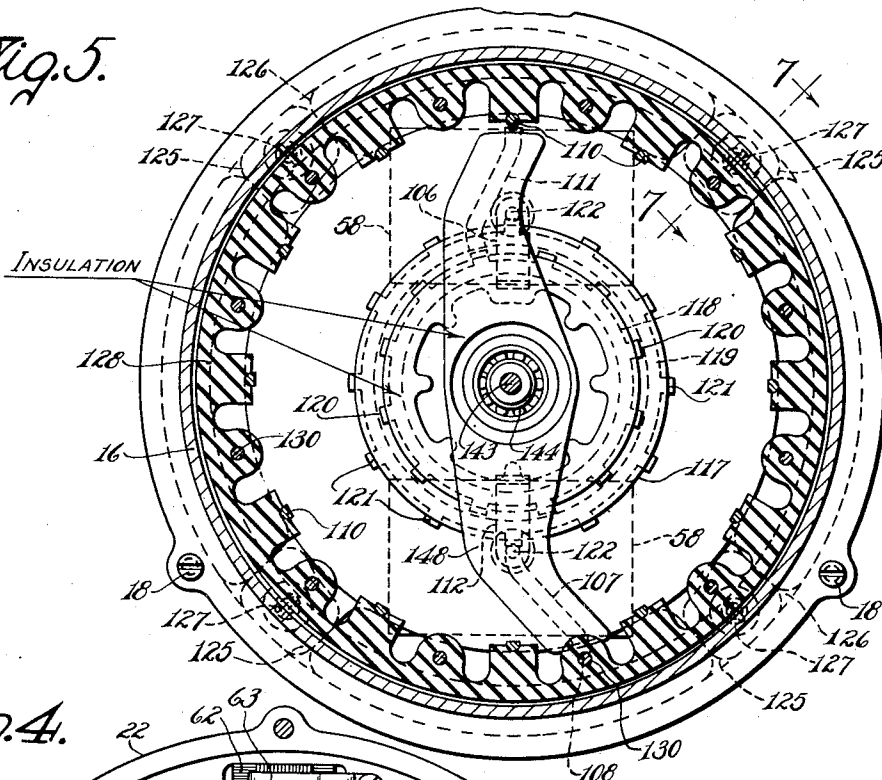
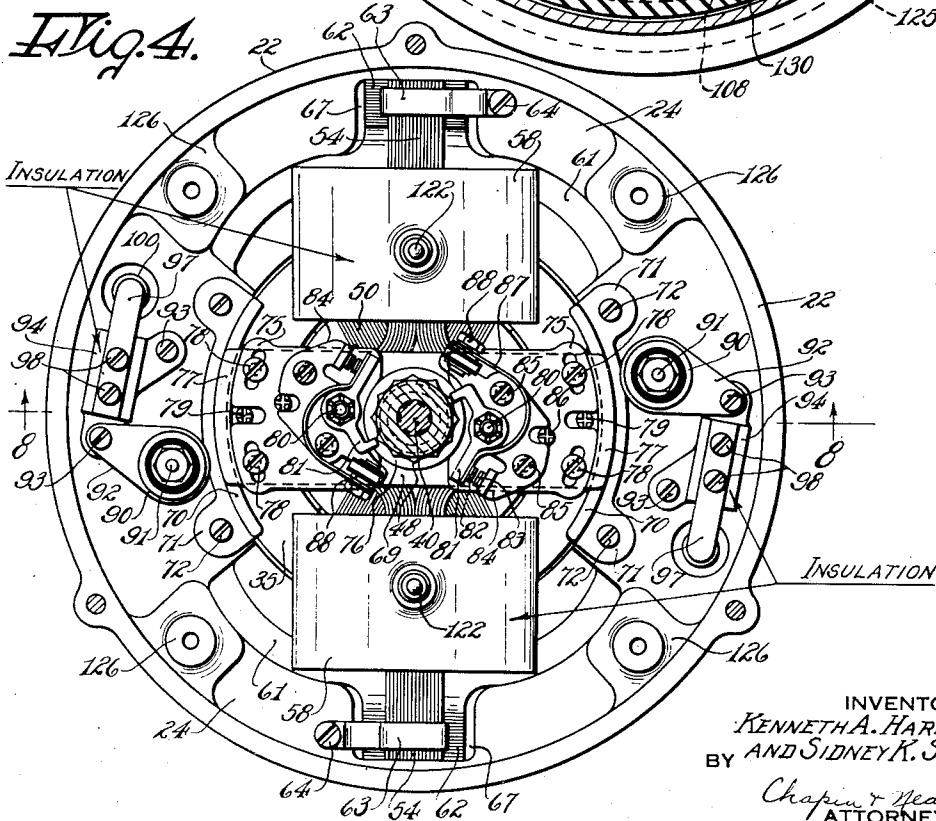


Fig. 4.



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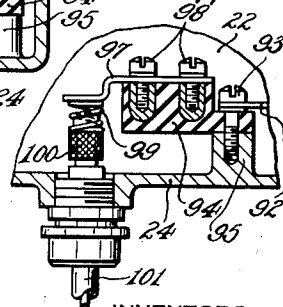
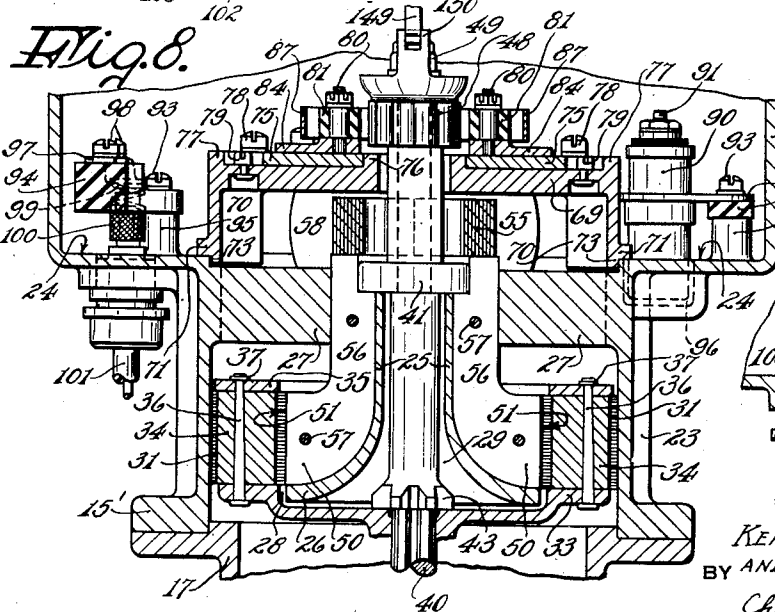
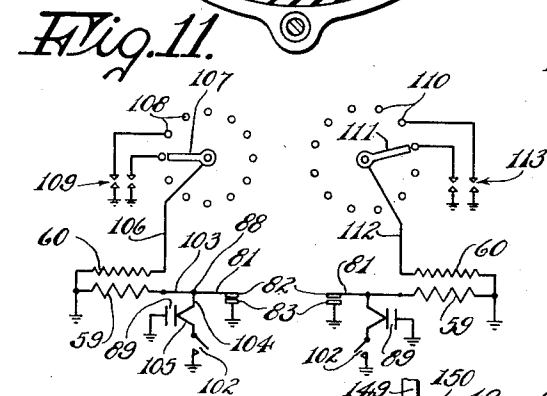
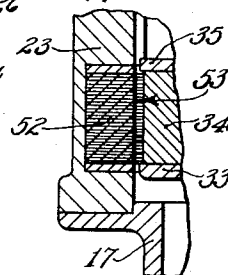
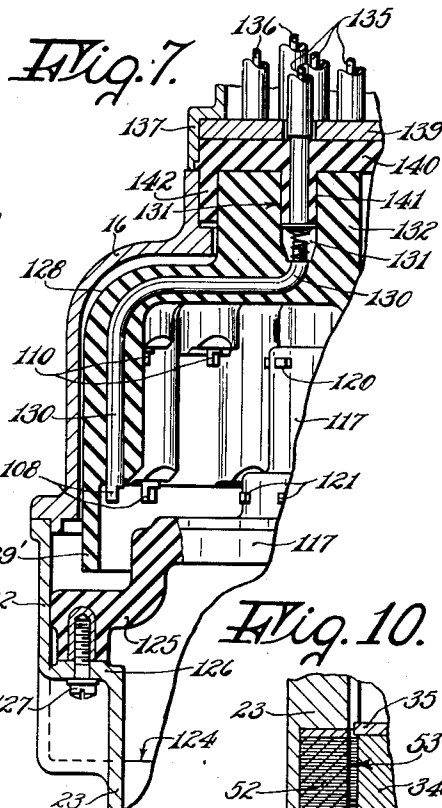
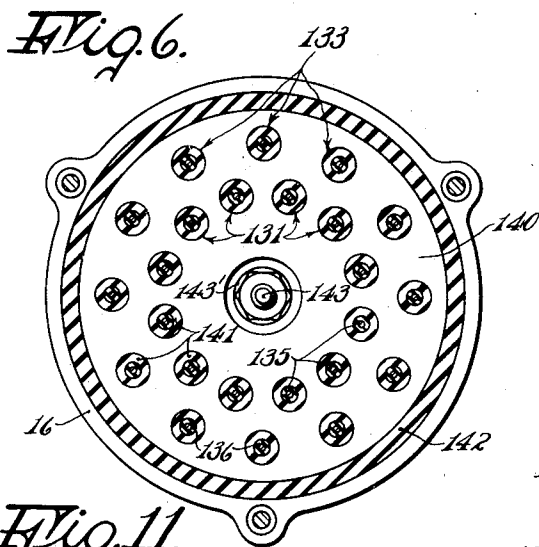
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UNITED STATES PATENT OFFICE

2,352,894

MAGNETO

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Application June 26, 1942, Serial No. 448,536

12 Claims. (Cl. 171-209)

This invention relates to magnetos and, more particularly, to magnetos which are especially suited for use in furnishing ignition for aircraft engines.

The invention has for an object the provision of an improved armature structure, involving two coil cores and two coil units thereon for providing dual ignition, and a single magnetic rotor for controlling flow of flux through both cores and coil units, characterized in that the cores radiate from the axis of rotation of the rotor and in that the coils on the cores are located one on each side of said axis.

The invention also has for an object to provide a magneto for dual ignition having a pair of armature units, a pair of breaker units, and a pair of distributor units, and drive shaft means extending between the units of each of said pairs, said means having thereon a single magnetic rotor for controlling flux flow through both armature units, a single cam for actuating both breaker units and a single rotor for actuating both distributors.

Another object of the invention is to provide in a magneto of the type described, an improved arrangement and disposition of the various flux-conducting elements of the magnetic circuits, characterized in that said elements may be grouped within a housing in compact relation around the drive shaft of the magneto.

These objects will best be understood as the detailed description proceeds and they 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 sectional elevational view of a magneto embodying the invention;

Figs. 2, 3, 4, 5 and 6 are cross sectional views taken on the lines 2-2, 3-3, 4-4, 5-5 and 6-6, respectively, of Fig. 1;

Fig. 7 is a fragmentary sectional elevational view taken on the line 7-7 of Fig. 5;

Fig. 8 is a fragmentary sectional view taken on the line 8-8 of Fig. 4;

Figs. 9 and 10 are fragmentary sectional views taken on the lines 9-9 and 10-10 respectively, of Fig. 3; and

Fig. 11 is a diagrammatical view showing the electrical connections of the magneto.

Referring to these drawings and particularly to Fig. 1 thereof, the magneto includes a housing which is made up of any suitable non-magnetic material and which comprises a central and tubular body portion 15 and two covers or end walls 16 and 17 for closing opposite ends of the

portion 15. The covers 16 and 17 are secured to the body 15 by cap screws 18 and 19, respectively. The coils, magnetic rotor and all elements of the magnetic circuits of the magneto, together with the breaker mechanisms, are contained within the body portion. The distributors are contained within the cover 16 which is cup-shaped for that purpose. The other cover or end plate 17 serves in part to support the drive shaft of the magneto and to support the housing from the engine with which the magneto is used. For this purpose the plate 17 has a pilot 20 to fit a hole in the engine crankcase and a flange 21 which is adapted to be bolted to said crankcase.

The tubular casing 15 has an outer portion 22 (Fig. 4) which is of circular cross section and an inner portion 23 which is of the irregular cross sectional shape shown in Fig. 2 and of less width than the portion 22. At the intersection of these portions 22 and 23 are flat faces 24 which lie in a plane at right angles to the axis of the portion 22 (see also Fig. 8). Located centrally in the portion 23 (Figs. 1 and 2) is a hollow hub 25, the lower end of which flares outwardly into a part 26 of larger diameter. This hub is an integral part of casing section 15 and is connected thereto near its outer end by spider arms 27 (Fig. 3). The inner end of casing 15 (Fig. 1) is turned inwardly toward the hub 25 and terminates with a circular flange 15' to receive a corresponding flange on the end section 17. The inner end of casing section 15 therefore has an annular slot 28 between the outer periphery of hub 25 and the inner periphery of flange 15'. There is also the central hole 29 through hub 25 but otherwise the inner end of section 15 is closed.

The magnetic rotor enters through the slot 28. It includes a plurality (six in this case) of short bar magnets 30 (Fig. 2), mounted in angularly-spaced relation in a circular series coaxial with the hub 25. Each magnet has pole shoes 31 made up of iron laminations suitably held together, as by rivets 32. The magnets and shoes are assembled on top of a face plate 33 of non-magnetic material and moved into the proper radial positions against a form, after which wedge blocks 34 of non-magnetic material are driven in, one between each pair of pole shoes, to hold the parts in place. While the wedge blocks are held in the positions shown, a ring 35 of non-metallic material is laid on top of the magnets, shoes and wedge blocks and a hole is drilled through each block and the ring and face plate to receive a tapered pin 36. The ends of each pin 36 after

being driven home, are headed over, one against the face plate and one against a washer 37, which lies against ring 35. The pole shoes 31 are provided with outer convex pole faces 38 and inner concave pole faces 39. These faces are coaxial with the hub 25.

The magnetic rotor is driven by a shaft 40 to which the hub of face plate 33 is splined as indicated in Fig. 1. This shaft is supported in part in hub 25 and in part in the end plate 17. An outer ball bearing 41 is set into a counterbore in the outermost end face of hub 25 and an inner ball bearing 42 is mounted in the hub of cover 17. These bearings 41 and 42 rotatably support the shaft, as indicated. The inner race of the inner bearing 42 is mounted on the hub of face plate 33 and abuts a shoulder on such hub. The face plate abuts a flange 43 on shaft 40. A sleeve 44, also splined to shaft 40, carries a gear 45 to mesh with a driving gear (not shown) in the engine crankcase. A nut 46, threaded on the inner end of shaft 40, serves to force the sleeve against the inner race of bearing 42 and the latter against the shoulder on the hub of face plate 33 and the latter against flange 43, thereby holding the sleeve, inner race and face plate in proper axial position on the shaft. A suitable seal 47 cooperates with a part of sleeve 44 as shown in Fig. 1. The outer end of shaft 40 receives breaker cam 48 which is splined thereto and also clamped in axial position between a nut 49 and the inner race of the outer bearing 41.

The armature structure of the magneto will next be described. There are two circular and coaxial series of pole pieces for cooperation with the pole shoes 31 of the rotor. One series, the inner one, consists of a plurality (six as shown) of pole pieces 50 angularly spaced about the hub 25. Each pole piece 50 has a convex pole face 51 which is coaxial with the hub and shaft 40 and which is adapted for cooperation with the concave faces 39 of the pole shoes 31 of the rotor. The other and outer series consists of a plurality (six as shown) of pole pieces 52, which are angularly spaced about the shaft and hub and which have concave pole faces 53 coaxial therewith. The pole faces 53 are adapted for cooperation with the convex pole faces of the pole shoes 31 of the rotor.

Beyond the rotor is a laminated member (Figs. 1 and 3) which extends diametrically across the casing 15 in parallel relation to the face plate of the rotor. This member affords two coil cores 54, one on each side of hub 25, and a central ring 55 which interconnects the inner ends of the two cores. These three parts are integral. The ring 55 is formed by dividing the laminations at the center, spreading them apart and bending them into the form shown.

The inner series of pole pieces are connected to the ring 55. This is effected by a plurality of flux-conducting members 56 (Figs. 2 and 8), one for each pole piece 50 as herein shown. Each pole piece 50 and its flux-conducting member 56 are integral and they are made up of laminations of the shape shown in Fig. 8. These laminations are suitably bound together into a unit, as by the rivets 57, and the units are fixed in the hub section 25 and its enlargement 26, in any suitable way, as by embedding them in the non-magnetic metal of the casing 15 during the casting thereof. The members 56 parallel the shaft and extend up to the level of the flat faces 24, terminating with finished end faces on which the ring 55 rests. On each core 54 is mounted a coil case 58 of in-

sulating material which case contains a primary coil 59 and a secondary coil 60.

The pole pieces 52 of the outer series (Fig. 2) are divided into two groups of three each. The units of each group are interconnected by an arc-shaped laminated member 61 which extends part way around the section 23 of casing 15 in a plane at right angles to the axis of shaft 40 and is suitably fixed to the casing. Each member 61 has connected thereto a flux-conducting member 62 which extends parallel to the axis of shaft 40 (Fig. 1) along an outer wall of the casing and terminates with a finished end face in the same plane as the end faces of the inner members 56. The outer ends of the cores 54 rest one on each of these finished end faces of the outer flux-conducting members 62. The cores 54 and the ring 55, from which they radiate, may be held to the several end faces described in any suitable way, as for example by the clips 63 (Fig. 3), one engaging each outer end of each of the cores 54. These clips may be secured by cap screws 64 one threaded into each of the flat faces 24.

The pole pieces 52 and their arc-shaped connecting member 61 are integral. They are made up of a stack of laminations and secured together in any suitable way, as by the rivets 65. Alternate members of each stack have extensions which are bent up at right angles to the member 61 and form the outer flux-conducting member 62. The laminations of each member 62 are suitably held together in group form, as by the rivets 66. The laminated unit 52, 61, 62 is fixed to the outer wall of casing section 23 in any suitable way. As herein shown, the two end pole pieces 52 of each member 61 are surrounded (above, below, in back and on the outer end) by the non-magnetic metal of which the casing 15 is cast. Thus, as will be clear from Fig. 2, each arc-shaped member 61 is held against inward or outward radial movement and turning movement. Also, as will be clear from Fig. 10, it is likewise held from movement parallel to the axis of shaft 40. Each member 61 is therefore securely anchored to the housing. The outer flux-conducting members 62 lie in recesses 67 in the wall of housing section 23 and there is clearance between the sides of these members and the sides of the recesses. The back of each member 62 engages the bottom of the recess but elsewhere the member is out of contact with the metal of the casing. The purpose of this arrangement is to avoid an eddy current loss which would otherwise occur if the member 62 were surrounded by a metal loop. For a similar reason the clips 63 do not engage but two walls of the cores 54. Each member 62 is anchored to the housing near its upper end (Fig. 1) by embedding the special head 68 of the rivet 66 in the metal of housing 15. This head is surrounded by such metal and holds its member 62 against the bottom of its groove 67.

Two breaker mechanisms are provided. Both are supported from a bridge 69 (Figs. 4 and 8) which spans diametrically across the casing section 23 at right angles to and beyond the cores 54. This bridge has legs 70, one at each end thereof, with out-turned feet 71 which abut one on each of the faces 24 and are secured thereto by cap screws 72. The legs 70 also have finished pilot portions 73 (Fig. 8) which engage the finished curved surface 74 of the section 23. The two breaker mechanisms on the bridge are located one on each side of the cam 48. The two breaker mechanisms are alike so that a descrip-

tion of one will suffice for both. Each such mechanism is mounted on a plate 75. These plates are located between a hub 76, upstanding centrally from the bridge, and flanges 77 upstanding one from each end of the bridge. The ends of each plate 75, as well as the surfaces of the hub 76 and flanges 77 which they engage, are finished surfaces coaxial with shaft 40. Each plate is held in place by two screws 78 which pass through curved slots in the plate coaxial with the shaft, and serve to clamp the plate to the bridge in various positions of angular adjustment relatively to the shaft. An eccentric 79, journaled in the bridge 69, lies in a recess in plate 75 and serves when turned, to move the plate around the axis of shaft 40 when screws 78 are loosened. The plate closely fits between the hub 76 and flange 77 is guided to swing about the shaft as a center. The plate 75 has fixed thereto the pivot stud 80 for the breaker arm 81, which carries the movable breaker point 82. The stationary breaker point 83 is fixed to a lug on a plate 84 which lies on top of plate 75 and is pivoted on stud 80. Two screws 85 serve to clamp plate 84 to plate 75 and these screws pass through slots in plate 84 which are curved from stud 80 as a center. An eccentric 86 journaled in plate 75 lies in a recess in plate 84 and, when turned, serves to move plate 84 about stud 80, providing that screws 85 are loosened—thereby varying the extent of separation of the breaker points 82 and 83. The adjustment 79 serves to bodily move the breaker relatively to cam 48 for varying the timing. The movable breaker point 82 is electrically connected by a spring 87 to an insulated terminal 88 on plate 84. This spring also serves to move the breaker arm against cam 48.

A condenser 89 is provided for each breaker. Each condenser is mounted in a metal, cartridge-like casing 90 (Figs. 3 and 8). One terminal of the condenser is the casing itself and the other terminal 91 is insulated from the casing. The casing 90 is supported by a metal plate 92. Each plate is clamped against an insulating block 94 on one of the faces 24 by one of a pair of cap screws 93, which thread into lugs 95 upstanding from the face 24. Thus, the plates 92 and the condensers 89 are grounded. One end of each condenser casing 90 is received in a small well 96 formed in one of the faces 24. Each block 94 (Fig. 9) carries a conducting plate 97, fixed thereto by screws 98. Each plate 97 has a projecting end which is engaged by the contact spring 99 of a member 100 electrically connected to a wire 101 which connects with the usual grounding switch indicated in Fig. 11 at 102.

The electrical connections of the primary circuit will be clear from Fig. 11. One terminal of each primary coil 59 is grounded. The other terminal is connected by a wire 103 to the insulated terminal 88 and thus to the breaker arm 81 and movable breaker point 82. The breaker point 83 is grounded. A wire 104 connects the terminal 88 to the insulated terminal 91 of the condenser 89 and a wire 105 connects the terminal 91 to plate 97 and thus to the grounding switch 102. The secondary coils 60 each have one terminal grounded. The other terminal of one secondary coil is connected by a conductor 106 to the rotatable electrode 107 of a distributor which successively moves into position so that the high tension sparks can jump to the distributor contacts 108. These contacts are connected one to

each of a series of twelve plugs some of which are indicated at 109. The second distributor has similar contacts 110 and a rotatable electrode 111 which is connected by a conductor 112 to one terminal of the other secondary coil. The other terminal of the latter is grounded. The contacts 110 are connected, one to each of a second series of twelve spark plugs, some of which are indicated at 113. The electrodes 107 and 111 simultaneously come into position opposite two contacts 108 and 110, respectively, and the two spark plugs 109 and 113 which are respectively connected to said contacts are positioned in the same cylinder of the engine.

The distributors, diagrammatically indicated in Fig. 11, are constructed as shown in Figs. 1, 5 and 7. Referring to Fig. 1, the distributors are combined and both are housed within the cover 16. There is an inner stator block 117 which is common to both distributors and made of suitable insulating material. In this block 117 are molded outer and inner metallic feed rings 118 and 119, having a plurality (twelve in this case) of outwardly projecting contacts 120 and 121, respectively. The conductors 106 and 112, previously described, are integral parts of the rings 118 and 119 respectively, and they extend inwardly and radially outwardly into position to be engaged by the ungrounded terminals 122 of secondary coils 60. These terminals are mounted one in each of two hollow hubs 123, which project radially one from each of the coil housings 58 and are adapted to enter hollow hubs 124 formed on the base of block 117. The block 117 has four feet 125 (Fig. 5) which support it from the section 22 of the housing. The section 22 is indented at four angularly-spaced points as shown in Fig. 3, to form supports 126 and these feet 125 rest one on each of these supports as indicated in Fig. 5. Fig. 7 clearly shows one of these feet in place on its support. Cap screws 127 fasten these feet to the supports as indicated.

The distributors are provided with an outer stator block 128 of insulating material (Figs. 1 and 5). This block is suitably secured to cover 16, as by the rivets 129, and like the cover, is roughly cup-shaped and telescopes the inner stator block 117. The block 128 supports the two sets of output contacts 108 and 110, arranged, respectively, in the planes of feed rings 119 and 118. A skirt-like barrier 129' on block 128 extends sufficiently beyond the contacts 108 to prevent flash-over from these contacts to the metallic wall of the housing. The contacts 108 (Fig. 7) are integral parts of wires 130 which are molded in block 128 and extend to and terminate in the base of sockets 131 formed in the hub 132 of the block. The twelve sockets 131 are arranged in an inner circular series as shown in Fig. 6. Surrounding this series is an outer and coaxial circular series of sockets 133. The contacts 110 are integral parts of wires 134 which are molded in block 128 (Fig. 1) and extend to and terminate in the base of sockets 133. The sockets 131 and 133 receive the spark plug wires 135 and 136 leading to the spark plug 109 and 113, respectively.

These wires 135 and 136 enter through a metallic conduit, exemplified in part by the fitting 137 which is secured by screws 138 to and closes the opening in the end of cover 16. The wires pass through openings in a circular gland plate 139 and through openings in a rubber ring 140—the latter having tubular parts 141 one to enter

each of the sockets 131 and 133 and having also a flange 142 to telescope hub 132. The gland plate 139 is forced inwardly when screws 138 are tightened, thereby compressing the rubber ring 140 and forcing it into close contact with each spark plug wire and into close contact with the inner wall of cover 16, thus sealing off the distributor chamber from the conduit 137.

The rotor of the distributor is rotatably supported from the stator block 128. A stud 143 is clamped to a metal insert 143' in block 128 as indicated in Fig. 1. This stud supports the inner races of two ball bearings 144 which races are separated by a spacer sleeve 145. A nut 146 clamps the inner races and spacer sleeve 145 in position as indicated. The outer races of these bearings are fixed one in each end of a tubular metal insert 147 molded into the body 148 of the rotor. For driving the rotor, the insert 147 is provided with an extension 149 which is directed axially inward to engage in a notch in an extension 150 of the cam 48 (see also Fig. 8). The rotor body which is of insulating material, has its hub telescoped in the central hole in the inner stator block 117. The rotor body extends outwardly in opposite directions from its hub (Fig. 5) and inwardly into the annular space between the two stator blocks 117 and 128 (Fig. 1). On one side, the rotor extends inwardly to, or slightly beyond, the plane of feed ring 118 and carries the electrode 111 to successively connect the feed ring contacts 120 with one or another of the contacts 110. On the other side, the rotor extends inwardly a greater distance and carries an electrode 107 for successively connecting the feed ring contacts 121 with one or another of the contacts 108.

The operation of the magneto will next be described. Referring to Fig. 2, the magnetic rotor, turning in the direction of the arrow, will make and break a magnetic circuit through each coil core twelve times per revolution. The rotor is shown in one of its twelve "sparking positions" in Fig. 2. Two circuits, in each of which the flux travels axially outward through the members 56, radially outward through the coil cores 54 and axially inward through the members 62, have just been broken and circuits in the reverse direction have been established. A reversal of flux through both primary coils 59 thus occurs simultaneously. At the moment when the rotor moves into the illustrated position, the twelve-lobed breaker cam 48 simultaneously separates both sets of breaker points 82 and 83 and thus opens both primary circuits. The E. M. F. simultaneously induced in each secondary coil 60 results in two sparks which occur simultaneously in the same cylinder of the engine—the electrodes 107 and 111 being then positioned as shown in Fig. 5 so as to cooperate respectively, with one of the contacts 108 and with one of the contacts 110.

As the rotor continues to turn in the illustrated direction the shoes 31 of north polarity move into full engagement with the pole pieces 52 and the shoes 31 of south polarity move into full engagement with the pole pieces 50. The breaker cam 48 then allows the breaker points to close. The primary circuits are thus closed and the effect of the closed-circuit primary coils is to resist change of flux in the magnetic circuits. Just before the shoes 31 of north polarity leave the pole pieces 52 and before the shoes 31 of south polarity leave the pole pieces 50, succeeding pole shoes of south polarity have engaged pole pieces 52 and succeeding pole shoes of north polarity

have engaged pole pieces 50 to set up a magnetic circuit in the reverse direction. Then, when the first described circuit is broken sufficiently and the breaker points again open, a quick reversal of flux will occur simultaneously in both coil cores and high tension sparks will be produced in two more spark plugs, both located in another cylinder of the engine. This condition occurs when the rotor has moved 30 degrees from the illustrated position. A succeeding 30 degree movement of the rotor will similarly cause another reversal of flux in the coil cores and the production of two more sparks in another cylinder of the engine and so on—flux changes and resulting sparks being produced at each 30 degree movement of the rotor.

The tubular portion of the housing is machined from opposite ends. First, working from the inner end, said portion is bored out up to the level of the faces 24 to the finished diameter of the faces 53 of the pole pieces 52 of the outer series and it is also bored out to a less depth sufficient to finish the faces 51 of the inner pole pieces. Also, the inner end face of flange 15' is faced off. The remaining machining operations are performed from the outer end of said tubular portion. The outer end faces of the flux-conducting members 62, the outer end face of hub 25, including the embedded members 56, the feet 126 and the faces 24 may all be finished with an end mill, working from said outer end. Then, the rotor and driving shaft are put in place through the inner end of said tubular portion, after which the inner end closure 17 is bolted in place. The coil units are slipped on their cores 54 on opposite sides of the ring 55 and this laminated member 54, 55 is put in place and secured by the clips 63 and screws 64, working from the outer end of the tubular portion of the housing. The bridge 69, having the two breaker mechanisms assembled thereon, is put in place through said outer end and secured by screws 72. The breaker cam 48 is then assembled on shaft 40; the condenser casings 90 put in place, together with the ground terminals; and all the wiring for the primary circuits is done. The inner stator block 117 is then put in place with its feed 125 resting on supports 126 and the screws 127 are applied to fasten the feet and supports together. Then the outer stator block 128 and the distributor rotor 148 are assembled in the order named in cover 16, after which this cover is applied to close the outer end of the tubular portion of the housing and is fastened thereto by the screws 18.

The invention affords an improved arrangement of the flux-conducting elements of the armature of the magneto. These elements are packed within the tubular casing and around the drive shaft in exceedingly compact relation. The greatest radial dimension of this casing, measured from the axis of the shaft, is but slightly greater than the minimum permissible radial dimension of the distributor. The arrangement enables the two coil units and cores therefor, necessary for a dual magneto, to be mounted within the small space limits shown and served by a single magnetic rotor. Likewise the two breaker units are served by a single cam 48 and the two distributors are served by a single rotor 148. The invention nevertheless affords a very efficient magneto for furnishing dual ignition for airplane engines having a large number of cylinders.

What we claim is:

1. In a magneto, a magnetic rotor, a drive shaft

therefor, a plurality of generating coils, cores one for each coil, said cores radiating from the shaft with their axes located at right angles to the axis thereof, and inner and outer flux-conducting members extending respectively from the inner and outer ends of the cores in a direction along the shaft and into position for cooperation with said rotor.

2. In a magneto, a magnetic rotor, a drive shaft therefor, a plurality of generating coils, cores one for each coil, means interconnecting the inner ends of said cores, said cores radiating from said shaft with their axes located at right angles to the axis thereof, and inner and outer flux-conducting members extending respectively from the said interconnecting means and from the outer ends of said cores in a direction along the shaft and into position for cooperation with said rotor.

3. In a magneto, a magnetic rotor, a drive shaft therefor, a plurality of generating coils, cores one for each coil, said cores radiating from the shaft with their axes located at right angles to the axis thereof, inner and outer flux-conducting members extending respectively from the inner and outer ends of the cores in a direction along the shaft and into position for cooperation with said rotor; and a housing of non-magnetic material for enclosing said coils, cores, members and rotor; said housing having a tubular portion with a central hub supported therein, said inner and outer members being fixed respectively in said hub and in said tubular portion.

4. In a magneto, a magnetic rotor, a drive shaft therefor, a plurality of generating coils, cores one for each coil, said cores radiating from the shaft with their axes located at right angles to the axis thereof, inner and outer flux-conducting members extending respectively from the inner and outer ends of the cores in a direction along the shaft and into position for cooperation with said rotor; and a housing of non-magnetic material for enclosing said coils, cores, members and rotor; said housing having a tubular portion with a central hub supported therein, said inner and outer members being fixed respectively in said hub and in said tubular portion, said cores being separable from said inner and outer members.

5. In a magneto, a magnetic rotor, a drive shaft therefor, a plurality of generating coils, cores one for each coil, said cores radiating from the shaft with their axes located at right angles to the axis thereof, inner and outer flux-conducting members extending respectively from the inner and outer ends of the cores in a direction along the shaft and into position for cooperation with said rotor, and a housing of non-magnetic material for enclosing said coils, cores, members and rotor, said housing having a tubular portion with a central hub supported therein and having removable end walls for closing opposite ends of said tubular portion, said inner and outer members being fixed respectively in said hub and in said tubular portion, said cores being separable from said inner and outer members and removable therefrom and replaceable thereon through one of said end walls, said rotor being removable and replaceable through the other of said end walls.

6. In a magneto, a magnetic rotor, a drive shaft therefor, a plurality of generating coils, cores one for each coil, said cores radiating from the shaft with their axes located at right angles

to the axis thereof, inner and outer flux-conducting members extending from the inner and outer ends of the cores in a direction along the shaft and into position for cooperation with said rotor, a housing of non-magnetic material for enclosing said coils, cores, members and rotor, said housing having a tubular portion with a central hub supported therein and having removable end walls for closing opposite ends of said tubular portion, said inner and outer members being fixed respectively in the hub and tubular portion, said cores being separable from said inner and outer members and removable therefrom and replaceable thereon through one of said end walls, said rotor being removable and replaceable through the other of said end walls, and bearings for said shaft one in said last-named end wall and one in said hub.

7. In a magneto, a magnetic rotor, a driving shaft therefor, said rotor having a plurality of bar magnets angularly-spaced in a circular series around the axis of rotation of said shaft, pole shoes for said magnets, each shoe having an inner concave and an outer convex face in coaxial relation with said shaft, an inner and an outer circular series of angularly-spaced pole pieces having convex and concave faces coaxial with said shaft for cooperation respectively with the concave and convex faces of said shoes, a plurality of cores radiating from said axis and spaced axially away from the pole shoes of said rotor, generating coils one on each core, flux-conducting means interconnecting the inner ends of said cores and extending along said axis to and connecting with all the pole pieces of said inner series, and flux-conducting means interconnecting all the pole pieces of said outer series and extending substantially parallel with the first-named means to and connecting with the outer ends of said cores.

8. In a magneto, a housing of non-magnetic material having a tubular portion, a removable end wall closing one end of said portion, a removable member closing the other end of said portion, a hollow hub located centrally in said portion and supported from the wall thereof by radially-extending connecting means, a drive shaft rotatably mounted in said end wall and hub and extending through said wall and through and beyond said hub, an inner circular series of pole pieces coaxial with said shaft and fixed in said hub, an outer circular series of pole pieces coaxial with said shaft and fixed in the wall of said tubular portion, a magnetic rotor fixed to said shaft and having a circular series of magnets and pole shoes therefor to cooperate with said pole pieces, a plurality of inner and a pair of outer flux-conducting members extending respectively from the inner and outer series of pole pieces in a direction along the shaft and terminating with end faces, said pair of members being located at opposite points in said tubular portion, a laminated member spanning said portion at right angles to said means and interconnecting the end faces of said pair of outer members and connected with the end faces of the inner members, coil units each comprising primary and secondary coils arranged on said laminated member one on each side of said shaft, a bridge removably secured to said tubular portion and spanning the same at right angles to the laminated member, said bridge and said connecting means located on opposite sides of the laminated member, a pair of breaker mechanisms mounted at opposite points on said

bridge, said shaft extending through and beyond said bridge, and a cam fixed to said shaft for actuating both breaker mechanisms.

9. In a magneto, a housing of non-magnetic material having a tubular portion, a removable end wall closing one end of said portion, a cup-shaped removable member closing the other end of said portion, a hollow hub located centrally in said portion and supported from the wall thereof by a radially-extending connecting means, a drive shaft rotatably mounted in said end wall and hub and extending through said wall and through and beyond said hub, an inner circular series of pole pieces coaxial with said shaft and fixed in said hub, an outer circular series of pole pieces coaxial with said shaft and fixed in the wall of said tubular portion, a magnetic rotor fixed to said shaft and having a circular series of magnets and pole shoes therefor to cooperate with said pole pieces, a plurality of inner and a pair of outer flux-conducting members extending respectively from the inner and outer series of pole pieces in a direction along the shaft and terminating with end faces, said pair of members being located at opposite points in said tubular portion, a laminated member spanning said portion at right angles to said connecting means and interconnecting the end faces of said pair of outer members and connected with the end faces of said inner members, coil units each comprising primary and secondary coils arranged on said laminated member one on each side of said shaft, a bridge removably secured to said tubular portion and spanning the same at right angles to the laminated member, said bridge and said connecting means being located on opposite sides of the laminated member, a pair of breaker mechanisms mounted at opposite points on said bridge, said shaft extending through and beyond said bridge, a single cam fixed to said shaft for actuating both breaker mechanisms, a pair of distributors mounted in the cup-shaped member, and a single rotor for actuating both distributors drivingly connected to said shaft.

10. In a magneto, a magnetic rotor, a driving shaft therefor, an inner circular series of pole pieces angularly-spaced around said shaft and having convex pole faces coaxial therewith, a plurality of inner flux-conducting members each connected at one end to one of said pole pieces and extending alongside said shaft and terminating at the other end with a finished end face, an outer circular series of pole pieces angularly-spaced around said shaft and having concave pole faces coaxial therewith, outer flux-conducting members one on each side of said shaft and one connected to some of the outer pole pieces and the other connected to the rest of the outer pole pieces, said outer members extending substantially parallel to the inner members and each terminating with a finished end face, and a laminated member having its ends engaged one with each of the finished end faces of said outer members and having its laminations spread apart at a location between its ends and bent to form a ring, said ring encompassing said shaft and engaged with the finished end faces of said inner members, said laminated member affording a pair of cores one on each side of said ring, said rotor having a plurality of bar magnets angularly-spaced in a circular series around said shaft, and having pole shoes for the magnets, each said shoe having inner concave and outer

convex pole faces coaxial with the shaft for cooperation respectively with the convex and concave pole faces of the pole pieces of the inner and outer series.

11. In a magneto, a housing of non-magnetic material having a tubular portion, a pair of removable end walls closing opposite ends of said portion and a central hollow hub supported from the tubular portion and having its ends spaced one from each of the adjacent end walls; a drive shaft extending through said hub and through one end wall and supported in part by the hub and in part by the last-named end wall, a magnetic rotor fixed to the drive shaft between the last-named end wall and the adjacent end of said hub, said rotor having a plurality of bar magnets angularly-spaced in a circular series around said shaft and having pole shoes for the magnets, each said shoe having inner concave and outer convex pole faces coaxial with said shaft, an inner and an outer circular series of angularly-spaced pole pieces having convex and concave pole faces coaxial with said shaft for respective cooperation with the concave and convex pole faces of said pole shoes, a plurality of inner flux-conducting members connected at one end to said inner pole pieces and embedded in said hub and extending along the same to the opposite end thereof, a laminated flux-conducting member having a central ring and two diametrically-opposed cores radiating therefrom and spanning the tubular portion of said casing, said ring engaging the opposite ends of the inner flux-conducting members, outer flux-conducting members embedded in said tubular portion and connecting the outer ends of said cores to the pole pieces of the outer series, means for fastening said laminated member in said casing, and generating coils one on each core.

12. In a magneto, a housing of non-magnetic material having a tubular portion with a central hollow hub supported therefrom and removable end walls for closing opposite ends of said portion, a pair of laminated flux-conducting members anchored to the wall of said tubular portion one on each side of said hub in opposed relation, each said member comprising an arc-shaped portion extending part way around the inner wall of the tubular portion parallel to a plane at right angles to the axis of said hub and provided with a plurality of angularly-spaced pole faces coaxial with said hub and a portion at right angles to the arc-shaped portion, said second-named portion extending along the inner wall of the tubular portion in a direction substantially parallel to the axis of said hub and terminating with a finished end face, a plurality of angularly-spaced flux-conducting members anchored to said hub and having on one end a plurality of angularly-spaced pole faces coaxial with said hub, and at the other end terminating with a finished end face, a flux conducting member having its outer ends engaged one with each of the first-named finished end faces and intermediate its ends being engaged with the second-named end faces, generating coils on the last-named member one on each side of said hub, and a magnetic rotor cooperating with said pole faces to make and break magnetic circuits through said flux-conducting members and coils.

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