Oct. 1, 1935. M. E. SPOHN 2,015,697

MAGNETO

Original Filed June 6, 1931 3 Sheets-Sheet 1

FIG. 1

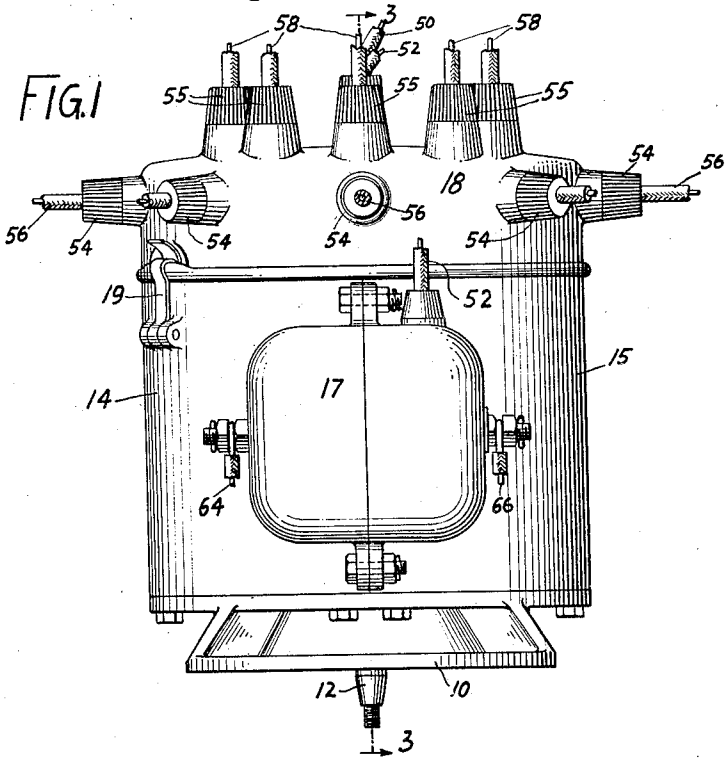
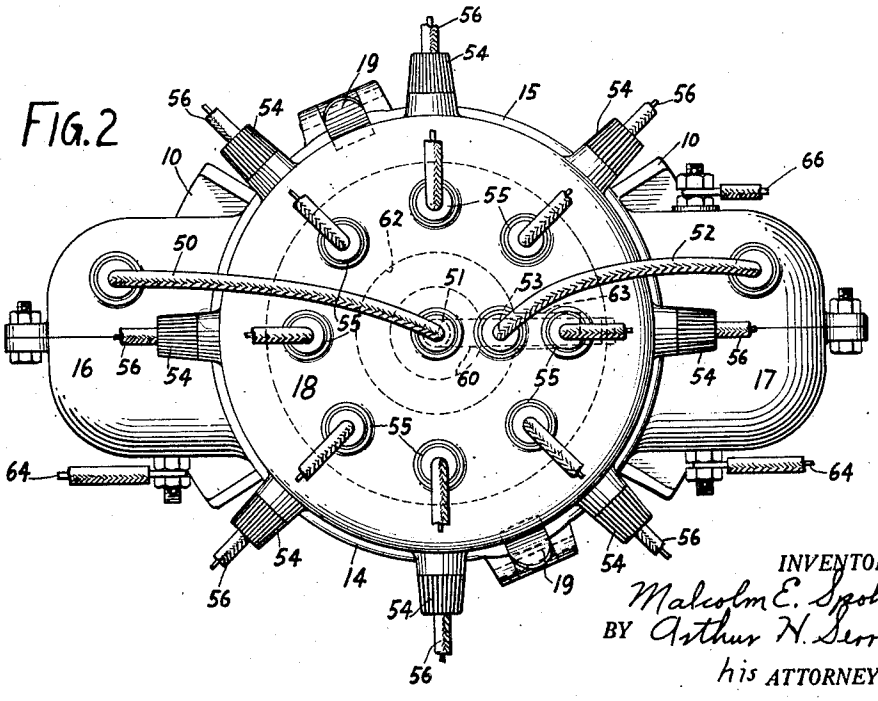


FIG. 2



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MAGNETO

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FIG. 3

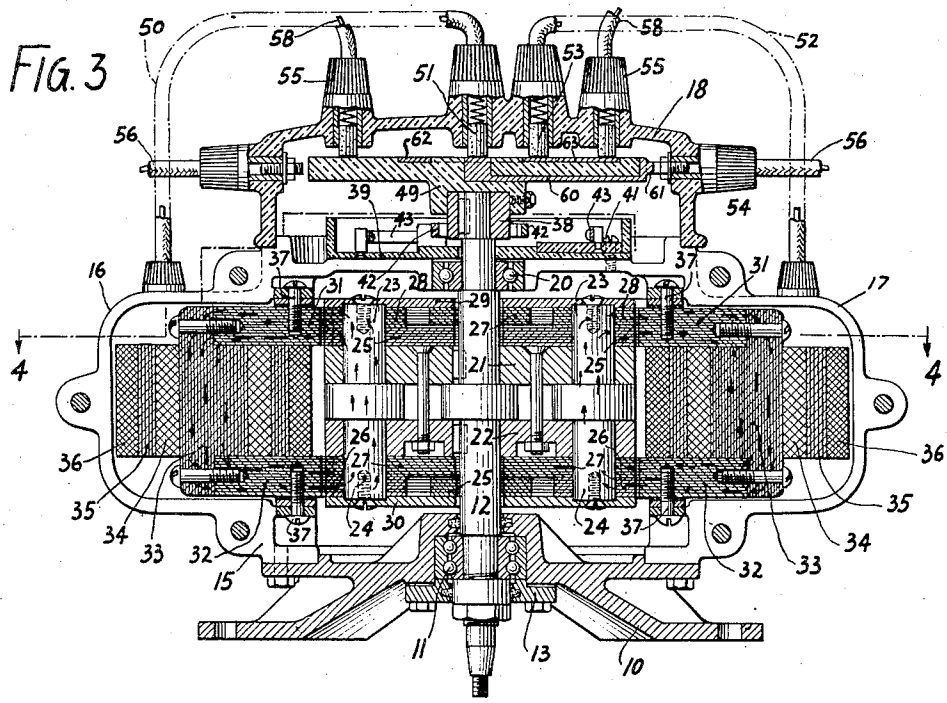

FIG. 4

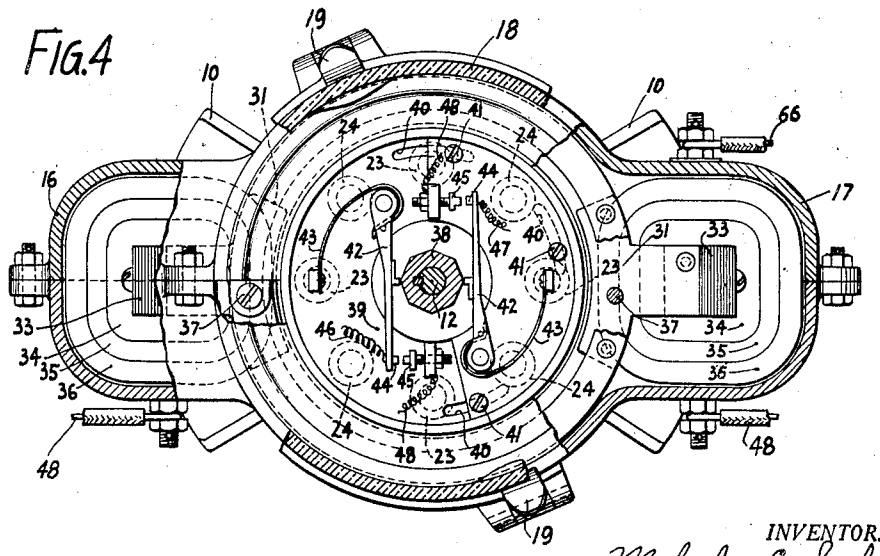

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FIG. 5

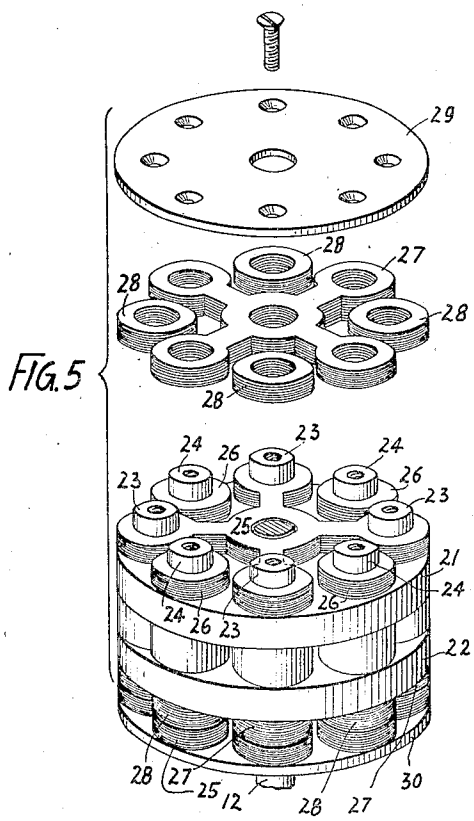

FIG. 6

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UNITED STATES PATENT OFFICE

2,015,697

MAGNETO

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Application June 6, 1931, Serial No. 542,586
Renewed June 9, 1934

5 Claims. (Cl. 171—252)

This invention relates in general to generators of the magneto type, and more particularly to a magneto for supplying electrical energy for igniting the working substance of a prime mover, such as an internal combustion engine. The adaptation to which the invention is primarily susceptible is in connection with prime movers of a type which require more than a single ignition spark per cylinder, such as is presently employed in the dual ignition system of airplane motors, where the safety factor of the machine demands such positive ignition. It is equally suited for use in other types of internal combustion engines which require, and may in the future demand because of the present trend toward increased motor speeds, a double, or if necessary, a greater number of independent ignition impulses per cylinder. The advantages of such an ignition system result in a more positive and thorough ignition of the compressed charge causing a more complete combustion of the working substance in the cylinders of the engine to thereby attain a greater over-all efficiency of the motor.

Heretofore in certain automotive vehicles and airplane engines it has been necessary to utilize two independent magnetos to obtain the benefit inherent in a dual ignition system. In some instances the electrical generators have also been combined into a single unit in order to reduce weight, particularly in airplanes, but the construction has necessitated the use of two individually driven distributors.

The primary object of the present invention is therefore to construct a unitary magneto which will simultaneously generate and distribute therefrom any desired number of electrical sparking impulses to the ignition points of an internal combustion engine.

Another object of the invention is to provide a magneto rotor in which there is a plurality of bar magnets, the polarities of the respective magnets being arranged to provide an alternating magnetic flux. The magnets on the rotor having similar polarities are strengthened by inter-locking laminations. Each magnet separate from the remaining magnets of like polarity is adapted to cause an independent magnetic field through the pole shoes and the core of a coil so that a sparking impulse is obtained. The number of individual magnets preferably utilized on the magneto rotor of this invention corresponds to the number of cylinders in the engine with which it is associated so that one revolution of the magneto rotor will provide a sufficient number of sparking impulses to fire each cylinder of the motor.

A further object is the provision of a magneto in which the distributor and generating elements are mounted upon a single shaft thereby eliminating the heretofore necessary gearing associating these elements and also by this simplified construction reducing the number of necessary bearings in the magneto. By reducing the number of movable mechanical parts of the magneto the efficiency is raised and the chances of failure of a given element are minimized.

Another object is to provide a magneto of this type in which the generating and distributing elements rotate at the same speed.

Still another object is to provide a magneto in which all moving parts will rotate at one-half engine speed and thereby prevent an internal overheating of the generating elements which is a frequent occurrence in high speed magnetos.

The invention also anticipates the utilization of an electrical generator of this type in which a plurality of separate pole shoes and cores are fixed in desired position about the magnet rotor so that each core may simultaneously and individually be affected by an alternating magnetic field. The coils are each provided with a breaker mechanism by which the primary current may be interrupted and the secondary current controlled to synchronize or stagger the sparking impulses depending upon the requirements of the motor with which the magneto is used.

While for purpose of simplicity in illustration the invention has been shown as comprising only a pair of such pole shoes and cores so that obviously dual ignition is obtained, it will be apparent that by increasing the number of these elements about the rotor any desired number of sparking impulses may be effected per cylinder.

My invention further includes other objects, advantages and novel features of design, construction and arrangement hereinafter more particularly referred to and which will be apparent from the accompanying drawings, in which I have illustrated the same in its preferred form.

In the drawings Figure 1 is a side elevation of a magneto made in accordance with the present invention,

Fig. 2 is a plan view of the device as shown in Fig. 1.

Fig. 3 is a sectional view taken on line 3—3, Fig. 1.

Fig. 4 is a sectional view taken on line 4—4, Fig. 3.

Fig. 5 is a perspective view showing the construction of the magnetic rotor element, and

Fig. 6 is a diagrammatic view illustrating the electrical connections associating the various elements comprising the magneto.

Referring more particularly to Figs. 1 to 3 inclusive in accomplishing the objects of the invention, the generator elements including an induction rotor, or a magnetic flux producing member, and stator members effected by the flux producing members, together with a distributor element and breaker mechanism are associated and contained within a unitary framework or casing. As shown this casing preferably includes a base member 10 formed to make provision for the bolting, or securing in any other desired manner, of the same to the body of the engine. The central portion of the base 10 is constructed to make provision for a bearing 11 and rotatable spindle or shaft 12. An end plate 13 suitably fastened to the base 10 prevents an axial displacement of the spindle 12 when in operative position in the casing. The end of the spindle 12 projects from the end plate of the base member and is adapted to either be geared to the cam shaft of the engine at an equal speed ratio or may be directly connected to the same as desired. It will be consequently understood that the rotating speed of the induction rotor of the generator is equal to the cam shaft speed of the engine which is always one-half the R. P. M. of the crankshaft.

Semi-sections of housing as indicated at 14 and 15 are secured to the base member, and include in their present construction, end portions 16 and 17 when connected for enclosing the stators of the generating elements. A distributor cap 18 is mounted above the housing members 14 and 15 and is preferably secured thereto by removable fastening means such as clips as indicated at 19. The construction of the housing members 14 and 15 also provides for a central bearing member 20 for the other end of the spindle 12.

Referring particularly to Figs. 3 and 5, the induction or rotor element of the generator comprises a plurality of individual bar magnets each fixed in position at equal radial distances from the spindle 12 by means of and between circular holding plates 21 and 22. For purposes of illustration, I have shown eight such magnets parallel to the axis of the spindle and spaced at equal arcuate distances from each other about the periphery of the rotor. The individual magnets on the rotor are separately adapted to cause a magnetic flux in each stator element of the generator, so that as illustrated in the present case, the eight magnets will cause eight corresponding sparking impulses to simultaneously emanate from the coil of the respective stator elements for every revolution of the cam shaft of the motor. It is apparent that any number of magnets could thus be placed on the rotor in accordance with the present invention to obtain the necessary sparking impulses to fire each cylinder of an engine in one revolution of the rotor.

The bar magnets are preferably arranged about the rotor so that the polarities of the same alternate in order to obtain a reversal of the direction of magnetic flux in the coil cores. The positive polarities of the magnets are indicated generally at 23 and the negative polarities at 24. In order to construct an induction rotor composed of many individual magnets, which will maintain its magnetic strength for a long period of time, I employ interlocking lamination sheets for associating the magnets of like polarities on the respective ends of the rotor. The sheets of interlocking laminations for the magnets in the top portion of the rotor of positive polarities are indicated at 25. Sheets of spacer laminatons 26 are employed on the magnets of negative polarities. The lamination sheets 26 are built slightly higher than the interlocking laminations 25 in order to separate the same from the interlocking laminations 27 for connecting the negative poles of the magnets. The lamination spacer sheets 28 are adapted to be placed in position on the extremities of the magnets having positive polarities. The sheets of lamination employed below the holding plate 22 associate the magnets in a like manner. The laminations employed are preferably of thin sheet steel, the sides of the respective sheets being oxidized in order to minimize so far as possible the formation of eddy current magnetic lines of flux within the rotor.

As illustrated, I employ circular brass end plates 29 and 30 for retaining the lamination sheets firmly in position on the rotor. The end plates are secured in position on the rotor structure by fastening screws which may be turned to position in tapped openings at the extremities of the magnets. However, in the event that the magnets are made of a very hard cobalt steel the end plates may be secured to the rotor in any other manner such as fastening the same by screws to the holding plates 21 and 22 respectively. The rotor induction element of the generator as assembled is compact and rigid in construction and efficient in operation.

Referring particularly to Figs. 3 and 4, the stator elements of the magneto are illustrated. In this instance only two independent elements are shown in order to effect dual ignition. The stator elements are similar in construction and are placed 180° apart when two are utilized. The invention also contemplates the use of as many such elements as may be required to produce a desired number of sparking impulses per cylinder such as may be provided by a housing which will enclose three stator elements spaced 120° apart, or four stator elements at 90° apart, as such a construction in connection with the rotor element described will obviously simultaneously produce three or four sparking impulses respectively per cylinder.

As shown the construction of the stator element includes pole shoes 31 and 32, a core 33, about which is located the usual primary winding 34, condenser 35 and secondary winding 36. Each stator is maintained in a fixed position within the end portions 16 and 17 of the housing provided therefor by means of screw fastenings such as indicated at 37 and the same may be magnetically insulated from the housing by bronze washers. The coil core and the fixed stator elements are parallel to the axis of the rotor shaft 12. The pole shoes extend perpendicularly therefrom, having their extremities curved so as to expose the face of the shoes to the rotary induction element.

As clearly shown in Fig. 3, as each individual magnet assumes a position adjacent the pole shoes, lines of magnetic flux traverse the stator element. The magnetic field caused by each magnet is represented by the arrows passing from the extremity of the magnet 23 of positive polarity, through the shoe 31, core 33 and shoe 32 to the extremity of the same magnet having a negative polarity. The individual magnets are arranged on the rotor so that magnetic flux will be produced in each of the stator elements simultaneously. The path of the magnetic field will be reversed in

the coil cores by the action of the successive magnets of alternating polarities as they assume a position adjacent the pole shoes. The pole shoes and cores are preferably constructed of sheets of laminated steel having oxidized surfaces similar to that employed in the rotor element in order to minimize the eddy currents which may tend to be set up in the stator element by the passage of the magnetic flux through the same.

From the foregoing description it is obvious that in the construction illustrated eight separate sparking impulses will be generated simultaneously from each of the coils of the stator elements for each revolution of the induction or rotor element.

Referring particularly to Figs. 3, 4 and 6, the magnetic flux, simultaneously effected in the respective cores of the stators, induces an electric current in each of the windings. The flow of the current through the windings is adapted to be interrupted by a breaker mechanism when the same reaches its highest intensity. This mechanism is preferably centrally located above the housing sections 14 and 15 containing the bearing 20, it being suitably insulated therefrom and is controlled by a cam 38 keyed to the end of the rotor shaft 12 which extends above the housing. A rotatable base plate 39 having slots is indicated at 40, by which the same may be retained in a fixed position by screws 41 facilitating an adjustment in the setting of the plate to obtain the proper timing for the sparking impulses of the engine.

As shown for the purposes of dual ignition, I employ an individual breaker arm for each of the generator stator elements. The breaker arms are indicated at 42, being pivotally secured to the plate 39, the same having cam cooperating points operative on opposite sides of the cam 38. Suitable means, such as leaf springs 43, are associated with the breaker arms so as to maintain the cam follower in cooperative relationship with the cam at all times. The ends of the respective breaker arms have the usual contact points 44 adapted to cooperate with the adjustable contacts 45, the supporting members of which are suitably insulated from the base plate. A lead 46, Fig. 6, connects one of the contact points 44 to the primary winding of one of the stator elements. A lead 47 makes a similar connection to the other stator element. Leads 48 from each of the contacts 45 are employed to facilitate the grounding of the primary current in the stator elements. The cam 38 of the breaker mechanism, being directly connected to the shaft 12 on which the induction element is mounted, necessarily rotates at one-half engine speed.

For the purpose of the present invention, the cam must be provided with a plurality of equidistant spaced lobes corresponding in number to the individual magnets as employed on the rotor so as to cause a break or interruption in the primary current induced in the stator by each magnet. The cam provided in the instant case must necessarily, therefore, have eight lobes as illustrated, the same being adapted to cooperate with the breaker arms to cause a simultaneous interruption of the primary current in the respective coils. The base plate 39 and the contacts 45 may be adjusted to any desired position to either synchronize or stagger the ignition impulses in order to meet the requirements of the motor with which the magneto is used.

Referring to Figs. 3 and 6, the distributor rotor or disc 49 of the magneto, operative within the distributor cap 18, is illustrated. This rotor is fixed to the end of the shaft 12 by a set screw or other means and is located above the breaker mechanism. The distributor cap is provided with individual leads from each of the secondary windings of the coils. The lead 50 connects one of the high tension windings to the distributing point 51 within the cap. Similarly the lead 52 connects the other secondary winding to the distributing point 53. The rotor or disc 49 is constructed to facilitate an individual and simultaneous closing of the high tension circuit to make communication at the desired instant with the sparking elements of the engine.

In accordance with the present invention eight duplicate distributing points of contact are made for one revolution of the rotor element 49. One group of contacts are spaced about the periphery of the distributor disc as indicated at 54, the same having leads to the respective cylinders of the engine. A corresponding number of distributor contact points 55 are similarly located on the top of the distributor cap 18, having leads connecting the same to the spark plugs of the engine.

Adjacent individual contacts in each group compose the set having leads for a given cylinder as indicated diagrammatically in Fig. 6, lead 56 connecting the high tension circuit to a spark plug 57, and a lead 58 performing a similar purpose for spark plug 59.

The rotor is constructed to include on its lower surface an intermediate strip 60 of conducting material connecting the high tension contact 51 to a contact 61 on the periphery of the disc. The contact 61 makes a connection with each of the eight distributing spaced contact points 54 at the sides of the distributor cap in one revolution of the rotor. At the top surface of the rotor 49 a circular conducting strip 62 is shown making contact with the high tension point 53 at all times. An arm 63 projecting radially from the circular strip 62 is adapted to close the circuit to the distributor contacts 55 located in the top of the distributor cap at the desired intervals. The contacts of the rotor element simultaneously close the separate high tension circuits to each of the spark plugs of a cylinder and distribute eight of such dual sparking impulses for every revolution of the rotor 12. The construction employed in accomplishing the objects of the present invention also makes it possible to mount the distributor, or the breaking mechanism and the induction rotor element on a single shaft thereby eliminating the heretofore necessary gearing.

Referring particularly to Fig. 6, a lead 64 from each of the primary windings of the coils may be utilized to short circuit the current supplied to the breaker mechanism so that the same can be directly grounded when an operating switch 65 is closed in order to stop the engine.

Also the magneto may be suitably provided with a booster or starting current line as indicated at 66 associated directly with the distributor in order to facilitate the starting of the engine, by initially firing the cylinder by means of an independent source of electrical energy.

It is also apparent that the construction utilized eliminates the necessity of making specific provision for the radio shielding of the magneto at the contact points of high tension current inasmuch as the coils are connected directly to the distributor by leads which are located exteriorly of the casing.

From the foregoing description it will now be understood that in the operation of the magne-

to, the rotation of the induction element on the shaft 12 creates a primary current in each of the stator windings the interruption of which, by the break of the current at the contacts 45 under the influence of the cam 48, causes the high tension current in the secondary windings of the stators. The dual distributor completes the high tension circuit at the desired interval to cause the sparking impulses in the respective cylinders of the engine.

It is apparent that the foregoing description in connection with the drawings is merely illustrative for the purposes of explaining the invention as it may be utilized to suit the requirements of a given type of engine.

Claims to subject matter common to this application and my co-pending application Serial No. 739,728, filed August 14, 1934, are being made in said co-pending application, which is a continuation in part of this application.

I claim as my invention:

1. In a magneto, an induction rotor element having a plurality of individual magnets positioned about its periphery and arranged so that their polarities alternate, each magnet being parallel to the shaft of the rotor, a stator element having a core, parallel to the magnets, and pole shoes adjacent the polar ends thereof so that in the course of rotation of the rotor element the individual magnets will cooperate with the core and pole shoes to complete alternating magnetic circuits in the stator, like poles at the respective ends of the rotor being magnetically connected but the groups of magnets having opposite polarities at the respective ends of the rotor being magnetically unconnected.

2. In a magneto, an induction rotor element having a plurality of individual magnets positioned about its periphery and arranged so that their polarities alternate, each magnet being parallel to the shaft of the rotor, means for magnetically connecting magnets having like polarities at the respective ends of the rotor, a stator element comprising a core and pole shoes, said core being disposed in parallel arrangement to the shaft of the rotor, and the respective pole shoes thereof adjacent in relationship to the polar ends of the individual magnets, the group of magnets having its positive poles at an end of the rotor being magnetically unconnected to the group having its negative poles at said end.

3. In a magneto, an induction rotor element having a plurality of individual magnets spaced about its periphery and arranged so that their polarities alternate, each magnet being parallel to the shaft of the rotor, a plurality of stator elements spaced about the rotor, each stator having an individual core and pole shoes, the cores being disposed in parallel arrangement to the shaft of the rotor and the pole shoes extending perpendicularly therefrom to a position adjacent the polar ends of the magnets, like poles at the respective ends of the rotor being magnetically connected but the groups of magnets having opposite polarities at the respective ends of the rotor being magnetically unconnected.

4. In a magneto, an induction rotor element having a plurality of individual magnets positioned about its periphery, each magnet being parallel to the shaft of the rotor, a plurality of stator elements having independent cores and pole shoes spaced about the rotor, the cores being parallel to the shaft of the rotor and the pole shoes extending perpendicularly therefrom to a position adjacent the polar ends of the magnets so that, in the course of rotation of the rotor element, the magnets will cooperate with each of the cores and pole shoes to simultaneously complete a magnetic circuit in each of the stators, each magnet being magnetically connected at its respective ends to all the other magnets having a corresponding arrangement of the poles along the rotor axis but being magnetically unconnected to those magnets which have a reverse arrangement of the poles along the rotor axis.

5. In a magneto, an induction rotor element having a plurality of individual magnets spaced about its periphery and arranged so that their polarities alternate, each magnet being parallel to the shaft of the rotor, a plurality of stator elements spaced about the rotor, each stator having an individual core and pole shoes, the cores being disposed in parallel arrangement to the shaft of the rotor and the pole shoes extending perpendicularly therefrom to a position adjacent the polar ends of the magnets so that in the course of rotation of the rotor element the individual magnets will cooperate with each of the cores and pole shoes to simultaneously complete alternating magnetic circuits in each of the stators, like poles at the respective ends of the rotor being magnetically connected but the groups of magnets having opposite polarities at the respective ends of the rotor being magnetically unconnected.

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