Oct. 27, 1942. K. A. HARMON 2,300,117

MAGNETO

Filed Oct. 31, 1941

Fig. 2.

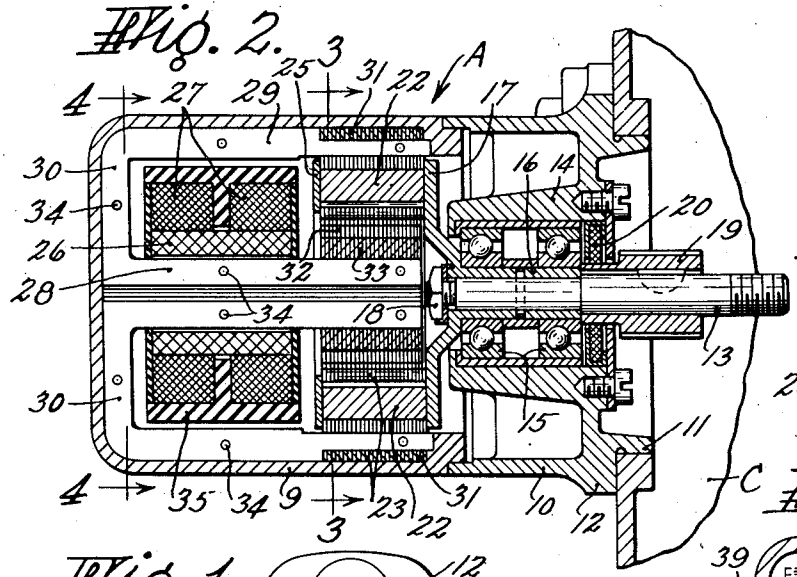


Fig. 6.

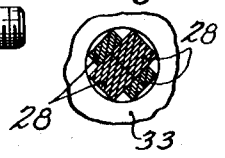


Fig. 5.

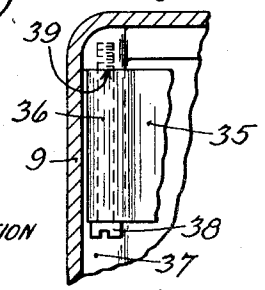


Fig. 1.

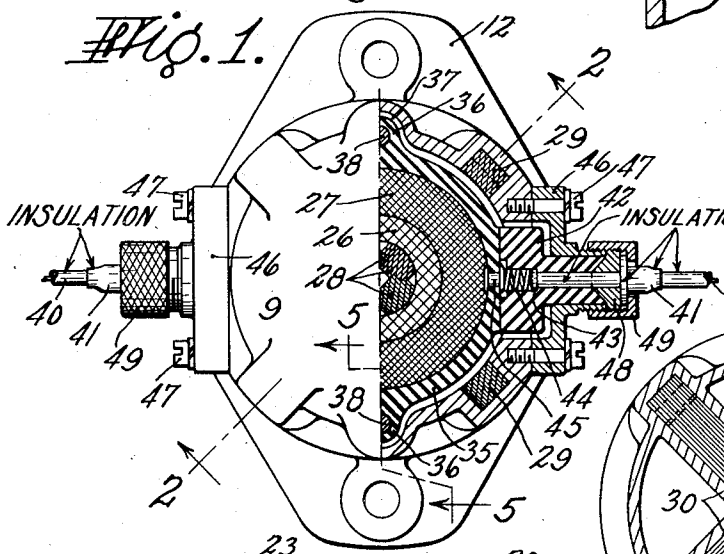


Fig. 4.

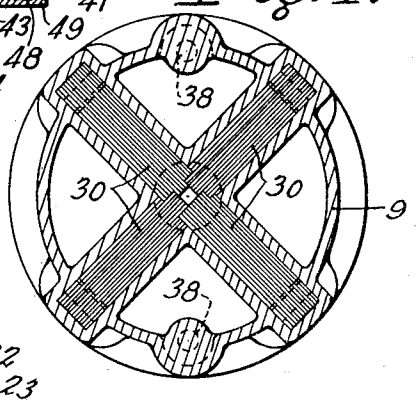
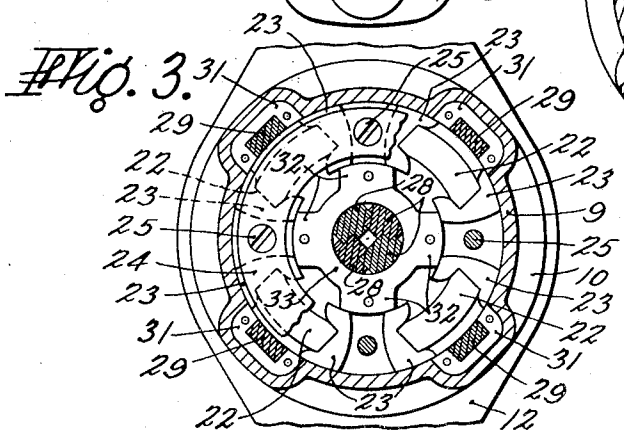


Fig. 3.



INVENTOR
KENNETH A. HARMON
BY Clapin & Neal
ATTORNEYS

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2,300,117

MAGNETO

Kenneth A. Harmon, Longmeadow, Mass., assignor to Wico Electric Company, West Springfield, Mass., a corporation of Massachusetts

Application October 31, 1941, Serial No. 417,237

7 Claims. (Cl. 171—209)

This invention relates to improvements in magnetos.

The invention is an improvement in the type of magneto shown in my U. S. Letters Patent No. 2,233,946, granted March 4, 1941.

This invention has for an object to provide in a magneto of the type having the coils located in coaxial relation with the drive shaft, an arrangement of the central core and rotor-driving-shaft in non-overlapping relation, whereby the coils for a given length and given number of turns and given size of wire may be reduced to the smallest possible diameter.

The reduction in coil diameter enables a reduction in the length of the wire in the coil and the resistance thereof. Also, the diameter of the magneto housing may be made smaller, which is especially important where, as in said patent, the magneto is to be mounted in place of the timer-distributor unit in an automobile. Savings in weight and in cost of materials are also effected by the improved arrangement of this invention.

More particularly, the invention has for an object the provision in a magneto having two cup-shaped sections mounted in opposed relation to form a substantially cylindrical casing closed at both ends, of a stator fixed in one said section and having a coil-bearing core extending from the closed end of the first section toward the second section and having a rotor-driving-shaft supported entirely from the closed end of the second casing and extending toward but terminating short of said core.

These and other objects will best be understood as the detailed description proceeds and will be pointed out in the appended claims.

The invention will be disclosed with reference to the accompanying drawing, in which:

Fig. 1 is a view, half in end elevation and half in cross section, of a magneto embodying the invention;

Fig. 2 is a sectional elevational view thereof taken on line 2—2 of Fig. 1;

Figs. 3 and 4 are cross sectional views taken on the lines 3—3 and 4—4, respectively, of Fig. 2;

Fig. 5 is a fragmentary sectional view taken on the line 5—5 of Fig. 1; and

Fig. 6 is a fragmentary cross sectional view showing a modification in the formation of the core.

Referring to this drawing: the magneto includes a suitable casing A, herein shown as of approximately cylindrical form with closed ends. The casing is made up of two sections 9 and 10, suitably held together. The section 10 is adapted for connection to the engine. In this particular case the section 10 is intended for connection to the crankcase C of the engine. Section 10 has a cylindrical pilot 11 to fit a hole in crankcase C and a flange 12 adapted to be bolted to the crankcase. The section 10 might equally well be mounted on the engine in the manner disclosed in the above named patent.

The section 10, however it may be mounted on the engine, serves to support the driving shaft 13 for the magnetic rotor of the magneto. This section has a central inwardly-extending hub 14 which is long enough to receive two axially-spaced bearings, such as the ball bearings 15, which support the hollow hub 16 of the face plate 17 of the magnetic rotor. The hub 16 is carried by the outer and smaller portion of shaft 13, being clamped against a shoulder on the shaft by a nut 18, threaded on the inner end of the shaft. The inner end of shaft 13 is adapted to be connected in any suitable way with an engine-driven shaft, located in crankcase C. As herein shown, a splined member 19 is keyed to the inner end of shaft 13 to receive a shaft coupling or a gear or other means for connection to the engine-driven-shaft and said end of the shaft is threaded to enable the coupling or gear to be clamped in place by a nut. Suitable sealing means 20 are provided to prevent entrance of lubricant into the magneto casing A.

The magnetic rotor (Fig. 3) consists of a plurality (four in this case) of permanent magnets 22 of short bar form with pole shoes 23, one for each polar extremity of each magnet. These magnets are set on edge as shown in Fig. 1 and the magnets with their shoes are arranged in a circular series on, and lie against one face of, the circular face plate 17, as shown in Fig. 3. The face plate is of any suitable non-magnetic material. A clamping ring 24, also of non-magnetic material, engages the magnets and shoes and acts to clamp them against plate 17 by means of a series of screws 25 which extend through the free space between each pair of magnets and thread into the face plate.

The stator of the magneto comprises a laminated iron structure rigidly mounted in the section 9 of casing A and primary and secondary coils 26 and 27, respectively, mounted coaxially with the magnetic rotor and its driving shaft 13. As shown, there are two secondary windings because this particular magneto is intended for use in a dual ignition system but this is not a necessary feature of the invention. The laminated iron structure comprises a plurality (four in this

case) of approximately U-shaped members, each having an inner leg 28, an outer leg 29 and a cross connecting portion 30, which interconnects one end of an outer leg to the corresponding end of an inner leg. The outer legs and the cross connecting portions are embedded in the peripheral wall and end wall, respectively, of the casing 9. This casing is of any suitable non-magnetic material. It may be a die casting or it may be formed of molded plastic. The laminated iron members are fixed in place during the casting or molding process, as the case may be. All the inner legs pass through the coils and combine to form one core which is located coaxially of shaft 13 and the magnetic rotor. These U-shaped members are arranged in a circular series (Fig. 3), with the outer legs circumferentially spaced one from another about the axis of the rotor by equal angular intervals. The number of these members may be varied as desired and the number shown is a convenient number for a magneto intended to serve an engine having eight, sixteen, or twenty-four cylinders.

The U-shaped members are provided with pole pieces on the ends remote from the cross bar portion 30. Each outer leg has a pole piece 31 of U-shape form which embraces the back face and both side faces of such leg and is suitably fixed thereto. These pieces are embedded in the peripheral wall of casing 9. The exposed front face of each pole piece 31 and the front face of the leg 29 to which it is secured are finished to provide a part-cylindrical concave face to cooperate with the finished part-cylindrical outer convex faces of the pole shoes 23. There are four pole pieces 32 formed on a single member 33 which is fixed to the core. These pole pieces 32 are also circumferentially spaced about the axis of the rotor by equal angular intervals but they are staggered with relation to the outer series of pole pieces 31 so that each pole piece 32 lies midway between a pair of adjacent pole pieces 31. The pole pieces 32 have finished, part-cylindrical, convex surfaces to cooperate with the finished, part-cylindrical concave surfaces of the pole shoes 23. All the surfaces of all the shoes and pole pieces are closely finished and lie in true coaxial relation one with another and the pairs of cooperating surfaces move in exceedingly close proximity to reduce air gaps to a minimum. The arrangement is such that when the outer surfaces of the pole shoes of north polarity are positioned to cooperate with the outer pole pieces 31, the inner surfaces of the pole shoes 23 of south polarity are positioned to cooperate with the pole shoes 32 of the inner series, and vice versa. Thus, flux from the magnets 22 will flow out through the outer legs 29, across the portions 30 and in through the inner legs 28, which combine to form a single core. As the rotor turns, the flow of flux will be reversed—the flux from the magnets passing out through the core, across the portions 30, and in through the legs 29. Thus, eight times during each revolution there will be breaks in the magnetic circuit accompanied by a reversal of flux and each such break and reversal of flux may be utilized to generate an E. M. F. for the ignition spark.

The laminations of each U-shaped member are held together in any suitable way, as by the rivets 34 indicated in Fig. 2, and the laminations of each pole piece are similarly held together. The four U-shaped members are assembled into a group with the inner legs interfitting in abutting relation, as indicated in Figs. 3 and 4 or as indicated in Fig. 6, and are held in such relation by brazing across the exposed edges of all of the laminations at the top and at the bottom of the core, thus rigidly tying together the laminations of the four inner legs into one unit and forming a solid or substantially solid core. The outer pole pieces are pressed on the outer legs of the U-shaped members. Then the unit, comprising the four U-shaped members with attached pole pieces 31 are inserted in the mold so as to become embedded in the molding or casting, as the case may be, which forms the casing 9. The inner pole piece member 33 is not applied until after the molding or casting process and then only after the composite core has been finished so as to closely fit the hole in the member 33.

As herein shown, the coils 26 and 27 are mounted in a casing 35 of insulating material. This casing has at diametrically opposite points two tongues 36 which fit into grooves 37 formed in casing 9. The casing is inserted from the open end thereof and held in place by two cap screws 38, indicated in Fig. 1. Fig. 5 shows one of these screws and how it holds the casing against a locating shoulder 39 on casing 9.

The high tension connection from each secondary coil is or may be made as shown in Fig. 1. The insulated high tension wire 40 fits tightly in a flanged sleeve 41 of rubber or the like and extends beyond this sleeve, part way through an insulator 42, where it terminates with a conducting terminal 43. In this insulator is a spring 44 which connects the terminal 43 to the high tension terminal 45 on the secondary coil 27. A member 46, held to casing 9 by cap screws 47, holds the insulator 42 against a side of casing 35. A gland 48 engages the outer face of the insulator and a cap 49 threaded onto the member 46 serves to draw the flange of sleeve 41 against the gland 48 and the latter against the insulator. There are two such high tension connections, one for each secondary coil but, of course, one only is necessary when a single secondary coil is used.

The details of the mounting of the coils and the details of the high tension connections described are not essential parts of the invention and may be varied as desired.

The electrical circuits of the magneto have not been illustrated because the invention does not depend for its novelty on such circuits. The usual breaker point mechanism to control the primary winding and the usual distributer may be provided to distribute the generated E. M. F. to the spark plugs of the engine in proper sequence. Examples of such mechanism and such distributer are found in my above-named prior patent. Such mechanism and such distributer are intended in this particular case to be driven from the engine at some other point than that from which the magneto is driven. For example, the usual timer and distributer unit of the engine would suffice to control the magneto. As a matter of fact, the invention is operative as an electrical generator of alternating currents without the use of any breaker point mechanism and distributer.

The magneto, herein illustrated, is suitable for the ignition of aircraft engines. Thus, if its shaft 13 is driven at half the crankshaft speed, its four sparks per crankshaft revolution will suffice for an eight cylinder engine, and if driven at crankshaft speed its eight sparks per revolution will suffice for a sixteen cylinder engine, and if driven at one and one-half crankshaft speed, will provide twelve sparks per revolution

of the crankshaft and thereby suffice for a twenty-four cylinder engine.

It will be clear that the non-overlapping arrangement of the drive shaft and core enables the core to be made of the least possible diameter for a given flux-carrying capacity. This, in turn, enables the coils to be made of smaller diameter and the same number of turns may be obtained with a materially less length, weight, and cost of wire and the resistance of the coil can be made less than in the magneto of said patent. Thus, the housing diameter may be decreased which is important where, as is usually the case, space limitations are a factor. The size and weight of the magneto can be kept down to minimum figures.

What I claim is:

1. In a dynamo electric machine, a coil having an axial opening therethrough, a plurality of U-shaped laminated flux-conducting members having inner and outer legs and radial portions interconnecting them at one end, said members disposed in angularly-spaced relation in a circular series around the axis of said coil, said inner legs abutting and forming a composite core which passes from one side of one end face of said coil through said opening substantially filling the same and which extends beyond the other end face of said coil by a substantial distance terminating with an end provided with pole piece means, said outer legs located outside but closely adjacent the periphery of said coil and terminating with ends substantially in the same plane as said end of the core and having pole piece means thereon, a magnetic rotor including a series of bar magnets mounted one after another in an endless series around its axis and having pole shoes for cooperation with both said pole piece means, the axis of the rotor and the axis of said core being aligned and said magnets being located entirely between two planes at right angles to said axes, one such plane passing through the second-named end face of said coil and the other passing substantially through said end of said core, and driving means for the rotor located entirely outside the space occupied by said magnets, coil and laminated members.

2. In a dynamo electric machine, a coil having an axial opening therethrough, a magnetic rotor having a series of bar magnets mounted one after another in an endless series around its axis and having pole shoes, the axis of said rotor and the axis of said coil being in alignment, a laminated core extending entirely through said opening and substantially filling the same, the perimeter of said core being substantially the minimum for a given cross sectional area and flux-carrying capacity, said core extending a substantial distance beyond one end face of said coil and terminating with an end having pole piece means thereon for cooperation with said pole shoes, the magnets of said rotor being located entirely between two planes located at right angles to the axis of the coil, one such plane passing through said end face of the coil and the other passing substantially through said end of said core, said core at its other end having a series of angularly-spaced radial extensions and said extensions having at their outer ends extensions which pass along outside but closely adjacent the periphery of said coil and outside but closely adjacent said magnets terminating with ends located substantially in the same plane as the first-named end of said core, pole piece means on said ends of the last-named extensions for cooperation with said pole shoes, and driving means for the rotor located entirely outside the space occupied by said coil, magnets, core and extensions.

3. In a dynamo electric machine, a coil having an axial opening therethrough, a plurality of U-shaped laminated flux-conducting members having inner and outer legs and radial portions interconnecting them at one end, said members disposed in angularly-spaced relation in a circular series around the axis of said coil, said inner legs abutting and forming a composite core which passes from one side of one end face of said coil through said opening substantially filling the same and which extends beyond the other end face of said coil by a substantial distance terminating with an end provided with pole piece means, said outer legs located outside but closely adjacent the periphery of said coil and terminating with ends substantially in the same plane as said end of the core and having pole piece means thereon, a housing having an end wall in which said radial extensions are fixed and a wall which encompasses the coil and in which the second-named extensions are fixed, a magnetic rotor including a series of bar magnets mounted one after another in an endless series around its axis and having pole shoes for cooperation with both said pole piece means, the axis of the rotor and the axis of said core being aligned and said magnets being located entirely between two planes at right angles to said axes, one such plane passing through the second-named end face of said coil and the other passing substantially through said end of said core, and driving means for the rotor located entirely outside the space occupied by said magnets, coil and laminated members.

4. In a dynamo electric machine, a coil having an axial opening therethrough, a magnetic rotor having a series of bar magnets mounted one after another in an endless series around its axis and having pole shoes, the axis of said rotor and the axis of said coil being in alignment, a laminated core extending entirely through said opening and substantially filling the same, the perimeter of said core being substantially the minimum for a given cross sectional area and flux-carrying capacity, said core extending a substantial distance beyond one end face of said coil and terminating with an end having pole piece means thereon for cooperation with said pole shoes, the magnets of said rotor being located entirely between two planes located at right angles to the axis of the coil, one such plane passing through said end face of the coil and the other passing substantially through said end of said core, said core at its other end having a series of angularly-spaced radial extensions and said extensions having at their outer ends extensions which pass along outside but closely adjacent the periphery of said coil and outside but closely adjacent said magnets terminating with ends located substantially in the same plane as the first-named end of said core, pole piece means on said ends of the last-named extensions for cooperation with said pole shoes, a housing having an end wall in which said radial extensions are fixed and a marginal wall which closely surrounds said coil and in which said outer legs are fixed, and driving means for the rotor located entirely outside the space occupied by said coil, magnets, core and extensions.

5. In a dynamo electric machine, a coil having an axial opening therethrough, a magnetic rotor having a series of bar magnets mounted

one after another in an endless series around its axis and having pole shoes, the axis of said rotor and the axis of said coil being in alignment, a laminated core extending entirely through said opening and substantially filling the same, the perimeter of said core being substantially the minimum for a given cross sectional area and flux-carrying capacity, said core extending a substantial distance beyond one end face of said coil and terminating with an end having pole piece means thereon for cooperation with said pole shoes, the magnets of said rotor being located entirely between two planes located at right angles to the axis of the coil, one such plane passing through said end face of the coil and the other passing substantially through said end of said core, said core at its other end having a series of angularly-spaced radial extensions and said extensions having at their outer ends extensions which pass along outside but closely adjacent the periphery of said coil and outside but closely adjacent said magnets terminating with ends located substantially in the same plane as the first-named end of said core, pole piece means on said ends of the last-named extensions for cooperation with said pole shoes, a housing having an end wall in which said radial extensions are fixed and a marginal wall which closely surrounds said coil and in which said outer legs are fixed, and driving means for the rotor located entirely outside the space occupied by said coil, magnets, core and extensions, said housing having a second end wall from which said rotor-driving means are supported.

6. In a dynamo electric machine, a coil, a plurality of substantially U-shaped flux-conducting members each made up of laminations and including inner and outer legs and a cross-connecting portion at one end of said legs all rigidly held together as one piece, said members disposed in angularly-spaced relation in a circular series around the axis of said coil with all the inner legs passing through the coil and all the outer legs located outside the coil, a housing for said coil and members having an end wall adjacent one end face of said coil and a marginal wall encompassing the coil, all said outer legs being fixed in said marginal wall and all said cross connecting portions being fixed in said end wall, said inner legs abutting and bound together into one unit to form a substantially solid core rigidly braced and supported by the outer legs and cross-connecting portions which are anchored in said marginal and end walls respectively, pole piece means carried by said outer legs, pole piece means carried by said core, a magnetic rotor having a plurality of bar magnets mounted one after another in an endless series extending around said axis in coaxial relation and cooperating with said pole piece means, and a driving shaft for said rotor supported entirely in the other end wall of said casing and in coaxial relation with said core and extending from the last-named end wall toward the adjacent end of said core but terminating short of the same.

7. In a dynamo electric machine, a coil, a plurality of substantially U-shaped flux-conducting members each made up of laminations and including inner and outer legs and a cross-connecting portion at one end of said legs all rigidly held together as one piece, said members disposed in angularly-spaced relation in a circular series around the axis of said coil with all the inner legs passing through the coil and all the outer legs located outside the coil, a housing for said coil and members having an end wall adjacent one end face of said coil and a marginal wall encompassing the coil, all said outer legs being fixed in said marginal wall and all said cross connecting portions being fixed in said end wall, said inner legs abutting and bound together into one unit to form a substantially solid core rigidly braced and supported by the outer legs and cross-connecting portions which are anchored in said marginal and end walls respectively, pole piece means carired by said outer legs, pole piece means carried by said core, a magnetic rotor having a plurality of bar magnets mounted one after another in an endless series extending around said axis in coaxial relation and cooperating with said pole piece means, said series of magnets telescoping part of said core and located in their entirety between the inner and outer legs of said laminated members, a non-magnetic member to which said magnets are fixed, and a driving shaft having one end fixed to said last-named member and extending toward and through the other end wall of said housing and supported entirely therefrom in coaxial relation with said core and coil.

KENNETH A. HARMON.