Sept. 16, 1947. R. E. PHELON 2,427,573

MAGNETO

Filed Oct. 12, 1943 2 Sheets-Sheet 1

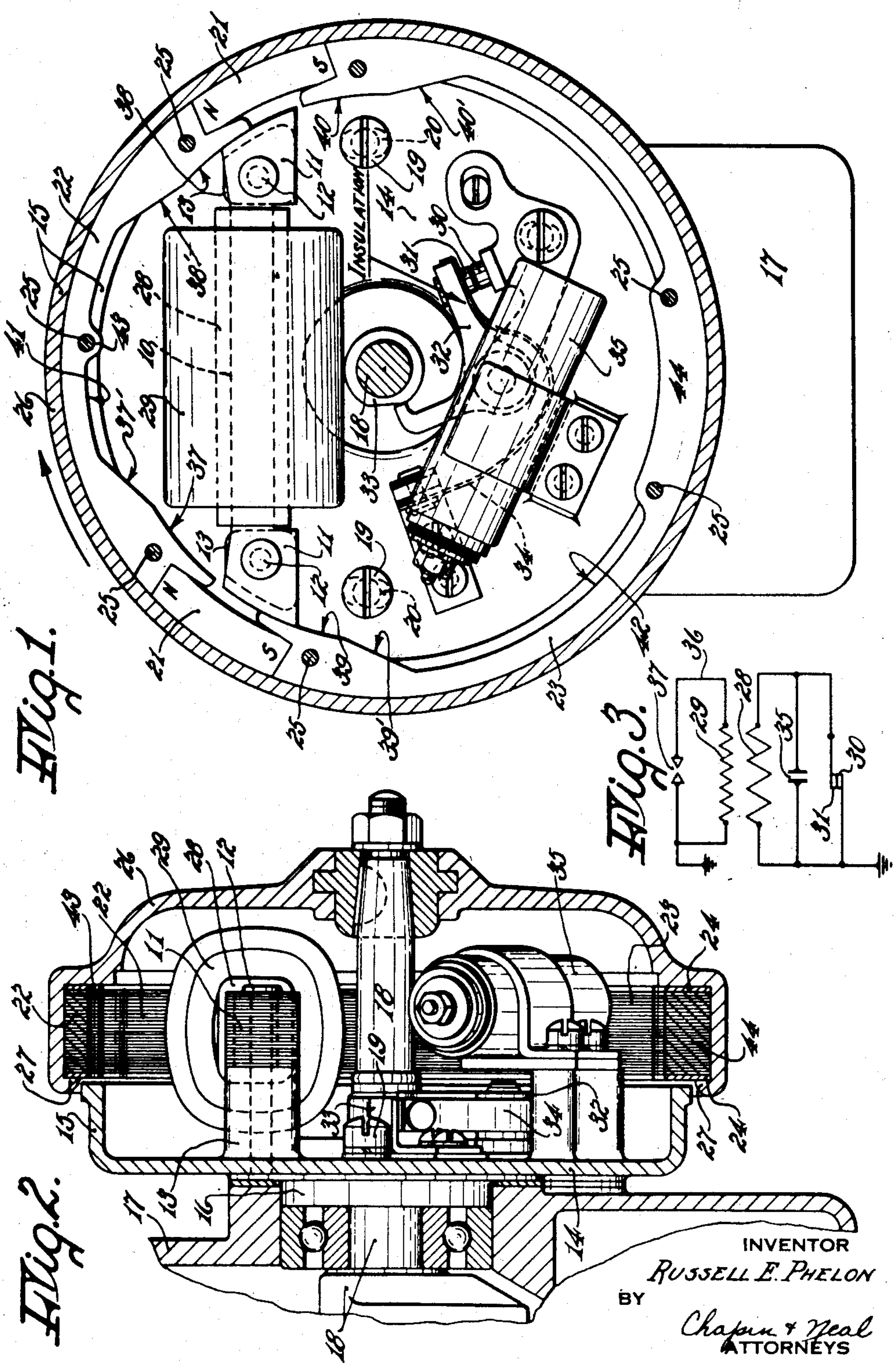

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Fig. 4.

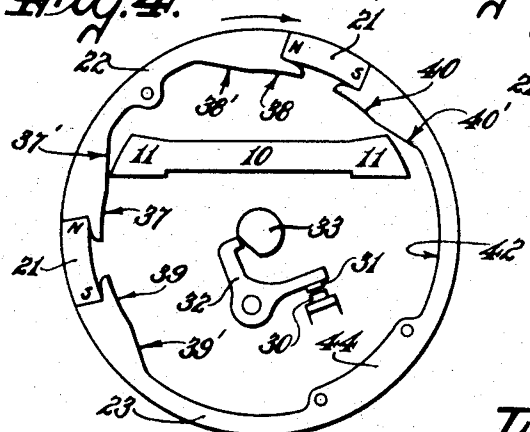


Fig. 5.

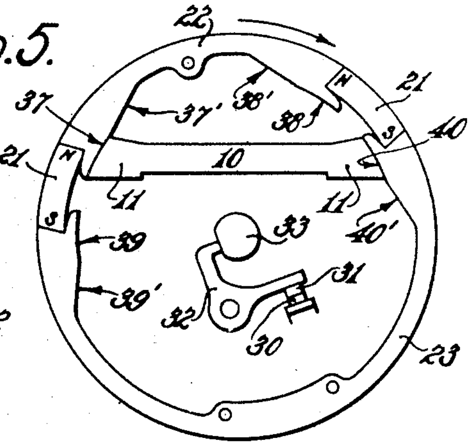


Fig. 6.

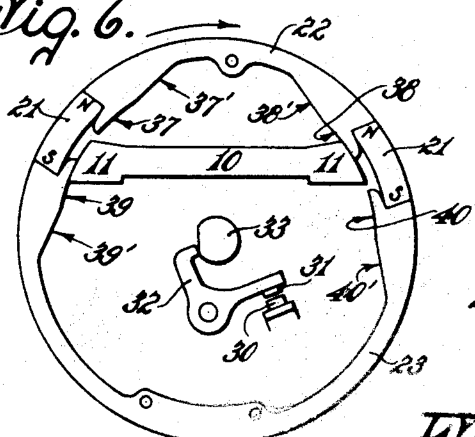


Fig. 7.

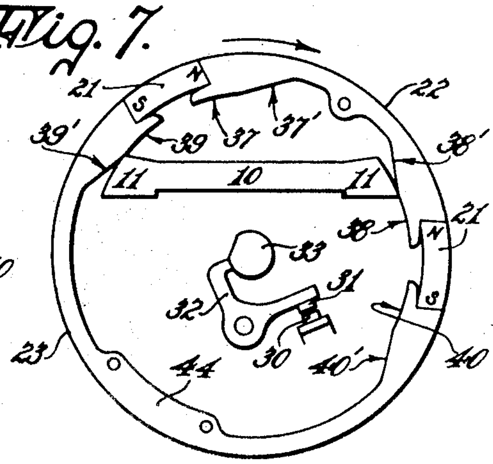


Fig. 8.

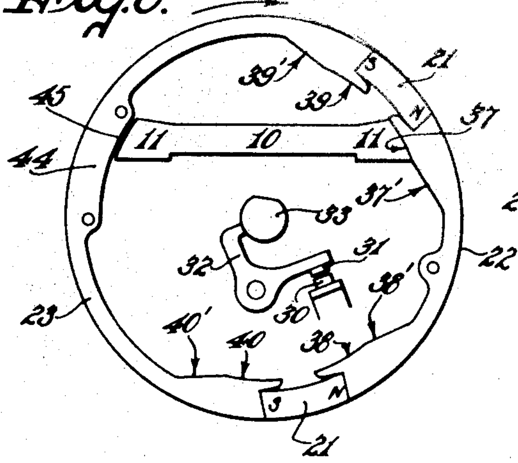
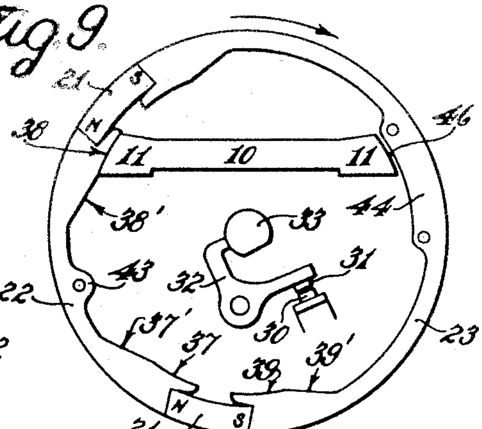


Fig. 9.



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UNITED STATES PATENT OFFICE

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MAGNETO

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3 Claims. (Cl. 171—209)

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This invention relates to improvements in magnetos.

The magneto of this invention is intended to be driven from an internal combustion engine at relatively high speed. A magneto construction, that may be satisfactory at relatively low engine speeds, may not be satisfactory at the relatively high speeds. For example, at high engine speeds, sparks may be produced at undesired times. A magnetic flux change which, at ordinary speeds, occurs so gradually as not to produce a spark, may at the higher speeds be so rapid as to cause the generation of a spark and this may occur independently of the operation of the breaker mechanism.

This invention has for one object the provision of means, whereby the building up of flux in the coil core of a magneto, or the collapse of flux therein, is effected so gradually as not to cause the generation of a spark, even at the highest engine speeds now used.

The invention also has for an object the provision of a magneto construction which may be made very small and of light weight and yet powerful and reliable in operation.

The invention also has for an object the provision of a construction suitable for a flywheel magneto, wherein the engine is so small that it may, for example, be carried on the belt of a soldier.

The invention has for another object the provision of a magneto, having a magnetic rotor with two magnets and a cooperating two pole stator, that will produce but a single spark during each revolution and cause the generation of such spark by means of a reversal of flux through the coil core of the magneto.

These and other 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 an enlarged sectional elevational view of a magneto embodying the invention;

Fig. 2 is an enlarged cross sectional view thereof;

Fig. 3 is a diagrammatical view of the electric circuits of the magneto; and

Figs. 4 to 9 are diagrammatical views of the elements of the magnetic circuit and of the breaker mechanism and its actuating means—such views showing the magnetic rotor and the breaker actuating means in several successive positions in their respective cycles of operation.

Referring to Fig. 1, the magneto includes a stator, comprising a substantially straight coil core 10, with integral pole pieces 11, one at each end thereof, the core and pole pieces being constructed of soft iron laminations in the usual or any suitable manner. This core is secured at its ends, as by rivets 12, to a pair of spaced lugs 13, formed on the back plate 14 of a substantially dish-shaped housing 15, made of any suitable non-magnetic material. Plate 14 has a hub 16 (Fig. 2) which is mounted in a wall 17 of the engine crank-case to turn about the axis of the engine crankshaft 18 and is suitably held in various positions of angular adjustment, as by two cap screws 19 (Fig. 1) passing through elongated arcuate slots 20 in plate 14 and threading into the wall 17 of the engine crankcase.

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The rotor of the magneto comprises a pair of relatively-short, permanent bar magnets 21. Like poles of these magnets are interconnected by laminated, soft-iron, arcuate members 22 and 23 which are relatively long but of unequal angular extent. These members 22 and 23 and the interposed magnets 21 form a complete annulus, which encompasses the stator and is located coaxially of the crankshaft. The annular assembly of members 21, 22 and 23 is held together between two annular non-magnetic rings 24 by a series of rivets 25. This assembly is suitably fixed in place in, and coaxially of, the engine flywheel 26, carried on the outer end of the crankshaft 18.

One desirable way of holding the aforesaid assembly to the flywheel is as follows. The flywheel is bored out to receive the annular assembly which is then pressed into the flywheel bore and held therein by a press fit or by shrinking. The outer edge of the flywheel rim is then spun over as shown at 27 in Fig. 2.

The two dish-shaped parts 15 and 26 are mounted in opposed relation and their rims terminate in closely adjacent relation, the whole affording a housing within which all parts of the magneto are enclosed.

The coil core 10 has wound thereon a primary coil 28, superposed on which is a secondary coil 29, having an opening large enough to permit the passage of one of the pole pieces 11. Mounted on plate 14 is the breaker mechanism, consisting of relatively fixed and movable breaker points 30 and 31 respectively. The point 30 is grounded to plate 14. The point 31 is carried by a breaker arm 32 of insulating material and this arm is actuated by a cam 33 on crankshaft 18. A spring 34 tends to hold the points 30 and 31 engaged and also serves as an electrical conductor for point 31. A condenser 35 is also mounted on plate 14.

The primary coil 28 is connected, as shown in Fig. 3, in an electrical circuit which is opened and closed as the breaker points 30 and 31, respectively, disengage and engage. The condenser 35 is bridged across the breaker points and one side of the primary circuit is grounded all in the usual manner. The secondary coil 29 is connected by a high tension wire 36 to the spark plug 37 of the engine, the other side of coil 29 and the plug being grounded in the usual manner.

Referring again to the magnetic rotor, it is provided with four pole shoes of equal angular extent. These shoes are designated 37, 38, 39 and 40, the first two shoes being formed on the laminated member 22 and the last two on the laminated member 23. The radius of each shoe is only slightly greater than that of the pole pieces 11 on the stator so that the shoes will successively move into close proximity with the stator pole pieces and magnetically connect therewith, as indicated for example in Figs. 5 and 6, being separated by air gaps equal to the running clearance between the parts. Intermediate the pole shoes the members 22 and 23 are of relatively narrow radial width with their inner arcuate walls such as 41 and 42 of much greater radius than the radius of pole pieces 11, whereby, when these narrow portions move past the stator pole pieces 11, no magnetic effect of any substantial amount occurs because of the large air gaps therebetween. Intermediate these narrow portions of the members 22 and 23 are other portions 43 and 44 respectively, which are of greater width but which are also sufficiently separated from the pole pieces 11, when passing the same to prevent any substantial passage of flux therebetween. The portion 44 has no functional effect magnetically and its purpose is simply to counterbalance the magnets 21. The sole purpose of the portion 43 is to receive one of the rivets 25. Each of the most narrow portions, is connected to its pole shoe portion by a ramp-like inclined portion. Each such inclined portion has been given the same reference numeral as its pole piece with the addition of a prime. These inclined portions are provided to insure a gradual building up and a gradual collapse of flux in the coil core 10, as a pole shoe approaches or leaves a stator pole piece 11, respectively. The common form of connection between a pole shoe and the narrow portion of its laminated member consists of a sharp radial shoulder. Such a connection causes a quick transition from a minimum air gap (constituted by the running clearance between a pole shoe and a pole piece) to a large air gap. These quick transitions, at the very high engine speeds, now proposed to be employed, are likely to produce flux changes which are sufficiently great to cause a spark to occur at an undesired time. The inclined portions are intended to eliminate this trouble.

The operation of the magneto will next be described. Referring first to Fig. 4, the rotor travelling in the direction of the arrow is moving into a position such that flux will be built up in core 10 in one direction, as from left to right for example. As the rotor shoes 40 and 37 approach the adjacent pole pieces 11 of the stator, there is a gradual, as distinguished from a sudden change, in the air gaps between the pole pieces and the inclined approaches 40′ and 37′. The air gaps gradually change from the maximum to the minimum and the building up of flux in the coil core is gradually effected, even though the rotor is travelling at very high speed. The rate of change can be controlled by the degree of slope of the inclined approaches. At the time that the flux is building up in the coil core, the breaker points are open as indicated.

As the rotor moves into the position shown in Fig. 5, the shoes 37 and 40 fully connect with the stator pole pieces and the flow in the aforesaid direction has been completely built up in core 10. The cam 33 is constructed and arranged to allow closing of the points just about as the motor moves into the illustrated position. The primary circuit is thus closed and the primary coil then acts by its choking effect with a tendency to restrain change of flux in the core.

When the rotor moves into the position shown in Fig. 6, its shoes 40 and 37 have moved out of engagement with the pole pieces 11 and substantial air gaps between the shoes and pole pieces have been created. Also, the pole shoes 38 and 39 have become connected with the pole pieces 11. The breaker points then open and a reversal of flux through the coil core is effected. The large flux change, thus occurring, induces in the secondary coil 29 an electromotive force of sufficient magnitude to create the desired spark.

Fig. 7 shows the rotor as it is about to be disconnected from the pole shoes 38 and 39 after leaving its spark-producing position. The flux flow from right to left through the coil core 10 has become nearly completely broken and this has been effected gradually because of the inclined portions 38′ and 39′. Thus, a gradual collapse of flux in the core 10 is effected and such that no spark will be created even at high engine speeds and with the breakers open.

The breakers remain open until the rotor again moves into the position shown in Fig. 5 when they close as and for the purpose above described.

Figs. 8 and 9 show two other positions of the rotor wherein one pole piece 11 of the coil core is connected to one pole shoe of the rotor while the part 44 of the rotor lies opposite the other pole piece of the core. No substantial flow of flux through the core 10 will be effected in either of these positions because of the air gap 45 in the case of Fig. 8 and the air gap 46 in the case of Fig. 9. Each such air gap is large enough to prevent any substantial flow of flux across it and thus prevents the making of any effective magnetic circuit when the member 44 passes a pole shoe.

The invention thus affords an arrangement of the relatively movable magnetic elements of a magneto which may be operated at very high speeds without causing the production of undesired sparks at undesired times even if the breaker points are open. The arrangement, because of the location of the stator pole pieces and the unequal angular extent of the rotor members 22 and 23 is such that flux will be built up in core 10 and then reversed only once during each revolution of the rotor. The second spark which would occur if the members 22 and 23 were of equal angular extent and if the stator was diametrically located, is definitely and positively avoided.

The arrangement of the ramp-like inclined portions adjacent the pole shoes is capable of general application and may be used to advantage in other types of magnetos differing specifically from the one herein disclosed. Such last-named arrangement provides for the gradual building up and for the gradual collapse, if desired, of flux in the coil core as the rotor pole shoes respectively approach and withdraw from the pole pieces of the stator.

The magneto construction disclosed is such that it may be incorporated in the very small flywheels now used on some of the very small internal combustion engines. The magneto is shown in Figs. 1 and 2 greater than actual size. In the particular embodiment illustrated the flywheel is only four inches in external diameter. The magneto is thus very small and compact and yet, because of the use of magnets of very high coercive force, it provides for the powerful spark needed.

The arrangement of the cooperating rotor and stator elements is of particular importance where only a small amount of space is available to house these elements. The rotor is annular in form and may be housed within the rim of a small flywheel. The stator may thus be located within and encompassed by the rotor as may also the breaker mechanism and related parts. The rotor utilizes two, and only two, short bar magnets of high coercive force. These magnets are preferably spaced as shown (120° apart), whereby a single weight, such as the portion **44**, will suffice to balance the rotor and the flywheel. This spacing of the magnets allows the use of a straight core which extends as a chord across the circle formed by the annular rotor with the ends of the core forming pole pieces to cooperate with the pole shoes of the rotor. One piece laminations only need be used to make up the stator. There are no separable end pieces to enable the coils to be put in place on the core. Moreover, the ends of the core do not need to be offset laterally from the core to secure the proper spacing for cooperation with the pole shoes of the rotor. The location of the chord-like core is such that there is just room between the shaft and the inner periphery of the rotor to accommodate the necessary primary and secondary windings, as will be clear from an inspection of Fig. 1. The parts are thus packed together into small compass, such for example as to fit within the space available in a flywheel of the exceedingly small dimensions above mentioned. The magneto, although very small, is nevertheless powerful and capable of producing adequate sparks for the ignition of internal combustion engines.

What I claim is:

1. In a magneto, a stator, and a rotor substantially annular in form and encompassing the stator, said rotor comprising two permanent magnets which are very short in angular extent and two arcuate members of magnetic material interconnecting like poles of the magnets, both said members being substantially greater in angular extent than either magnet and one member being substantially greater in angular extent than the other, each member having two arcuate pole shoes one at each end thereof and an intermediate portion which is radially spaced from the axis of the rotor by a greater amount than its shoes, said stator having two pole pieces so spaced angularly that once during each revolution of the rotor they will connect one with one pole shoe of one polarity on one member and the other with the remote pole shoe of opposite polarity on the other member and then shortly after such connection has been broken they will connect with the other two pole shoes to reverse the flow of flux in the stator.

2. In a magneto, a stator, and a rotor substantially annular in form and encompassing the stator, said rotor comprising two permanent magnets which are equal and very short in angular extent and two arcuate members of magnetic material interconnecting like poles of the magnets, both said members being substantially greater in angular extent than either magnet and one member being substantially greater in angular extent than the other, each member having two arcuate pole shoes one at each end thereof and an intermediate portion which is radially spaced from the axis of the rotor by a greater amount than its shoes, all said shoes being of equal angular extent, said stator having two pole pieces of equal angular extent and each substantially equal in angular extent to one of said shoes, said pole pieces being so spaced angularly that once during each revolution of the rotor they will connect one with one pole shoe of one polarity on one member and the other with the remote pole shoe of opposite polarity on the other member and then shortly after such connection has been broken they will connect with the other two pole shoes to reverse the flow of flux in the stator.

3. In a magneto, a stator, and a rotor substantially annular in form and encompassing the stator, said rotor comprising two permanent magnets which are very short in angular extent and two arcuate members of magnetic material interconnecting like poles of the magnets, both said members being substantially greater in angular extent than either magnet and one member being substantially greater in angular extent than the other, each member having two arcuate pole shoes one at each end thereof and an intermediate portion which is radially spaced from the axis of the rotor by a greater amount than its shoes, each magnet being partially overlapped by its two pole shoes, whereby the shoes are separated to an angular extent less than that of the magnet, said stator having two pole pieces so spaced angularly that once during each revolution of the rotor they will connect one with one pole shoe of one polarity on one member and the other with the remote pole shoe of opposite polarity on the other member and then shortly after such connection has been broken they will connect with the other two pole shoes to reverse the flow of flux in the stator.

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