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MAGNETO BREAKER POINT ASSEMBLY

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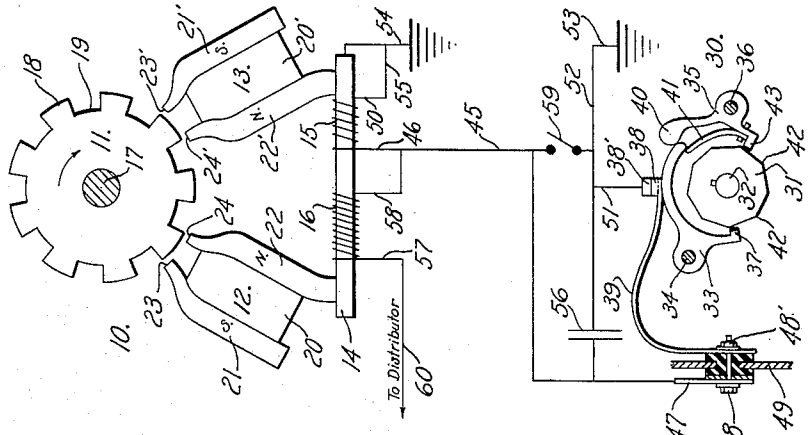


FIG. 3

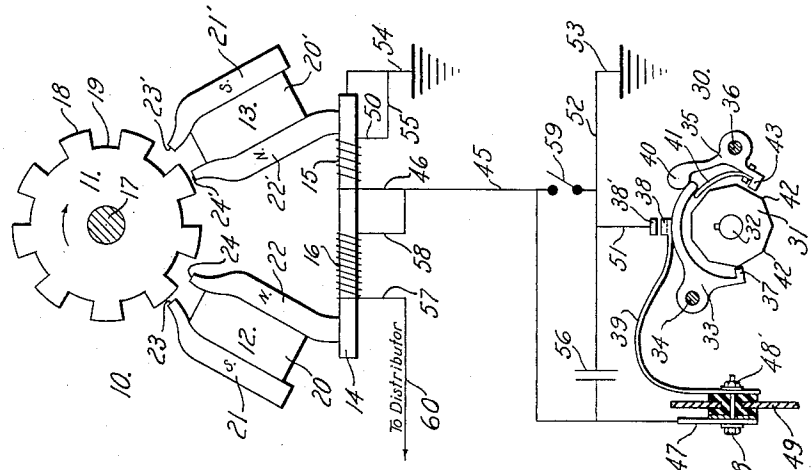


FIG. 2

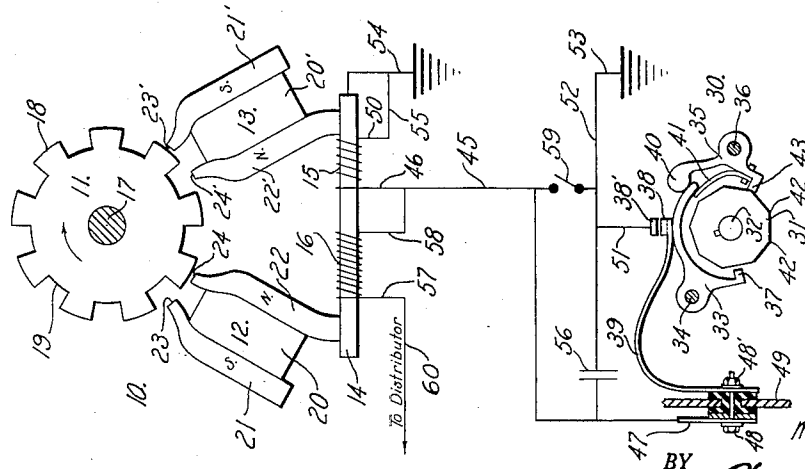


FIG. 1

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MAGNETO BREAKER POINT ASSEMBLY

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This invention relates generally to improvements in magnetos and ignition systems for internal combustion engines and particularly to improvements in the magnetos and ignition systems for use in conjunction with aircraft engines and proposes modifications of the cam operated breaker point assembly and associated electrical circuits to improve the overall operating characteristics of the system and prolong the life of the component parts.

Ignition systems usually comprise a suitable low voltage source of power together with a means for interrupting that source to produce a series of electric pulses. By suitable electrical equipment responsive to these low voltage pulses, a similar series of high voltage pulses are produced for igniting the combustible gases within the engine cylinders. These systems, however, are unsatisfactory because the points of the interrupter or breaker point assemblmy pit and erode with the result that the material of one point is deposited on its companion point producing a teat and the parts otherwise mechanically deteriorate. To overcome these difficulties, this invention proposes an improved electric circuit for producing low voltage pulses wherein the unidirectional transfer of metallic particles between the contacts is converted to a bidirectional transfer with the resultant prevention of deterioration of the contacts. This improved circuit therefore not only lengthens the life of the contacts, but also improves the operating efficiency of the entire ignition system since the meeting surfaces of the contacts are maintained essentially in their original condition for a much longer period of time.

The instant invention also contemplates a composite actuating arm for opening and closing the breaker points, which by reason of its composite construction is not subject to the normal deterioration experienced with conventional unitary actuating arms. It is apparent therefore that these mechanical and electrical modifications result in a substantially higher engine operating efficiency as well as a reduction of general maintenance problems.

With the above and other objects in view, as will be apparent, this invention consists in the construction, combination and arrangement of parts, all as hereinafter more fully described, claimed and illustrated in the accompanying drawings wherein:

Fig. 1 is a schematic wiring diagram of the circuit employed by this invention illustrating a magneto and the breaker point assembly associated therewith;

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Fig. 2 is a similar view illustrating the position of the magneto armature for the generation of a voltage having a polarity opposite to that generated by the armature positioned as in Fig. 1; and

Fig. 3 is also a view like Fig. 1 and illustrates the magneto and the breaker point assembly at the zero voltage or polarity transition point, this being the position the parts occupy between the positions shown in Figs. 1 and 2.

The improved ignition system is particularly applicable to aircraft engines although it is apparent that it would be of general application and use. This system consists of an alternating current magneto having a dual winding permanent magnetic field interconnected with an improved cam operated breaker point assembly so that the breaker points when closed shunt one of the magneto windings. The breaker points are periodically actuated by rotation of the cam in synchronism with the alternations of the magneto current so that they will open when the current through them attains an approximate maximum value. The opening of the contacts causes the current in the winding to die away suddenly and, by reason of transformer action between the shunted winding and the remaining winding, a high voltage pulse is induced into that other winding. Suitable connections between the high voltage winding and the distributor then conduct these high voltage pulses to the spark plugs of the engine to ignite the combustible gases in the cylinders thereof.

Referring to the drawings, 10 denotes the magneto for the generation of the low voltage pulses which comprises a rotor or armature 11 and a field having two magnetic cells 12 and 13 connected by a bar or strip of magnetic material 14. On the bar 14 are two windings, a low voltage winding 15 connected with the breaker point assembly 30 and a high voltage winding 16 in which the high voltage ignition pulses are induced as will be hereinafter described. The rotor 11 is fastened to and rotates with a shaft 17.

In the illustrated form of the invention, the rotor 11 is provided with nine pole faces 18 spaced uniformly about the periphery thereof and separated by slots or grooves 19 having an angular width equivalent to that of the pole faces 18. The magnetic cell 12 consists of a permanent magnet 20 having pole pieces 21 and 22 which in turn are provided with pole faces 23 and 24 respectively. The pole faces 23 and 24, shaped to conform with the curvature of the pole faces 18 of the armature 10 are positioned in close proximity thereto and spaced one from the other

so that one of them is centrally aligned with a pole face 18 when the other is aligned with an adjacent slot 19. Being in all respects similar to the cell 12 the corresponding parts of the magnetic cell 13 have been designated by the reference characters 20', 21', 22', 23' and 24'. This cell 13, however, is preferably positioned with its pole pieces reversed to those of the cell 12 and in addition is angularly spaced therefrom so that one of the armature pole faces 18 is in line with the north pole face 24 of the cell 12 when another armature pole face 18 is in alignment with the south pole face 23' of the cell 13. Since the airgap, between the pole faces of the cells 12 and 13 and the armature 11, is small, and since unlike magnetic poles are always presented to the rotor or armature simultaneously, the magnetic flux or lines of force will pass from the north pole of one cell through the rotor 11 to the south pole of the other cell, and as the rotor 11 is turned, the direction of the flux therethrough will be successively alternated. The magnetic circuit between the two cells is completed through the bar 14, which connects like magnetic poles of each cell 12 and 13. As shown, the north pole pieces 22 and 22' of each cell are magnetically joined, although a similar result would be accomplished if the south poles 21 and 21' were similarly joined.

Surrounding the bar 14 are two windings 15 and 16 in which voltages are generated by the successive alternations of the magnetic flux produced by the rotation of the rotor 11. In effect, the operation of the magneto 10 can be compared to an alternating current transformer, the flux alternations in the latter being produced by a separate winding energized by an alternating current whereas the alternations in the former are produced mechanically through rotation of the armature or rotor 11.

The breaker point and cam assembly 30, arranged to cooperate with the magneto 10, has a nonagonal cam 31 keyed to and rotatable with the shaft 32. The breaker arm is of a composite construction having an arcuate primary lever 33 mounted on a fixed pivot 34 and a secondary lever 35 mounted on a second fixed pivot 36. The primary lever 33 is provided with a shoe 37 adapted to ride on the periphery of the cam 31 and respond to its apices or lobes 42 as the cam is rotated. Fastened adjacent to the opposite end of the lever 33 is a movable contact 38 electrically insulated therefrom and adapted to cooperate with the stationary contact 38'. A spring conductor 39 having one end fastened to the movable contact 38 and the other to an insulated screw 48, in the circuit breaker housing 49, constitutes part of the electrical circuit for the contacts as well as the means by which a constant counterclockwise force is exerted on the lever 33. On the opposite side of cam 31 is the secondary lever 35, which has a shoe 43 at one end for slidably engaging the periphery of cam 31 in the same manner as shoe 37 of the primary lever 33. The remaining end of the secondary lever 35 is provided with an enlarged cylindrical section 40 extending beyond and over the adjoining end of the primary lever 33, and is forcibly held in slidable contact therewith by a leaf spring 41 attached to the lever 35 and pressing under the extremity of the primary lever 33.

From the foregoing it is evident that as the cam 31 is rotated one of the apices or lobes 42 of the cam 31 will contact one of the shoes 37

or 43 while a flat surface or side of the cam is presented to the other shoe. In Fig. 1, the shoe 43 of the secondary lever 35 has been actuated by one of the apices 42 of the cam 31 to cause the lever 35 to rotate in a counter-clockwise direction. Since the cylindrical section 40 of the lever 35 is held in constant contact with the terminal of the primary lever 33, the counter-clockwise rotation of the lever 35 is transmitted to lever 33 moving it clockwise to open contacts 38 and 38'. Fig. 2 shows the position of the levers 33 and 35 when the cam is rotated 1/18 of a revolution, the primary lever 33 being rotated clockwise by the action of its shoe 37 on the cam 31 to again open the contacts 38 and 38', the secondary lever 35 merely following the action of lever 33. Fig. 3 shows an intermediate position (i. e. the position attained by the parts during rotation of the cam between the positions illustrated in Figs. 1 and 2) of the cam 31 where both shoes ride on the cam and the contacts 38 and 38' are closed.

The electrical circuit connecting the magneto 10 with the breaker assembly 30, both previously described, consists primarily of shunting connections between the low voltage magneto winding 15 and the breaker points 38—38', the winding 16 being connected to the ignition distributor (not shown), and responsive to pulses induced therein as hereinafter described.

More particularly, the shunting or primary circuit consists of the winding 15 connected in parallel with the contacts 38 and 38'. One side of this parallel circuit is through lead 45 connecting terminal 46 of the winding 15 with the lug 47, lug 47, and insulated screw 48 and nut 48' securing both the lug 47 and spring 39 which is electrically connected to contact 38, as previously described. The remaining side of the circuit connects contact 38' with terminal 50 of winding 15 and consists of leads 51 and 52, grounds 53 and 54, and lead 55. Associated with the primary shunting circuit are a condenser 56, and an "On-Off" switch 59, both of which are connected between leads 45 and 52.

The secondary or output circuit of the magneto includes winding 16, which provides the high voltage for operation of the sparkplugs of an internal combustion engine through a usual distributing system (not shown). Specifically lead 60 connects the terminal 57 of the winding 16 with an ignition distributor, and the ground return circuit from the sparkplugs is accomplished in the conventional manner through the body of the engine proper (not shown) to the ground 54, then through lead 55, terminals 50 and 46 of winding 15, to terminal 58 of winding 16.

In operation the magneto rotor shaft 17 and the shaft 32 of cam 31 are both rotated at the same angular speed, causing the contacts 38—38' to be opened a total number of 18 times during each revolution of the cam and since the flux in the magnetic circuit of the magneto 10 is also reversed 18 times during each revolution of the rotor 11 the contacts will therefore open once during each such reversal of the flux. With the switch 59 in "Open" or "On" position the contacts 38 and 38' alternately open and close the shunting or primary circuit and cause successive high voltage pulses of opposite polarity to be induced in the secondary winding. More specifically, as the rotor 11 and cam 31 are rotated in unison, successive pairs of pole faces 18 will be presented in turn to the stator pole faces 24—23' and 23—24' of the magnetic cells 12 and 13. For

example, in Fig. 1 a magnetic circuit is completed from the north pole N of cell 12 through a pole face 18 of the rotor 11, the rotor 11, another pole face 18 of the said rotor, the south pole S of cell 13, the magnet 20', a section of the north pole N of the cell 13 and through the bar 14 to the north pole piece 22 of the cell 12. As the pole faces 18 approach the positions shown in Fig. 1, the flux is built up to a maximum value and a voltage is generated in the windings 15 and 16 and since the contacts 38—38' are closed during this approach they short-circuit the winding 15 to produce a relatively large current flow through that winding. When the primary current attains an approximate maximum value, the contacts 38 and 38' are opened by the cam 31 causing the current in winding 15 to die away suddenly. By reason of the transformer or inductive action between windings 15 and 16, a high voltage will be generated in winding 16 which will be transmitted to the distributor through lead 60 and the ground return connection 54. As the rotor 11 leaves the position shown in Fig. 1 and passes through the position shown in Fig. 3, the contacts 38 and 38' are closed and the flux through bar 14 reaches a zero value. The rotor, however, continues to rotate and upon passing through the position shown in Fig. 2 the flux will be built up in bar 14 in a direction opposite to that heretofore described in connection with Fig. 1. This reversal of flux will produce a current of opposite direction through the contacts 38 and 38' whereupon the contacts are opened by the cam 31 and a voltage pulse of opposite polarity is thereby induced in winding 16. As the rotor 11 and cam 31 continue to rotate, successive pulses of opposite polarity will be induced in the winding 15 by reason of the sinusoidal flux variations through the bar 14.

Since the breaker point assembly employs a composite arm to actuate the contacts 38 and 38' in synchronism with alternating currents generated by the magneto, the contacts will successively break currents of opposite polarity and prevent a unidirectional current flow between the contacts and the transfer of metallic particles from one of the contacts to the other. In addition, the particular construction of the composite breaker arm assembly materially reduces wear on any individual component thereof, lengthening the operating life of the entire assembly and reducing overall ignition maintenance problems.

What is claimed is:

1. A breaker point assembly comprising a cam, two interrelated levers each having a shoe for cooperation with said cam, a pair of contacts in operable association with and under the control of either of said levers, and means for rotating said cam to cause said levers to alternately effect the operation of said contacts.

2. A cam operated breaker point assembly for controlling an electric circuit comprising a movable and a stationary contact to open and close the said circuit, a cam having a plurality of lobes thereon, two mechanically interrelated levers each having a shoe for cooperation with the cam, one of the said levers carrying the movable contact aforesaid, and means for rotating the said cam whereby each of said levers alternately effects the opening and closing of said contacts.

3. An apparatus for making and breaking an electric circuit comprising two operably associated contacts for opening and closing the said circuit, a cam having a multiplicity of lobes thereon, a primary lever carrying one of the aforesaid contacts and having a shoe for cooperation with the cam, a secondary lever mechanically connected with the primary lever also having a shoe for cooperation with the said cam, and means for rotating the said cam whereby each of said levers alternately effects the opening and closing of said contacts.

4. An apparatus for making and breaking an electric circuit comprising a cam, a pair of medially pivoted levers each having a shoe on one end thereof for cooperation with the cam, means of mechanical interengagement between other ends of said levers, a contact secured to one of the said levers, a stationary contact for cooperation with the first said contact, electrical connections between the circuit and the contacts, and means for rotating the said cam whereby the said levers alternately actuate the contacts to make and break the circuit aforesaid.

5. A breaker point assembly comprising a pair of relatively movable contacts, a multiple lobe cam, coacting levers disposed at the periphery of said cam each having a shoe for successive and periodic cooperation with the lobes of the cam, a connection between said levers whereby the movement of one by the cooperation between its shoe and a cam lobe causes the movement of the other lever, and a connection between one of said contacts and one of said levers.

6. A breaker point assembly for opening and closing a pair of relatively movable contacts comprising a multiple lobe cam, a pair of levers associated with the periphery of said cam, shoes on the corresponding ends of said levers for independent and successive cooperation with the lobes of the cam, said shoes being so relatively positioned that when one shoe engages the apex of one lobe the other shoe is located over the space between adjacent lobes, means whereby the movement of one lever under the influence of a lobe of the cam causes the movement of the other lever, and a connection by which the movement of either lever causes a relative movement of the contacts.

7. A breaker point assembly comprising a multiple lobe cam, a primary and a secondary lever positioned about the periphery of the cam with an arm of the secondary lever partially overlying an arm of the primary lever, a shoe on the free end of each lever coacting with the cam, a spring for maintaining the overlying arms of said levers in slidable contact, a pair of contact points controlled by the primary lever, and means for rotating the cam whereby the lobes thereof alternately contact the shoes to open and close the contact points.

8. A breaker point assembly comprising a rotatable cam having a plurality of lobes thereon, a pair of intermediately pivoted levers positioned on opposite sides of the said cam with the adjoining ends overlapping, a spring associated with said overlapping ends to hold them in constant slidable contact, shoes on the other ends of said levers for cooperation with the said cam, a contact point on one of said levers, a stationary contact point positioned in operable association with the first said contact, and means for rotating the said cam to alternately actuate said levers to open and close said contact points.

9. A breaker point assembly for the ignition system of an internal combustion engine comprising a rotatable cam having a plurality of lobes on its periphery, a pair of intermediately pivoted levers positioned on opposite sides of said cam

with an arm of one lever overlapping an arm of the other lever, a spring associated with said overlapping ends to maintain them in slidable contact, shoes on the free ends of said levers, a second spring mechanically connected to one of the levers to slidably engage both shoes with the periphery of the cam, a breaker point on one of said levers, a stationary breaker point in operable association with the first mentioned breaker point, and means for rotating the said cam whereby the levers alternately open and close the breaker points.

10. A breaker point assembly comprising a rotatable cam having a plurality of lobes on the periphery thereof, a pair of intermediately pivoted levers positioned on opposite sides of said cam with an end of one lever overlapping an end of the other, a spring associated with said overlapping ends to maintain them in slidable contact, shoes on the other ends of said levers, a second spring mechanically coupled to one of the levers to cause both shoes to coact with the periphery of the cam, a breaker point on the second spring aforesaid, a stationary breaker point positioned in operable association with the first mentioned breaker point, and means for rotating the said cam whereby the alternate operation of said levers open and close the breaker points.

11. A breaker point assembly for the ignition system of an internal combustion engine comprising a rotatable cam having a plurality of lobes about its periphery, a pair of intermediately pivoted levers positioned on opposite sides of said cam with an end of one lever overlapping an end of the other lever, a spring associated with said overlapping ends of the levers to maintain them constantly overlapping, a shoe on the remaining end of each lever, a principal spring mechanically connected to one of the levers to control the engaging cooperation of both shoes with the periphery of the cam, a breaker point movable by one of said levers, a stationary breaker point mounted in operable association with the movable breaker point, means for rotating the said cam thereby causing the alternate operation of the levers to open and close the breaker points at a frequency equivalent to twice the number of lobes on the said cam, and electrical connections between the breaker points and the ignition system.

12. The combination with an alternating current magneto including an armature and a permanent magnet multiple winding stator, of a mechanically operated breaker point assembly comprising a rotatable cam having a plurality of lobes on its periphery, a pair of intermediately pivoted levers positioned on opposite sides of the cam with adjoining ends thereof overlapping, means associated with said ends of the levers to maintain them in overlapping relationship, shoes on the other ends of said levers, a spring cooperating with one of the levers to position said shoes for successive and alternate coaction with the lobes of the cam, a movable breaker point mounted on one lever, a stationary breaker point located for cooperation with the movable breaker point, electrical connections between the breaker points and one of the windings of the stator aforesaid, and means for rotating the cam in synchronism with said magneto armature whereby the said levers open and close the breaker points during each reversal of the generated current, said successive openings of the breaker points producing pulses of opposite polarity in the other magneto winding.

13. In an apparatus for producing electrical pulses of alternating polarity the combination with an alternating current generator having an armature and a permanent magnet dual wound stator, of a mechanically operated breaker point assembly comprising a rotatable cam having a plurality of lobes on its periphery, two medially pivoted levers positioned on opposite sides of the cam with adjacent ends overlapping, a spring associated with said overlapping lever ends to maintain them in slidable contact, shoes on the levers for successively cooperating with the lobes of the cam, spring means acting on one of the levers to direct the shoes toward the lobes of the cam, a movable breaker point carried by the lever coacting with said spring means, a stationary breaker point located for operation with the first point, parallel shunting connections between the breaker points and one of the stator windings aforesaid, and means for rotating the armature and cam whereby the said levers alternately open and close the breaker points during successive reversals of current produced by rotation of the armature, said successive openings producing electrical pulses of alternating polarity in the other of said stator windings.

14. A breaker point assembly comprising a pair of contacts, one fixed against movement and the other movable relative thereto, means tending to maintain engagement between said contacts, a cam, a pair of levers cooperating with said cam and so associated with the aforesaid means that the operation of either of said levers may cause the disengagement of said contacts, and means for rotating said cam to alternately operate said levers.

15. A breaker point assembly comprising a pair of contacts, one fixed against movement and the other movable relative thereto, supporting means for the movable contact normally operating to maintain engagement between said contacts, a multiple-lobe cam, a pair of levers disposed on opposed sides of said cam to be independently actuated by the lobes thereof, said levers being connected one to the other and to said supporting means, and each lever being adapted to disengage said contacts by operating the movable contact against the normal action of said supporting means, and means for rotating the cam to alternately operate the levers.

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