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IGNITION SYSTEM FOR INTERNAL COMBUSTION ENGINES

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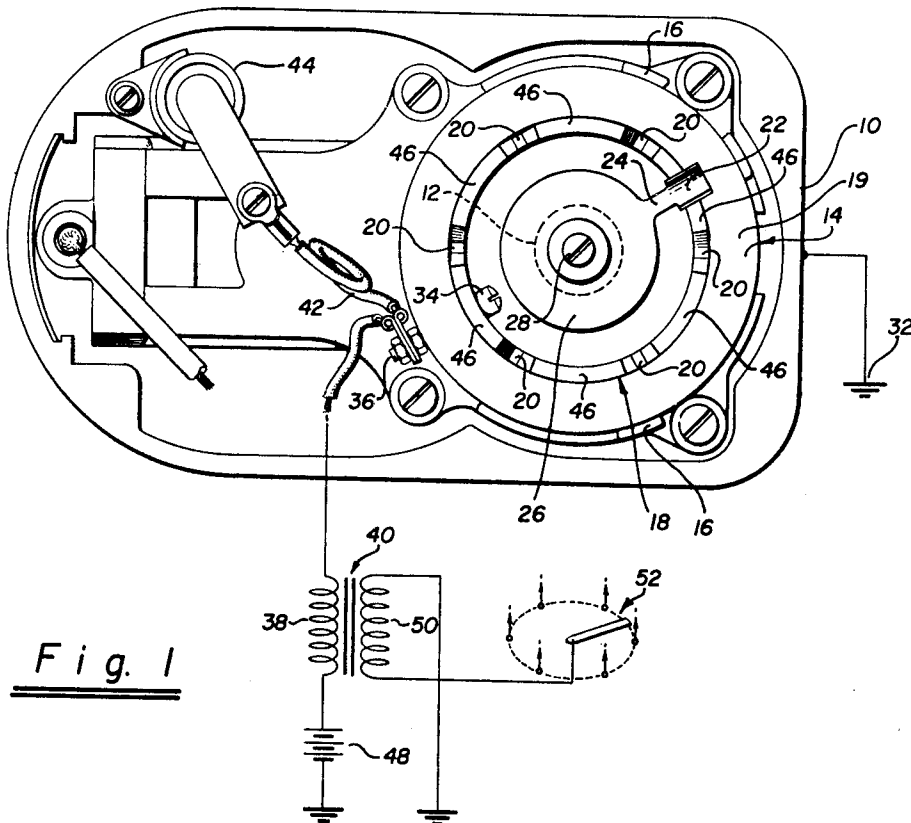


Fig. 1

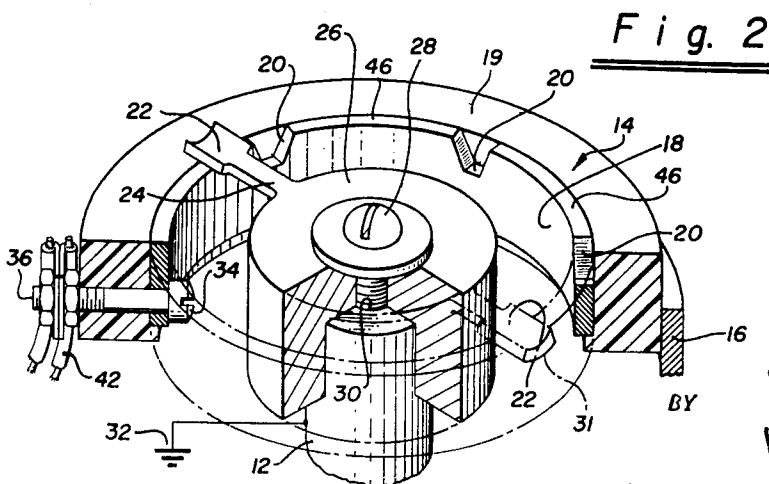


Fig. 2

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IGNITION SYSTEM FOR INTERNAL COMBUSTION ENGINES

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Original application July 25, 1958, Ser. No. 750,962, now Patent No. 2,905,775, dated Sept. 22, 1959. Divided and this application Apr. 28, 1959, Ser. No. 809,423

2 Claims. (Cl. 200—24)

The present invention relates to the ignition system for the cylinders of internal combustion engines, such as are used in automobiles, airplanes, motor boats, power stations and the like, to produce high voltage surges of electric currents which are sequentially applied to the spark plugs of these cylinders to cause ignition of the explosive mixture contained therein. More particularly the present invention relates to the devices, employed in such systems, for producing the required current surges at the proper intervals.

Devices of this kind comprise usually a step-up transformer which has a primary and a secondary winding, and to said primary winding is applied a low voltage current from a suitable source of electric power, such as a battery or a magneto. This current is periodically interrupted at predetermined intervals to produce in the secondary winding accurately timed current surges of a higher voltage that are delivered in the proper order to the cylinders of the motor or engine by a suitable current distributing means which operates in timed relation with the engine shaft. To alternately interrupt and re-establish the current flow through the primary winding in properly timed relation with the operation of the engine shaft, it has been customary in the past to interpose a normally closed switch in the circuit of the primary winding, and said switch was opened and closed in quick succession to "break and make" the circuit, by rotary camming means mounted upon an auxiliary shaft that was driven from the engine shaft in timed relation therewith.

Ignition systems of this type have many serious disadvantages and defects. Due to the low voltage character of the supply current the "make and break" switches require very accurate adjustment of their cam-actuated contact points to assure proper operation. The useful life time of these points is limited because they become burnt and pitted by the sparks developed as they open and close. As a result, they must frequently be readjusted and/or replaced to maintain satisfactory performance of the engine, and both, adjustment and replacement of these points, require expert attendance. It has therefore been proposed more recently, to replace the cam-operated "make and break" switches by a rotary switch arrangement comprising a stationary conductive brush in engagement with the peripheral edge of a rotary switch body which is mounted upon and turns with the auxiliary shaft that served formerly to turn the control cam of the "make and break" switches, and the peripheral edge of said switch body is formed alternately by conductive and non-conductive areas with the former arranged to close the power circuit of the primary winding and the latter arranged to interrupt said power circuit whenever they come into contact with the stationary brush. Systems of this type do not have the problem of accurate adjustment of cam-actuated contact points. They are inherently more rugged and hence more dependable in operation and less in need for supervision and servicing by expert personnel than the systems employing cam-operated "make and break" switches. They have a much smaller problem of

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wear and have therefore a much longer period of useful life.

It is an object of my invention to provide an improved ignition arrangement of the latter type.

5 Another object of my invention is to provide an ignition arrangement, of the type referred to, that is of simple and rugged construction.

Still another object of my invention is to provide a rotary switch arrangement, for an ignition system, of the type referred to, that may readily be installed in conventional ignition systems in place of the cam-operated contact point switches.

An additional object of my invention is to provide an ignition arrangement, of the type referred to, that has no adjustment problem and no problem of wear, and which will give peak performance over practically unlimited periods of time.

These and other objects of the present invention will be apparent from the following description of the accompanying drawing which illustrates a preferred embodiment thereof and wherein

Figure 1 is a fragmentary plan view of a distributor, for an automobile engine, wherein my invention is incorporated; and

25 Figure 2 is a fragmentary perspective, partly in section, of some of the components of the device illustrated in Figure 1.

Having first reference to Figures 1 and 2, the reference numeral 10 indicates the outer case or housing of a distributor mechanism, such as is employed in automobiles, from which the dust cover has been removed. Rotatably supported in said housing is the distributor shaft 12 which is driven from the engine shaft in timed relation thereto, in any suitable manner, such as by means of a belt and pulley train (not shown). Ordinarily the distributor shaft carries firmly secured to its upper end a six- or eight-peaked cam structure depending upon the number of cylinders which the distributor serves, for opening with each revolution of the distributor shaft the conventional "make and break" switch six or eight times, as the case may be. In the embodiment of the invention illustrated in Figures 1 and 2, which represents a conversion of a conventional distributor in accordance with the present invention, both, the cam structure and the switch mechanism ordinarily associated therewith, have been removed and arranged coaxially around the upper end of said shaft is an annular member 14 of an insulating material, such as Bakelite, which is rigidly supported from the internal frame structure 16 of the distributor in any suitable manner. Said annular member 14 is of a substantially larger internal diameter than the diameter of the distributor shaft, and rigidly secured to the inner face of said annular member is a ring member 18 of a hard, electrically conductive material, such as nickel steel. Provided in the upper edge of said ring member at points spaced equal angular distances apart are notches or recesses 20, and urged into electrically conductive contact with the upper edge of said ring member is the head 22 of a resilient arm 24 that projects radially from a centrally located cap 26. Said cap covers the end face of the distributor shaft 12 and is suitably secured to said shaft in conductive contact and for rotation therewith, such as by means of a headed screw 28 that passes through a central aperture in said cap and engages a threaded bore 30 which has been tapped into the shaft. The contact head 22 of arm 24 has the form of a short cross bar whose end edges are curved upwardly so that it presents a convex area 31 to the edge of the ring member 18, as shown in phantom lines in Figure 2. The arrangement is preferably such that the top surface 19 of the annular support member is flush with the top edge of the ring member and the contact head 22 is sufficiently

long to bear partially against the top surface of the annular support member, so that it is supported by said annular member as it passes over the notches in the ring member during operation of the device.

In the particular embodiment of the invention illustrated in Figures 1 and 2, there are six notches or recesses 20 in the ring member 18 indicating that the device of the invention is to serve an engine having six cylinders. It will be understood that the number of notches may be less or more, depending on the number of cylinders in the engine, to which the device of the invention is to be applied. The distributor shaft 12 is grounded through the housing 10 in which it is rotatably mounted, as indicated at 32 in Figure 1, and a conductive lead member in the form of a screw bolt 45 passes from the inner face of the ring member 18 through said member and through the annular support member 14 to the outer face thereof whereat it forms a terminal 36. To said terminal is connected the low voltage end of the primary winding 38 of the induction transformer 40, as diagrammatically indicated in Figure 1, and said terminal 36 may also be connected by a lead 42 to the grounded condenser 44.

In operation, when the distributor shaft 12 rotates, the head 22 of arm 24 glides along the upper edge of the ring member 18 and the top surface of the annular support member 14. When the head is in conductive contact with the ring member 18 by contact with the segments 46 of its upper edge immediately of the notches 20, a circuit is established from the source of electric power 48, through the primary winding of transformer 40, the lead member 34, the ring member 18, the contact arm 24, cap 26 and the shaft 12 to ground 32. But whenever the head 22 passes over a notch 20, it remains supported by the annular member 14, but loses briefly conductive contact with the ring member 18, so that the above described circuit is momentarily interrupted. As a result thereof the primary winding 38 of transformer 40 induces a high voltage current surge of opposite polarity into the secondary winding 50, which is delivered to the distributor diagrammatically represented by the ellipse 52 in Figure 1, and said distributor directs the current impulses in a well known manner to the proper spark plug in the cylinders of the engine (not shown); and as the contact head 22 passes over the notch 20 and re-establishes contact with the consecutive edge 46 of the ring member, it re-establishes the initial current flow in the primary winding, which is effective upon interruption by the succeeding notch 20 in ring member 18 to deliver another current impulse of high voltage from the secondary winding 50 to the distributor 52.

The described attachment for converting the ignition system of an internal combustion engine in such a manner as to render the conventional cam-operated "make and break" switch with its numerous drawbacks and disadvantages dispensable, is of extremely simple and inexpensive construction, and is easy to install in ignition systems of conventional design. It is highly effective and dependable in operation and will perform for very long periods of use without break-downs and without need for adjustment or replacement of its component parts. There is no harmful wear because the head 22 is of a sturdy construction and the ring member may be made of a very hard metal, such as nickel steel. On the other hand, the sliding engagement of the contact head with the upper edge of the ring member has a polishing effect which prevents the formation of deposits that may interfere with the proper operation of the device. Also, I have found that when the notches 20 in the upper edge of the ring member 18 are left open, as illustrated in Figure 2, i.e., are not filled with an insulating material, their edges are not damaged by the electric sparks that form as the contact head 22 passes over them. This is especially true of the edges, of said notches, that are first encountered by the orbiting head 22, i.e. the edges whereat said head loses

contact with the ring member. These edges show frequently appreciable damage by searing when said notches are filled out with an insulating material. Furthermore, due to the concave contact surface 31 of the head 22, the effective contact area between said head and the upper edge of the ring member 18 may be made very small, and as a result thereof the notches 20 may be made of a relatively small angular width, without endangering their effectiveness in breaking the primary circuit. Hence, many notches may be provided in a ring member of given size. Alternatively, the contact segments 46 of the ring member 18 may be made long in relation to the angular width of the notches 20 at the contact level, thus providing a relatively long period of time for a current build-up in the primary circuit followed by a sudden and brief interruption of said circuit, which is effective to induce an accurately timed current surge of maximum voltage into the secondary winding 50 for delivery in properly timed relation to the spark plugs of the engine cylinders.

This is division of my co-pending U.S. patent application Serial No. 750,962, filed July 25, 1958 now Patent No. 2,905,775 issued September 22, 1959 for an Ignition System for Internal Combustion Engines.

While I have explained my invention with the aid of a preferred embodiment thereof, it will be understood that the invention is not limited to the specific constructional details shown and described, which may be departed from without departing from the scope and spirit of the invention.

I claim:

1. In the power supply of an ignition system for the cylinders of internal combustion engines, a switch arrangement for interrupting the flow of electric power through the primary winding of the induction transformer in synchronism with the operation of the engine shaft, said arrangement comprising a casing, an auxiliary shaft rotatably mounted in said casing and driven from the engine shaft in timed relation thereto, an annular member of insulating material supported from said casing coaxially around said auxiliary shaft, said annular member having an annular guide edge, a ring member of electrically conductive material arranged coaxially within and supported from said annular member, said ring member having an upper annular contact edge flush with the guide edge of said annular member and containing a plurality of angularly equi-spaced recesses, and an arm supported from and in electrically conductive contact with said auxiliary shaft with its free end in slidable contact with the guide edge of said annular member and the contact edge of said ring member.

2. A rotary switch comprising a casing, a shaft rotatably mounted in said casing, an annular member of insulating material supported from said casing coaxially around said shaft, said annular member having an annular guide edge, a ring member of electrically conductive material arranged coaxially within and supported from said annular member, said ring member having an upper annular contact edge flush with the guide edge of said annular member and containing a plurality of angularly equi-spaced recesses, and an arm supported from said shaft and having at its free end a convex surface in slidable contact with the guide edge of said annular member and the contact edge of said ring member.

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