

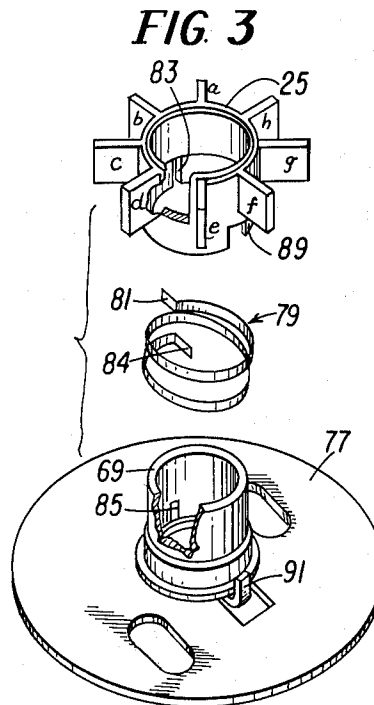
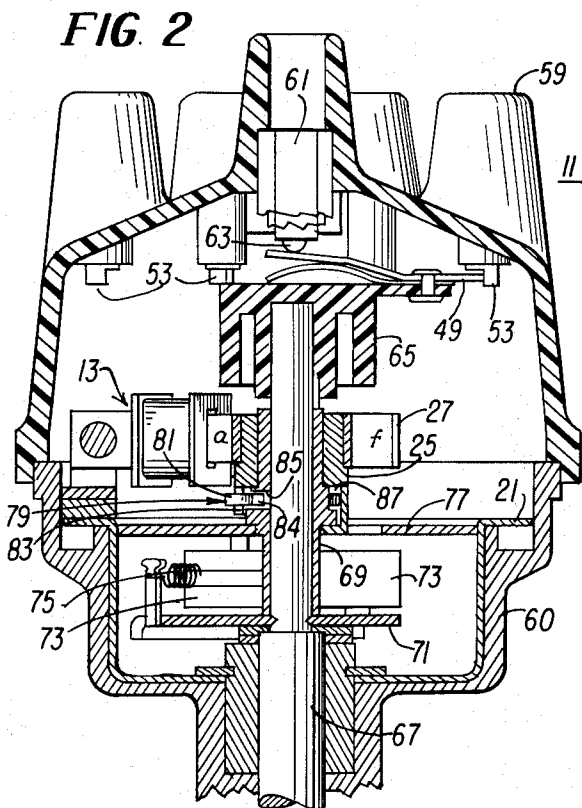
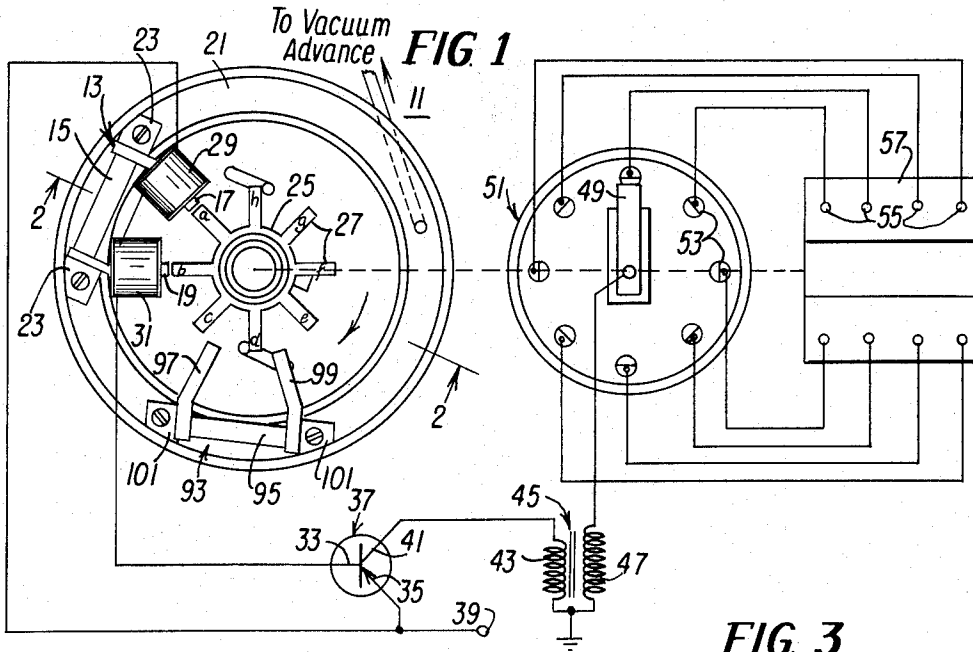
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3,233,128

DISTRIBUTOR

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1

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2 Claims. (Cl. 310-70)

This invention relates to magnetic pulse generators and more particularly to an improved magnetic pulse generator for use in an ignition system for an internal combustion engine which maintains pulses of a given magnitude at relatively low engine speeds.

Magnetic pulse generators usually incorporate some type of magnet together with a rotor and stator forming a magnetic circuit. The rotor has portions thereon which cause variations in the flux through the magnetic circuit. By placing a winding around the magnetic circuit, voltage pulses may be induced according to the changing flux in the magnetic circuit. The voltage generated depends upon the speed at which the flux through the winding is changed. Pulsers used with variable speed engines, such as automobile engines, are driven by the engine over a wide range of speeds and must operate satisfactorily at all speeds. At slow speeds the angular velocity of the rotor will be low, and the flux change is relatively slower, resulting in reduced voltage output. Of course, the rotor could be driven at an increased angular velocity to produce higher voltage pulses but the frequency of the pulses would also be increased and in certain applications, this may be undesirable. Further this might result in excessive angular velocity at high engine speeds.

In ignition systems for internal combustion engines, a pulse generator of the above type which triggers one or more switching transistors may be used in place of conventional breaker points for interrupting the current to the high voltage ignition coil. If the voltage output of the pulse generator is insufficient, amplifying stages with high voltage transistors or an extra transformer may be needed to provide the necessary voltage step-up. This can add cost and undesirable complication to the system. Also, the timing of the spark may be thrown off because of the increased pulse frequency.

Accordingly, it is an object of this invention to provide an improved magnetic pulse generator having a substantially higher output voltage at relatively low speed operation.

Another object of the invention is to provide a structure for increasing the speed of the rotor of a magnetic pulse generator without affecting the frequency of the pulses produced.

A further object of this invention is to provide a transistor ignition system for an internal combustion engine having a magnetic pulse generator providing increased voltage output, at low speeds, which is used with a minimum number of amplifying stages to provide the ignition voltage.

A feature of the invention is the provision, in a pulse generator, of means intermittently retarding the rotor to store energy in a resilient coupling and then permit the resilient coupling to apply its energy to increase the angular velocity of the rotor during a limited period of its revolution.

Another feature of the invention is the provision, in a pulse generator, of a spring driven rotor and of a magnet retarding the rotor against the spring until the magnetic attraction is overcome, whereby the angular velocity of the rotor is increased by action of the spring during a limited period of its revolution.

Still another feature of the invention is the provision of a distributor assembly for an internal combustion engine incorporating a magnetic pulser with a stator and a

2

rotor having a portion thereon alignable with the stator during each revolution, with a coilable spring loading the rotor to the forward position of a limited angular movement with respect to the driving mechanism, and a magnet to retard the rotor to permit the spring to store energy and then drive the portion of the rotor past the stator at an angular velocity exceeding that of the driving mechanism during a limited period of its revolution.

In the drawing:

FIG. 1 is a schematic diagram of an ignition system for an internal combustion engine with a structural representation of the lower portion of a distributor assembly incorporating the invention, and a schematic representation of the upper portion of the distributor assembly.

FIG. 2 is a half sectional view, taken along the line 2-2 of FIG. 1, of the distributor assembly with the top portion in place; and

FIG. 3 is an exploded view of several components of the distributor assembly of FIG. 2.

In accordance with the invention, a magnetic pulse generator for an ignition system is provided including a rotor adapted to be driven by an engine and a stator including a permanent magnet, which together form a magnetic circuit. A pick-up winding is placed about a portion of the magnetic circuit, and the rotor contains a plurality of extensions thereon which successively align themselves with pole pieces on the stator to vary the flux through the magnetic circuit and induce voltage pulses in the pick-up winding. A drive shaft drives the rotor through a coupling assembly which includes stop means permitting limited angular movement of the rotor with respect to the coupling assembly. The coupling assembly further includes a coilable spring having an end secured to the rotor for supplying the driving connection. A second magnetic circuit has pole pieces disposed proximate extensions on the rotor for exerting a retarding force on the rotor to wind up the spring. When the rotor is driven far enough to overcome the force of the retarding magnet, the energy stored in the spring drives the rotor so that the extensions thereon move past the pole pieces of the stator at an angular velocity greater than that of the drive shaft, to thereby increase the rate of flux change in the pulser magnetic circuit, and the magnitude of the voltage pulses generated in the pick-up winding.

Referring now to FIG. 1, a pulse generator constructed in accordance with the invention is shown incorporated in an ignition system for an internal combustion engine. The pulse generator is shown incorporated as a part of a distributor assembly 11. A stator structure 13 includes a permanent magnet 15 with a pair of pole pieces 17 and 19 connected thereto. Stator structure 13 is secured to the vacuum advance plate 21 of distributor 11 by means of brackets 23 extending from pole pieces 17 and 19, and may be advanced by a conventional vacuum advance mechanism to advance the timing of the spark. A rotor 25, having a plurality of extensions 27 thereon, is mounted so that the extensions 27 (denoted a through h) successively align themselves in pairs with pole pieces 17 and 19. It will be noted that as rotor 25 rotates, and extensions 27 successively pass by the pole pieces 17 and 19, the flux through the magnetic circuit formed by the stator and the rotor will change, and its rate of change will vary between maximum and minimum values.

A pair of pick-up windings 29 and 31 are wound about the magnetic circuit on pole pieces 17 and 19 respectively. Windings 29 and 31 are connected in series between the base 33 and emitter 35 of transistor 37. Voltage is applied to the emitter 35 from D.C. potential supply 39, and collector 41 is connected to the D.C. supply by the switching action of transistor 37. The collector applies pulses to the primary winding 43 of high voltage ignition

coil 45. As the flux through the magnetic circuit is varied by rotor 25, a voltage will be produced in windings 29 and 31. This voltage will include pulses of alternate positive and negative peaks during the moment of the most rapid change of the flux in the magnetic circuit. When the voltage pulse drives the base 33 negative with respect to emitter 35 transistor 37 will conduct and current will flow through the primary winding 43 of high voltage ignition coil 45. When the next pulse drives the base positive with respect to the emitter, transistor 37 is rapidly switched off collapsing the field in primary winding 43 to generate a high voltage spike in the secondary winding 47. This high voltage spike is applied to the moving contact 49 in distributor 51, and then to the proper one of contacts 53 which are connected to the spark plugs 55 on internal combustion engine 57.

Referring now to FIG. 2, the distributor assembly 11 is shown having a molded cover 59 with contacts 53 extending downwardly therefrom. Cover 59 fits over the lower housing 60 of distributor assembly 11 to enclose the various components of the assembly. Connection is made from the secondary winding 47 of high voltage transformer 45 through the center connector 61 of cover 59 to the center post 63 of the distributor 51. Electrical connection from center post 63 is then made to the rotor arm 49 and from there to the contacts 53. Contact 49 is mounted on an insulating cap 65 secured to the end of distributor shaft 67.

Distributor shaft 67 extends through the bottom of lower housing 60 of distributor assembly 11 and a sleeve 69 is mounted concentrically therewith. A centrifugal advance plate 71 is driven directly from shaft 67 and contains a pair of fly-weights 73 pivotally mounted thereon and biased inwardly by springs 75. Centrifugal advance mechanisms are well known in the art and this particular advance mechanism may be of a well known type. Shaft 67 drives advance plate 77 through the centrifugal advance mechanism, and the relative position of advance plate 77 with respect to drive shaft 67 is controlled by the fly-weights 73, as is well known in the art.

Rotor 25 is mounted on sleeve 69 secured to advance plate 77, and is driven by sleeve 69 through a coillable spring 79 which is wound about sleeve 69. One end 81 of spring 79 is anchored in a slot 83 in rotor 25. The other end 84 of spring 79 is anchored in slot 85 in sleeve 69. The spring 79, when wound about sleeve 69, is contained in a recess 87 formed between rotor 25 and sleeve 69. The remainder of the components of the distributor assembly, such as teeth 27 and stator assembly 13, may be seen in FIG. 2.

Referring now also to FIG. 3, the construction of the rotor and sleeve assembly may be more clearly seen. In addition to slot 83, an opening 89, which is substantially wider than slot 83, is formed on the opposite side of rotor 25. An extension 91, which has a width less than that of slot 83, is formed out of advance plate 77, being turned upwardly to be parallel with the axis of sleeve 69. When rotor 25 is positioned on sleeve 69, extension 91 extends within slot 89 and accordingly, the relative movement between sleeve 69 and rotor 25 is limited according to the freedom of extension 91 in slot 89.

The direction of rotation of shaft 67 is according to the arrow of FIG. 1. Spring 79 is so tensioned as to bias rotor 25 to its forward limit of rotation with respect to sleeve 69, as limited by extension 91 in slot 89. That is, in normal condition extension 91 will engage the right hand edge of slot 89 as viewed in FIG. 3. Thus any movement of rotor 25 with respect to sleeve 69 will serve to store energy in spring 79.

Returning now to FIG. 1, a magnet assembly 93, including a permanent magnet 95 and pole pieces 97 and 99, is mounted by brackets 101 to vacuum advance plate 21. Accordingly, the same relative position between assembly 93 and the pulser stator structure 13 is maintained. It will be seen that as the teeth 27 of rotor 25 pass by the

pole pieces 97 and 99, the rotor 25 will be retarded by the force of the magnetic attraction until the edge of slot 89 engages extension 91. This will store energy in spring 79. Rotor 25 will then be driven by the positive engagement of extension 91 an angular amount sufficient to overcome the force of attraction of magnet 95. Spring 79 will then expend its energy and cause teeth 27 to pass pole pieces 17 and 19 at a rate of speed which is greater than the angular velocity of shaft 67. This takes place when teeth 27 approach pole pieces 17 and 19 so that the rate of change in the flux is increased. The rate of change of flux through coils 29 and 31 is therefore greater, inducing a higher voltage pulse therein. Once rotor 25 is returned by spring 79 to its forward limit of rotation with respect to sleeve 69, it once again moves at the angular velocity of shaft 67 until the effect of magnet 95 influences the next successive pair of teeth 27.

Ideally, the second magnet 95 should align itself with a pair of teeth 27 approximately 10° prior to alignment of a pair of teeth 27 with poles 17 and 19. Accordingly, in a 6-cylinder engine the critical angle would be 70° , whereas in an 8-cylinder engine, the critical angle would be 55° . The 10° spacing may not be critical in all applications and variations according to the particular needs of the system may be desirable. In addition, the distance between the teeth 27 and the pole pieces 97 and 99 in passing may also affect the amount of retardation placed upon rotor 25. Magnet assembly 93 need not have two pole pieces, for any type of arrangement for retarding rotor 25 at the proper time is well within the teaching of the invention. It is conceivable that a single magnet could be used for both the stator and the retarding magnet, with pole pieces placed slightly out of phase with teeth 27 to both retard the rotor and vary the flux.

At low speeds of angular rotation of shaft 67, insufficient voltage may be generated because teeth 27 are not passing pole pieces 17 and 19 at a sufficient rate of speed. Because the invention, including spring 19, causes the teeth to pass by pole pieces 17 and 19 at an increased rate of speed, a higher voltage may be maintained despite the lower speed of rotation. Since the period, during which the speed of the rotor is increased, is limited within the normal cycle of rotation, the frequency of the generated pulses is unchanged. As speed of shaft 67 is increased, the momentum of rotor 25 will more readily overcome the retarding force of the magnet 95 until at high speeds, the rotor will rotate relatively unimpeded at a constant angular velocity. Thus at high engine speeds, where the effect of the spring 79 is unnecessary, the inherent characteristics of the system override its effect.

It may therefore be seen that the invention provides an improved magnetic pulse generator which provides pulses of a higher peak voltage at slow driving speeds without affecting pulse frequency. The unit may be readily incorporated in a standard automotive distributor assembly and reduces the necessary number of amplifying stages required for the ignition system.

I claim:

1. A mechanically driven rotary pulse generator for producing voltage pulses of a given magnitude at relatively low driving speeds including in combination, a magnetic structure including stator means and rotor means cooperating therewith to form a magnetic circuit, said rotor means having a pole portion passing proximate a portion of said stator means to cause change in the strength of flux through said magnetic circuit from a maximum flux to a minimum flux, winding means disposed about said magnetic circuit to produce voltage pulses according to the changing flux therethrough, rotary drive means rotating at a given velocity, linking means coupling said drive means to said rotor means and permitting relative angular movement of said rotor means with respect to said drive means, said linking means including stop means limiting angular movement of said rotor

5

means with respect to said drive means between forward and rearward limits, said linking means further including a spring urging said rotor means to said forward limit of angular movement, and a magnet positioned proximate the path of said portion of said rotor means to intermittently retard said rotor means against said spring to store energy therein until said rotor means reaches said rearward limit of angular movement, said stop means driving said rotor means so that said portion thereof is moved away from said magnet to overcome the force of said magnet and permit said spring to discharge energy as said portion of said rotor means passes through a point of maximum flux, thereby increasing the angular velocity of said rotor means so that the flux in said magnetic circuit changes at an increased rate to produce a higher voltage pulse in said winding means than would be attainable by rotation of said rotor means at the given angular velocity.

2. In a distributor assembly for an internal combustion engine, a magnetic generator for producing trigger pulses for the ignition of the engine including in combination, stator means including magnetic means disposed to comprise a portion of a magnetic circuit, said stator means including a pair of pole pieces extending therefrom, a rotor completing said magnetic circuit and having a plurality of extensions thereon successively alignable with said pair of pole pieces on said stator means to vary the flux in said magnetic circuit, winding means disposed about said magnetic circuit to produce voltage pulses according to the changing flux therethrough, a distributor shaft for driving the components of the distributor assembly, a sleeve concentrically mounted on said distrib-

6

utor shaft, advance means coupling said distributor shaft to said sleeve, stop means defining forward and rearward limits of angular movement of said rotor with respect to said sleeve, a coil spring surrounding said sleeve and drivingly connecting said rotor with said sleeve and urging said rotor to said forward limit of angular movement with respect to said sleeve, and a magnet positioned proximate the path of said extensions on said rotor to retard said rotor just prior to alignment of a pair of extensions with said pair of pole pieces on said stator means, said spring storing energy therein as said rotor is retarded until said rotor reaches said rearward limit of angular movement, said stop means driving said rotor to move said extensions thereof away from said magnet to overcome the force of said magnet so that said spring releases the energy stored therein and causes said extensions to pass said pole pieces at an angular velocity greater than the angular velocity of said distributor shaft during a limited period of its rotation cycle, thereby producing a higher voltage pulse in said winding means than would be attainable at the velocity of said distributor shaft, without affecting pulse frequency.

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