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(54) **Engine ignition system**

Motorzündsystem

Système d'allumage d'un moteur

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Description

TECHNICAL FIELD

[0001] The present invention relates to an engine ignition system, and particularly to a coil ignition system in that an ignition coil is supplied with a voltage generated by an alternating current generator (ACG) that operates in conjunction with engine rotation to generate electricity.

BACKGROUND OF THE INVENTION

[0002] US-A-5 383 433, US-A-4 291 661 and US-A-3 405 347 describe known engine ignition systems according to the preamble of claim 1.

[0003] Conventionally, among ignition systems used in automotive gasoline engines, is known a so-called breakerless transistorized ignition system, which is typically used in passenger vehicles or large or middle-sized motorcycles. Figure 8 shows an example of the breakerless transistorized ignition system. As shown, an alternating current generator (ACG) 1 which rotates jointly with an engine (not shown) generates an AC voltage which is half-wave rectified by a regulator/rectifier 15 and typically charges a battery 16 so that the battery voltage is supplied to an ignition control circuit 22.

[0004] The battery voltage supplied to the ignition control circuit 22 is transmitted to a primary winding L1 of an ignition coil 13, and a current conduction through the primary winding L1 is on/off controlled by a transistor Q1 serving as a switching device. A pulser signal from a pulser coil (magnetic detection coil) 8 provided for detecting a rotational position (or angle) of a crankshaft is transmitted through a pulser waveform input block 12b to an ignition coil primary current control block 12c which conducts the on/off control of the transistor Q1 based on the pulser signal. The ignition control circuit 22 further comprises a power supply block 12a for providing an operation voltage Vcc to various parts in the ignition control circuit 22.

[0005] In the above constructed ignition system, first, the transistor Q1 is turned on to cause an electric current to flow through the primary winding L1 of the ignition coil 13. Then, when a sufficient energy has been stored in the primary winding L1, the ignition coil primary current control block 12c turns off the transistor Q1 at an ignition timing determined based on the pulser signal so as to interrupt the current flowing through the primary winding L1. Accordingly, the abrupt interruption of the current flowing through the primary winding L1 generates a counterelectromotive force in the primary winding L1, causing a high voltage in a secondary winding L2 of the ignition coil 13, which in turn produces a spark from a spark plug 14 to ignite an air-fuel mixture in the engine.

[0006] The breakerless transistorized ignition system as described above contains no mechanically contacting parts and thus may be preferable in view of conducting reliable and steady operation in a high engine speed range as well as facilitating high-voltage generation in a low engine speed range. Therefore, such a breakerless transistorized ignition system may also be used preferably in small-sized motorcycles, such as motor scooters. However, such small-sized motorcycles are usually equipped with a relatively small battery and thus it may occasionally happen that the battery is totally discharged when starting the engine. Further, the battery can sometimes be disconnected due to oscillation or for other reasons. Thus there was a problem that the disconnection or total discharge of the battery could disable the transistorized ignition system and prevent even starting the engine.

[0007] When the battery is disconnected or totally discharged, half-waves from the ACG 1 are directly provided to the ignition coil 13 as shown in an upper part of Figure 9. Accordingly, as shown in a lower part of Figure 9, a waveform of an electric current flowing through the primary winding L1 of the ignition coil 13 will consist of half-waves having a phase delay $\phi 1 (\phi 2)$ with respect to the output voltage from the ACG 1.

[0008] Thus, by adjusting a phase relationship between the generator voltage and the ignition timing T1 based on the phase delay $\phi 1$ at low engine speed so that the ignition timing T1 coincides with a point where the current flowing through the primary winding L1 is at its peak, it may be possible to produce an intense spark at low engine speed and start the engine by operating a kickstarter for example even if the battery is disconnected or totally discharged.

[0009] However, the amount of phase delay may vary with the engine speed and thus, when the engine speed is higher and the current waveform has a larger phase delay $\phi 2$ (phantom line), ignition may not be achieved because an adequate current is not flowing at the ignition timing T1. This can cause a problem in vehicle travel at high engine speed.

BRIEF SUMMARY OF THE INVENTION

[0010] In view of such problems of the prior art and the recognition by the inventors, the object of the present invention is to provide an engine ignition system that can achieve ignition even when the battery is in an inoperative condition; e.g. when the battery is not properly functioning, as for example over a wide engine speed range from low to high engine speeds, and can be used in various engines having different characteristics.

[0011] According to the present invention, this can be accomplished by providing an engine ignition system, comprising: an alternating current generator (1) for generating an AC voltage in conjunction with a rotation of a crankshaft (2) of an engine (E); an ignition timing sensor (7, 8) for generating an ignition timing reference signal based on a rotation angle of the crankshaft (2); an ignition coil (13) having a primary winding (L1) connected to the alternating current generator (1) and a secondary winding (L2) connected to a spark plug (14); a switching device (Q1) connected in series to the primary winding (L1) of the ignition coil (13) for allowing an electric current to flow through the primary winding (L1) of the ignition coil (13) when the switching device (Q1) is in an on state; and an ignition control circuit (12c) for controlling the switching device (Q1) so as to turn off the switching device (Q1) at an ignition timing (T1) determined based on the ignition timing reference signal, and wherein an electric current flowing through the primary winding (L1) due to the voltage generation by the alternating current generator (1) is greater than a predetermined current (Ad) at the ignition timing (T1), wherein said predetermined current (Ad) is sufficient for, upon interruption, inducing such a high voltage in the secondary winding (L2) of the ignition coil (13) that can produce a spark from the spark plug (14), characterized in that the alternating current generator generates an output voltage with a continuous sine wave and that a phase of the voltage from the alternating current generator (1) with respect to the ignition timing (T1) is determined so that the electric current flowing through the primary winding (L1) due to the voltage generation by the alternating current generator (1) at the ignition timing (T1) is greater than said predetermined current (Ad).

[0012] In this way, since a sufficient primary current for ignition is ensured at the ignition timing only by the electricity generated from the alternating current generator, it is possible to conduct ignition and start the engine even when a battery is disconnected or totally discharged.

[0013] Preferably, the current flowing through the primary winding (L1) at the ignition timing is greater than the predetermined current (Ad) both at low engine speed and at high engine speed. In other words, the ignition timing is preferably placed within an angle range (α) where the primary current due to the voltage generation by the alternating current generator (1) is greater, for any engine speed between a prescribed low and high engine speeds, than the predetermined current (Ad). Typically, the prescribed low engine speed is 500 rpm and the prescribed high engine speed is 10,000 rpm. In this way, a sufficient primary current for ignition can be ensured from low to high engine speeds and thus, it is possible not only to start the engine, but also to conduct ignition over a wide engine speed range even when the battery is not properly functioning.

[0014] Further preferably, a capacitor (Cl) may be connected in parallel with the primary winding (L1) of the ignition coil (13). The capacitor contributes to ensuring a sufficient primary current flowing at the ignition timing at high engine speed. Moreover, the capacitor may function to expand the angle range where the primary current is greater than the predetermined current (ignition requirement current Ad) to thereby allow an advance angle control to be conducted even when the battery is inoperative.

[0015] In view of increasing the versatility of the ignition system as well as preventing improper operation of the ignition system, it will be advantageous if a phase relationship (δ) between the ignition timing and the voltage from the alternating current generator (1) is adjustable. To achieve such an ignition system, according to one embodiment of the invention, the alternating current generator (1) has a magnet (4) adapted to rotate in conjunction with the crankshaft (2) and a stator coil (5) stationarily mounted to the engine (E), and a position of said stator coil (5) on the engine (E) is adjustable in a direction of rotation of said magnet (4). More specifically, the ignition system may comprise an annular stator core (6) which is disposed coaxially with the crankshaft (2) to support said stator coil (5), said stator core (6) being provided with an arcuate slot (6a) through which a securing bolt (10) is passed to attach the stator core (6) to the engine (E).

[0016] Thus, the position of the stator core supporting the stator coil is adjustable in the circumferential direction within a length of the arcuate slot. This makes it possible to fine-adjust the phase relationship between the ignition timing and the generator voltage after assembling the component parts or to vary the phase relationship depending on the particular engine type to thereby increase the versatility of the system.

[0017] Other and further objects, features and advantages of the invention will appear more fully from the following description.

BRIEF DESCRIPTION OF THE DRAWINGS

[0018] Now the present invention is described in the following with reference to the appended drawings, in which:

Figure 1 is a schematic side cross-sectional view of an alternating current generator of an ignition system to which the present invention is applied.
Figure 2 is an enlarged frontal view of an essential part of the generator taken along the lines II-II in Figure 1;
Figure 3 is an explanatory diagram for showing a generator voltage, primary current and ignition timing adjusted according to the present invention;
Figure 4 is a diagram corresponding to Figure 2 and showing a state at the ignition timing;
Figure 5 is a diagram corresponding to Figure 4 and showing a second embodiment according to the present invention;
Figure 6 is a circuit block diagram showing a second embodiment of an ignition control circuit according to the present invention;
Figure 7 is an explanatory diagram for showing a conducted electric current waveform and ignition timing in the second embodiment according to the present invention.
Figure 8 is a circuit block diagram showing an igni-

tion control circuit of a breakerless transistorized ignition type; and

Figure 9 is a diagram for showing an ignition timing and phase delay of the primary winding current relative to the generator output voltage in the breakerless transistorized ignition system.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0019] Figure 1 is a schematic side cross-sectional view showing an alternating current generator (ACG) 1 serving as a power supply for an ignition system of a motor vehicle, and Figure 2 is an enlarged front view showing an essential part thereof. As shown in the drawings, a flywheel 3 is coaxially secured to a crankshaft 2 of an engine E. The flywheel 3 is formed with a cylindrical wall portion extending from its outer peripheral portion toward the engine E side, and a predetermined number of arcuate magnets 4 are fixedly disposed on an inner circumferential surface of the cylindrical portion of the flywheel 3 such that N poles and S poles are arranged alternately in the circumferential direction.

[0020] Stator coils 5, which constitute the ACG 1 in combination with the magnets 4, are provided by the same number as that of the magnets 4. These stator coils 5 are disposed radially on the crankshaft 2 and inwardly of the cylindrical wall portion of the flywheel 3 so that they face the poles of the magnets 4. An annular stator core 6 is fixedly screwed by securing bolts 10 to an end surface of the engine E so as to surround the crankshaft 2. The stator core 6 is provided with a plurality of radially extending upright yokes on its outer circumferential surface, and the stator coils 5 are wound around the yokes. The stator coils 5 are electrically connected to the regulator/rectifier 15.

[0021] Further, a reluctor 7 consisting of a magnetic material is secured on an outer surface of the cylindrical wall portion of the flywheel 3. The reluctor 7 constitutes an ignition timing sensor in conjunction with a pulser coil 8 which is supported by a bracket 9 fixedly screwed on an end surface of the engine E so as to detect a change in a magnetic field due to passing of the reluctor 7.

[0022] As an ignition control circuit used in the present invention, the above-shown ignition control circuit 22 of Figure 8 may be used. Thus, the circuit shown in Figure 8 constitutes a first embodiment and a detailed explanation thereof is omitted here.

[0023] Figure 3 shows a waveform of an output voltage from the ACG 1 constructed as above (uppermost waveform). In this embodiment, the number of poles of the magnets 4 is eight, and accordingly, the output voltage waveform from the ACG 1 comprises four half waves for each single rotation of the crankshaft 2 (six waves will be produced if the number of magnetic poles is twelve.). It should be noted that the uppermost waveform in Figure 3 shows the generator output voltage after passing the regulator/rectifier 15 in the case where the battery 16 is disconnected or totally discharged, and thus contains positive half-waves of the sine wave.

[0024] When the transistor Q1 is turned on at a point S1 in Figure 3 and the generator voltage half-wave is applied to the primary winding L1 of the ignition coil 13, an electric current flows through the primary winding L1 as shown in a middle part of Figure 3 (the current that flows through the primary winding L1 of the ignition coil 13 is sometimes called a primary winding current or primary current). Due to an inductance in the ACG 1 and in the primary winding L1, the primary current has a phase delay ($\phi1,\phi2$) relative to the generator voltage as shown in the drawing, where the solid line having a phase delay $\phi1$ corresponds to a low engine speed (e.g., 500 rpm) while the phantom line having a phase delay $\phi2$ corresponds to a high engine speed (e.g., 10,000 rpm). As seen, as the engine E rotates at higher engine speed, usually the peak of the voltage (current) becomes higher and the phase delay increases ($\phi1<\phi2$).

[0025] As mentioned above, the ignition timing T1 is determined based on the pulser signal generated from the pulser coil 8. In the shown embodiment, for each single rotation of the crankshaft 2, the reluctor 7 passes the pulser coil 8 once to generate a pair of positive and negative pulses, and the negative pulse serves as an ignition timing reference signal. In this embodiment, the ignition timing T1 is determined by detecting a rising edge of the negative pulse, as shown in the lowermost waveform in Figure 3.

[0026] According to the present invention, a phase relationship between the generator voltage and the ignition timing T1 is determined so that the electric current flowing through the primary winding L1 at the point of ignition timing T1 is greater than a minimum primary current that, upon interruption, can induce such a high voltage in the secondary winding L2 that can produce a spark from the spark plug 14 to ignite the air-fuel mixture in the engine. The minimum primary current is herein referred to as "ignition requirement current" and denoted with Ad in Figure 3. The phase relationship between the generator voltage and the ignition timing T1 can be expressed for example by a phase difference between the peak in the generator voltage and the rising edge of the negative pulser signal as indicated by a reference δ in Figure 3.

[0027] As can be seen in Figure 3, the primary current at the ignition timing T1 is greater than the ignition requirement current Ad not only at low engine speed but also at high engine speed. In other words, the ignition timing is adjusted to be within a range denoted with a reference α which can be defined as an overlap between the angle ranges at high and low engine speeds where the primary current is greater than the ignition requirement current Ad. The range a is herein referred to as "ignition-achievable range." Thus, even when the battery is disconnected or totally discharged, it is ensured from low to high engine speeds that the electric power from the ACG 1 alone can provide a sufficient primary current at the ignition timing T1, and thus it is possible not only to start the engine but also to conduct ignition over a wide engine speed range.

[0028] It should be noted that although it may be preferable (particularly at low engine speed) that the peak of the primary current coincides with the ignition timing T1 in view of producing an intense spark from the spark plug, ignition can be achieved so long as the primary current at the ignition timing is greater than the ignition requirement current Ad, and the ignition timing T1 may be displaced from the peak of the primary current.

[0029] The phase relationship between the generator voltage and the ignition timing T1 may be determined by the positional relationship between the stator coils 5, magnets 4, reluctor 7 and pulser coil 8. Figure 4 illustrates the positional relationship between these component parts at the ignition timing T1 in the ignition system constructed according to the invention. In this drawing, the flywheel 3 rotates in a direction shown by an arrow A, and a rotational end of the reluctor 7 is positioned just under the pulser coil 8 to generate the negative pulser voltage that determines the ignition timing T1.

[0030] Peaks in the generator voltages are produced when a boundary between adjacent magnets 4 coincides with an axis of one of the stator coils 5. In Figure 4, the boundary of adjacent magnets 4 is displaced from the axis of the stator coil 5 by the rotation angle of δ, in other words, the ignition timing reference signal for determining the ignition timing is generated with the phase delay δ relative to the immediately preceding peak of the generator voltage. It should be noted that if the pulser coil 8 and the reluctor 7 were displaced together in a circumferential direction from the position shown in Figure 4 while maintaining the position of the stator coils 5 and magnets 4, the phase relationship between the generator voltage and the ignition timing reference signal (and hence the ignition timing) would not change. Thus, Figure 4 illustrates only an example of possible arrangements for embodying the principle of the present invention and should not be interpreted as limiting the present invention.

[0031] According to the inventor's experiment, by setting the phase delay δ at 14.5 degrees in the above constructed engine ignition system, it was possible to achieve a primary current of 1.5-3.0A, which was sufficient for ignition, for an engine speed range of 500-10,000 rpm.

[0032] In the above illustrated embodiment, the position of the pulser coil 8 and stator coils 5 on the engine E was fixed. However, it may be sometimes required to fine-adjust the phase relationship between the generator voltage and the ignition timing (or the ignition timing reference signal for determining the ignition timing) after assembling the component parts of the engine ignition system since variation in the manufacturing accuracy of the component parts could make it difficult to achieve completely identical electric generators for use in the ignition system. Further, there may be a demand for an engine ignition system that can be used in various engines having different characteristics.

[0033] Figure 5 shows an embodiment of an ACG for an engine ignition system according to the present invention to meet such requirements. In Figure 5, the parts similar to those in the above illustrated embodiment are denoted with same reference numerals and detailed explanation thereof is omitted.

[0034] In the ACG 1 shown in Figure 5, the annular stator core 6 for supporting the stator coils 5 is provided with coaxial arcuate slots 6a through which the securing bolts 10 are passed and screwed into threaded holes provided to the engine E to thereby attach the stator core 6 to the engine E. Thus, the position of the stator core 6 is adjustable within a circumferential length of the arcuate slots 6a. For example, by displacing the stator core 6 circumferentially in the direction shown by an arrow B in Figure 5, it is possible to secure the stator coils 5 at the position shown by phantom lines. Of course, the position adjustment may be possible in the opposite direction to that shown by arrow B.

[0035] Thus, in the ignition system utilizing the electric generator shown in Figure 5, by adjusting the circumferential position of the stator core 6, it is possible to vary the phase of the generator voltage relative to the pulser signal (or ignition timing reference signal) so that the phase relationship between the ignition timing and the generator voltage is adjusted, even after the assembly of the component parts. Also, since such an ignition system can comply with various engine characteristics, or in other words, can eliminate the need to provide different ignition systems depending on each engine type, an increase in the cost can be suppressed.

[0036] It should be understood to a person having an ordinary skill in the art that the above adjustment of the phase relationship between the ignition timing and the generator voltage may also be achieved by making the position of the pulser coil 8 on the engine E displaceable in the rotational direction of the reluctor 7. Also, a similar effect may be obtained by making the position on the flywheel 3 of at least one of the reluctor 7 and the magnets 4 displaceable in the rotational direction of the flywheel 3. This can be accomplished, for example, by providing the reluctor 7 with a circumferentially elongated opening so that the reluctor 7 is attached to the outer surface of the flywheel 3 by means of a screw passed through the elongated opening. Such alterations and modifications should fall within the scope of the present invention.

[0037] Thus, by providing an engine ignition system having an ACG constructed as hitherto described, it can be possible to start the engine or to conduct ignition over a wide engine speed range even when the battery is disconnected or totally discharged. However, in the above shown ignition system with the control circuit shown in Figure 8, it is not possible to conduct an advance angle control when the battery is not properly functioning since advancing the ignition timing T1 would place the ignition timing T1 outside the ignition-achievable range α.

[0038] Figure 6 shows a second embodiment of an ignition control circuit that may solve such a problem. In Figure 6, the parts similar to those in the previously illustrated embodiment are denoted with same reference numerals and detailed explanation thereof is omitted.

[0039] Similarly to the circuit shown in Figure 8, an ignition control circuit 12 shown in Figure 6 is connected to the ACG 1 via the regulator/rectifier 15 and comprises the pulser waveform input block 12b and ignition coil primary current control block 12c. The ignition control circuit 12 further comprises an advance angle control circuit 12d for controlling the ignition coil primary current control block 12c based on the pulser signal from the pulser waveform input block 12b so as to conduct an advance angle control for ignition. Further more, a capacitor C1 is connected to a node between the regulator 15 and the primary winding L1 so as to be in parallel with the primary winding L1.

[0040] Figure 7 shows a primary current waveform in the ignition system utilizing the ignition control circuit 12 constructed as above. As shown, in this embodiment, the transistor Q1 is turned on at an earlier point of time than the first embodiment (see Figure 3). More specifically, the transistor Q1 is turned on at a point S2 shown in a middle portion of Figure 7 so that the capacitor C1 can provide a discharge current to the primary winding L1 of the ignition coil 13 before an electric current due to the voltage generation by the ACG 1 begins to flow through the primary winding L1 with a phase delay (ϕ1, ϕ2) with respect to the generator voltage half-wave. It should be noted that before the transistor Q1 is turned on, the capacitor C1 is charged by the voltage half-waves from the ACG 1. Also it should be noted that as shown by phantom lines in the middle portion o Figure 7, the discharge current from the capacitor C1 increases as the generator voltage increases with the engine speed. Thus, at high engine speed, where the ignition timing T1 is advanced for example by an angle C to an ignition timing T2, the discharge current from the capacitor C1 functions to ensure a sufficient current (or a current which is greater than the ignition requirement current Ad) flowing through the primary winding L1 of the ignition coil 13 at the advanced ignition timing T2, whereby making it possible to conduct an advance control of ignition in a high engine speed range.

[0041] It should be noted that the capacitor C1 may have such a small capacitance that allows the discharge current at low engine speed to go below the ignition requirement current Ad in a possible advance angle range (as shown by a solid line in Figure 7) because at low engine speed, advancing of the ignition timing may not take place and a sufficient primary current at the ignition timing T1 is ensured by the phase adjustment as describe above. This can permit the capacitor C1 to be embodied by a small-sized capacitor.

[0042] In the ignition system using the circuit shown in Figure 8 without the capacitor C1, the primary current consists of a half-wave corresponding to the half-wave voltage from the ACG 1, as shown in Figure 3. In such an ignition system, though not shown in Figure 3, at high engine speed where the influence of the inductance of ACG 1 on the primary current may be significant, it may happen that the primary current has not reached a sufficiently high level even at the non-advanced ignition timing T1. In the ignition system using the second embodiment circuit shown in Figure 6, however, owing to the capacitor C1, the primary current can start flowing at an earlier time and thus it is facilitated to achieve a sufficiently high level of primary current at the point of ignition timing T1 at high engine speed.

[0043] Thus, according to the second embodiment of the ignition control circuit, by providing an energy storage element capable of storing an electric energy such as an electrolytic capacitor in parallel with the primary winding of the ignition coil, it is possible to achieve ignition even when the battery is disconnected or totally discharged and to conduct an advance angle control in a high engine speed region without creating a problem, whereby making it possible to provide a compact breakerless transistorized ignition system that may be operable without a battery.

[0044] It should be mentioned that if the capacitor were used in place of the battery and the energy stored in the capacitor alone had to ensure a sufficient electric current at low to high engine speeds, the capacitor would be an impractically large-sized or high-cost one. However, in the above inventive ignition system, since a sufficient primary current at low engine speed is ensured by the adjustment of the phase relationship between the ignition timing and the generator voltage, the capacitor is only required to provide a supplemental primary current at high engine speed, and accordingly the capacitance of the capacitor can be one sixth - one seventh with respect to the capacitance that would be required if the energy stored in the capacitor alone had to ensure a sufficient primary current over a wide engine speed range, whereby allowing the present invention to be practically achievable.

[0045] Although the present invention has been described in terms of preferred embodiments thereof, it is obvious to a person skilled in the art that various alterations and modifications are possible without departing from the scope of the present invention which is set forth in the appended claims.

Claims

1. An engine ignition system, comprising:

an alternating current generator (1) for generating an AC voltage in conjunction with a rotation of a crankshaft (2) of an engine (E);
an ignition timing sensor (7, 8) for generating an ignition timing reference signal based on a

rotation angle of the crankshaft (2);
an ignition coil (13) having a primary winding (L1) connected to the alternating current generator (1) and a secondary winding (L2) connected to a spark plug (14);
a switching device (Q1) connected in series to the primary winding (L1) of the ignition coil (13) for allowing an electric current to flow through the primary winding (L1) of the ignition coil (13) when the switching device (Q1) is in an on state;
an ignition control circuit (12c) for controlling the switching device (Q1) so as to turn off the switching device (Q1) at an ignition timing (T1) determined based on the ignition timing reference signal, and wherein
an electric current flowing through the primary winding (L1) due to the voltage generation by the alternating current generator (1) is greater than a predetermined current (Ad) at the ignition timing (T1), wherein said predetermined current (Ad) is sufficient for, upon interruption, inducing such a high voltage in the secondary winding (L2) of the ignition coil (13) that can produce a spark from the spark plug (14),

characterized in that the alternating current generator generates an output voltage with a continuous sine wave and that a phase of the voltage from the alternating current generator with respect to the ignition timing (T1) is determined so that the electric current flowing through the primary winding (L1) at the ignition timing (T1) due to the voltage generation by the alternating current generator (1) is greater than said predetermined current (Ad).

2. An engine ignition system according to claim 1, wherein the electric current flowing through the primary winding (L1) at the ignition timing (T1) due to the voltage generation by the alternating current generator (1) is greater than said predetermined current (Ad) at an engine speed of 500 rpm.

3. An engine ignition system according to claim 2, wherein the electric current flowing through the primary winding (L1) at the ignition timing (T1) due to the voltage generation by the alternating current generator (1) is greater than said predetermined current (Ad) at an engine speed of 10,000 rpm.

4. An engine ignition system according to claim 1, wherein the ignition timing is placed within an angle range (α) where the electric current flowing through the primary winding (L1) due to the voltage generation by the alternating current generator (1) is greater, for any engine speed between a prescribed low and high engine speeds, than the predetermined current (Ad)

5. An engine ignition system according to claim 1, wherein a capacitor (C1) is connected in parallel with the primary winding (L1) of the ignition coil (13).

6. An engine ignition system according to claim 5, further comprising an advance angle control circuit (12d) for advancing the ignition timing (T1, T2) according to the engine speed.

7. An engine ignition system according to claim 1, wherein a phase relationship (δ) between the ignition timing and the voltage from the alternating current generator is adjustable.

8. An engine ignition system according to claim 7, wherein said alternating current generator (1) has a magnet (4) adapted to rotate in conjunction with the crankshaft (2) and a stator coil (5) stationarily mounted to the engine (E), and wherein a position of said stator coil (5) on the engine (E) is adjustable in a direction of rotation of said magnet (4).

9. An engine ignition system according to claim 8, further comprising an annular stator core (6) which is disposed coaxially with the crankshaft (2) to support said stator coil (5), said stator core (6) being provided with an arcuate slot (6a) through which a securing bolt (10) is passed to attach the stator core (6) to the engine (E).

Patentansprüche

1. Motorzündsystem mit einem Wechselstromgenerator (1) zum Erzeugen einer Wechselspannung in Verbindung mit der Drehung einer Kurbelwelle (2) eines Motors (E); einem Zündzeitpunktfühler (7,8) zum Erzeugen eines Zündzeitpunktbezugssignals auf Grund eines Drehwinkels der Kurbelwelle (2): einer Zündspule (13) mit einer an dem Wechselstromgenerator (1) angeschlossenen Primärwicklung (L1) und einer an die Zündkerze angeschlossenen Sekundärwicklung (L2); eine mit der Primärwicklung (L1) der Zündspule (13) in Reihe geschalteten Schaltvorrichtung (Q1), um einen elektrischen Strom durch die Primärwicklung (L1) der Zündspule (13) fließen zu lassen, wenn die Schaltvorrichtung (Q1) geschlossen ist; einem Zündsteuerkreis (12c) zum Steuern der Schaltvorrichtung (Q1), um die Schaltvorrichtung (Q1) an einem vom Zündzeitpunktbezugssignal bestimmten Zündzeitpunt (T1) zu öffnen; und bei dem ein durch die Wechselspannungserzeugung durch den Wechselstromgenerator (1) erzeugten, durch die Primärwicklung (L1) fließenden elektrischen Strom im Zündzeitpunkt (T1) größer ist, als ein vorgegebenen Strom (Ad), wobei der vorgegebene Strom (Ad) ausreichend ist, um, bei Unterbrechung, in der Sekundärwicklung

(L2) der Zündspule (13) eine solch hohe Spannung zu erzeugen, die einen Funken an der Zündkerze (14) erzeugen kann, **dadurch gekennzeichnet, dass**

der Wechselstromgenerator eine Ausgangsspannung mit einer kontinuierlichen Sinuswelle erzeugt und, dass die Phase der Spannung vom Wechselstromgenerator mit Bezug auf den Zündzeitpunkt (T1) so bestimmt ist, dass der durch die Primärwicklung (L1) im Zündzeitpunkt (T1) fließende elektrische Strom in Folge der Spannungserzeugung des Wechselstromgenerators (1) größer als der vorgegebene Strom (Ad) ist.

2. Motorzündsystem nach Anspruch 1, bei dem der durch die Primärwicklung (L1) im Zündzeitpunkt (T1) fließende elektrische Strom in Folge der Spannungserzeugung durch den Wechselstromgenerator (1) größer ist, als der vorgegebene Strom (Ad) bei einer Motordrehzahl von 500 Umdrehungen pro Minute.

3. Motorzündsystem nach Anspruch 2, bei dem der durch die Primärwicklung (L1) im Zündzeitpunkt (T1) in Folge der Spannungserzeugung durch den Wechselstromgenerator (1) fließende Strom größer ist, als der vorgegebene Strom bei einer Motordrehzahl von 10.000 Umdrehungen pro Minute.

4. Motorzündsystem nach Anspruch 1, bei dem der Zündzeitpunkt innerhalb eines Winkelbereiches (α) liegt, wo der durch die Primärwicklung (L1) in Folge der Spannungserzeugung durch den Wechselstromgenerator (1) fließende Strom größer ist, als der für irgendeine Motordrehzahl zwischen einer vorgeschriebenen niedrigen und einer vorgeschriebenen hohen Drehzahl vorgegebene Strom (Ad).

5. Motorzündsystem nach Anspruch 1, bei dem ein Kondensator (2) parallel zur Primärwicklung (L1) der Zündspule (13) geschaltet ist.

6. Motorzündsystem nach Anspruch 5, mit desweitern einem Vorlaufwinkelsteuerkreis (12d), um den Zündzeitpunkt (T1,T2) in Übereinstimmung mit der Drehzahl voreilen zu lassen.

7. Motorzündsystem nach Anspruch 1, bei dem eine Phasenbeziehung (δ) zwischen dem Zündzeitpunkt und der Spannung des Wechselstromgenerators einstellbar ist.

8. Motorzündsysstem nach Anspruch 7, bei dem der Wechselstromgenerator (1) einen Magneten (4) hat, welcher dazu ausgelegt ist mit der Kurbelwelle (2) zu drehen und eine stationär zum Motor (E) montierte Statorspule (5), und bei dem eine Stellung der Statorspule (5) am Motor (E) in einer Drehrichtung des Magneten (4) einstellbar ist.

9. Motorzündsystem nach Anspruch 8, mit deweitern einem ringförmigen Statorkern (6), welcher koaxial zur Kurbelwelle (2) angeordnet ist, um die Statorspule zu tragen, wobei die Statorspule (6) mit einem bogenförmigen Schlitz (6a) versehen ist, durch den sich eine Schraube (16) erstreckt, um den Statorkern (6) am Motor zu befestigen.

Revendications

1. Système d'allumage d'un moteur, comprenant :

un générateur de courant alternatif (1) pour générer une tension alternative en même temps qu'une rotation d'un vilebrequin (2) d'un moteur (E) ;
un capteur de calage (7, 8) pour générer un signal de référence du calage de l'allumage sur la base d'un angle de rotation du vilebrequin (2) ;
une bobine d'allumage (13) comportant un enroulement primaire (L1) relié au générateur de courant alternatif (1) et un second enroulement (L2) relié à une bougie d'allumage (14) ;
un dispositif de commutation (Q1) relié en série à l'enroulement primaire (L1) de la bobine d'allumage (13) pour permettre à un courant électrique de s'écouler à travers l'enroulement primaire (L1) de la bobine d'allumage (13) lorsque le dispositif de commutation (Q1) est à l'état de marche ;
un circuit de commande d'allumage (12c) pour commander le dispositif de commutation (Q1) de manière à couper le dispositif de commutation (Q1) au moment d'un calage de l'allumage (T1) déterminé sur la base du signal de référence du calage de l'allumage, et dans lequel, un courant électrique s'écoulant à travers l'enroulement primaire (L1) dû à la production de tension par le générateur de courant alternatif (1) est supérieur à un courant prédéterminé (Ad) au moment du calage de l'allumage (T1), dans lequel ledit courant prédéterminé (Ad) est suffisant pour, lors de l'interruption, induire une tension élevée dans l'enroulement secondaire (L2) de la bobine d'allumage (13) telle qu'elle puisse produire une étincelle à partir de la bougie d'allumage (14),

caractérisé en ce que le générateur de courant alternatif génère une tension de sortie avec une onde sinusoïdale continue et **en ce qu'**une phase de la tension provenant du générateur de courant alternatif par rapport au moment du calage de l'allumage (T1) est déterminée de telle sorte que le courant électrique s'écoulant à travers l'enroulement primaire (L1) au moment du calage de l'allumage (T1) dû à la production de tension par le générateur de courant alternatif (1) est supérieure audit courant prédéterminé (Ad).

2. système d'allumage d'un moteur selon la revendication 1, dans lequel le courant électrique s'écoulant à travers l'enroulement primaire (L1) au moment du calage de l'allumage (T1) dû à la production de tension par le générateur de courant alternatif (1) est supérieure audit courant prédéterminé (Ad) à un régime moteur de 500 Tr/min.

3. système d'allumage d'un moteur selon la revendication 2, dans lequel le courant électrique s'écoulant à travers l'enroulement primaire (L1) au moment du calage de l'allumage (T1) dû à la production de tension par le générateur de courant alternatif (1) est supérieure audit courant prédéterminé (Ad) à un régime moteur de 10.000 Tr/min.

4. système d'allumage d'un moteur selon la revendication 1, dans lequel le calage de l'allumage est placé dans un intervalle d'angle (α) où le courant électrique s'écoulant à travers l'enroulement primaire (L1) dû à la production de tension par le générateur de courant alternatif (1) est supérieur, pour n'importe quel régime moteur situé entre un régime moteur inférieur prescrit et des régimes moteur élevés, au courant prédéterminé (Ad).

5. système d'allumage d'un moteur selon la revendication 1, dans lequel un condensateur (C1) est relié en parallèle à un enroulement primaire (L1) de la bobine d'allumage (13).

6. système d'allumage d'un moteur selon la revendication 5, comprenant, en outre, un circuit de commande de l'angle d'avance (12d) pour faire avancer le calage de l'allumage T1, T2) selon le régime moteur.

7. système d'allumage d'un moteur selon la revendication 1, dans lequel une relation de phase (δ) entre le calage de l'allumage et la tension provenant du générateur de courant alternatif peuvent être réglés.

8. système d'allumage d'un moteur selon la revendication 7, dans lequel ledit courant alernatif du générateur de courant (1) comporte un aimant (4) adapté pour tourner conjointement avec le vilebrequin (2) et une bobine de stator (5) montée de manière stationnaire sur le moteur (E), et dans lequel une position de ladite bobine de stator (5) sur le moteur (E) peut être réglée dans un sens de rotation dudit aimant (4).

9. système d'allumage d'un moteur selon la revendication 8, comprenant, en outre, un noyau de stator annulaire (6) qui est disposé coaxialement avec le vilebrequin (2) pour soutenir ladite bobine de stator (5), ledit noyau de stator (6) étant équipé d'une fente en forme d'arc (6a) à travers laquelle un boulon de fixation (10) est passé pour fixer le noyau de stator (6) sur le moteur (E).

Fig. 1

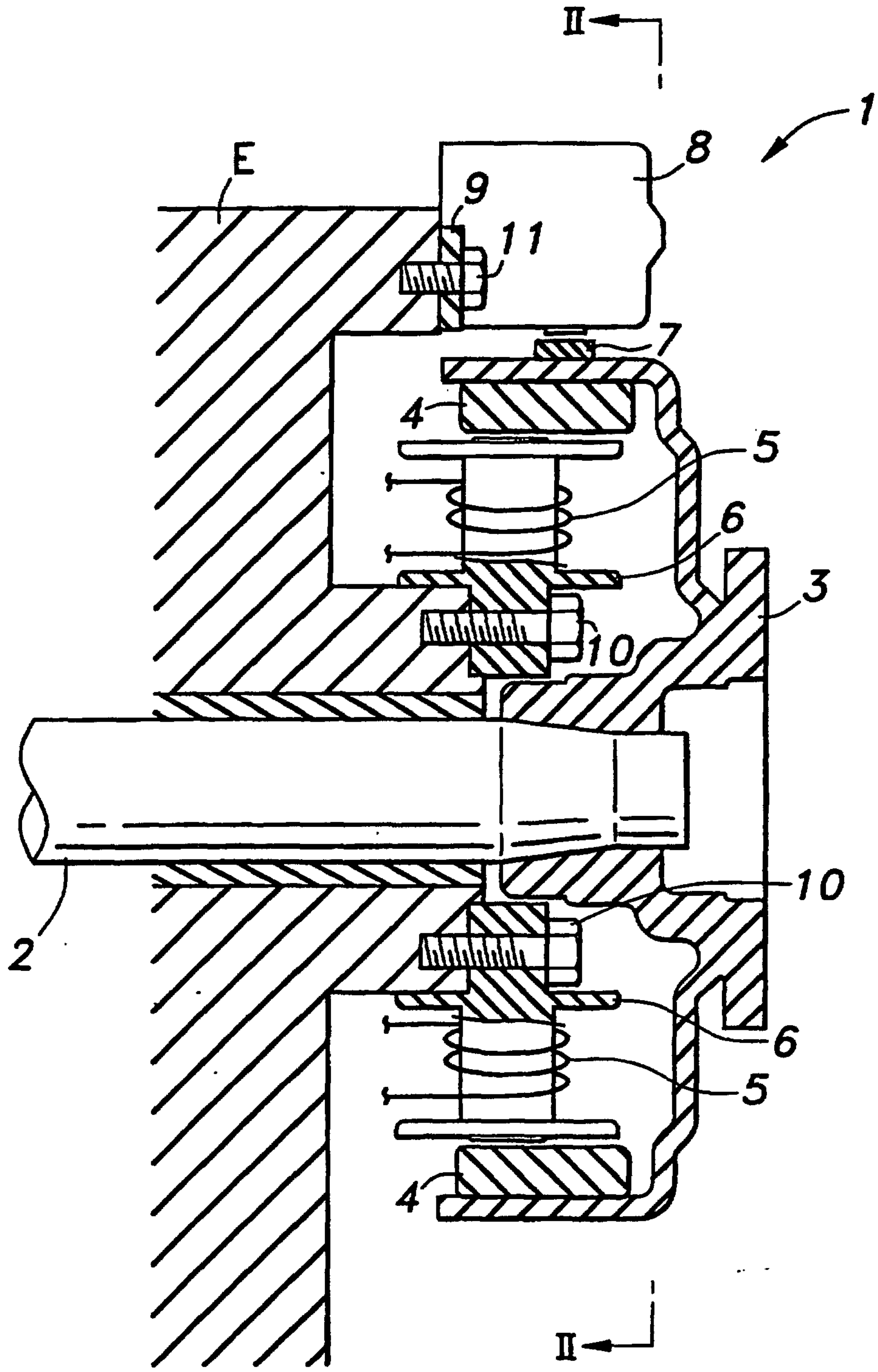


Fig. 2

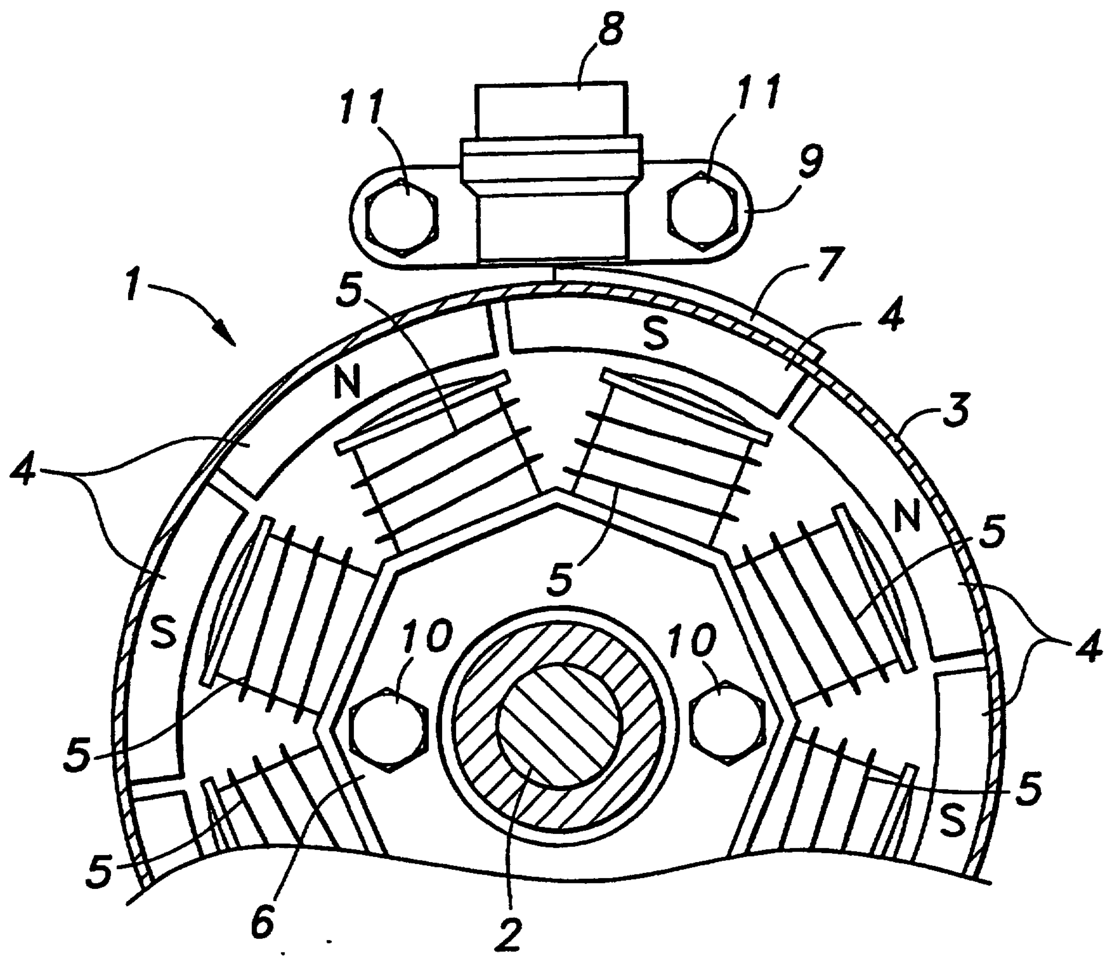


Fig. 3

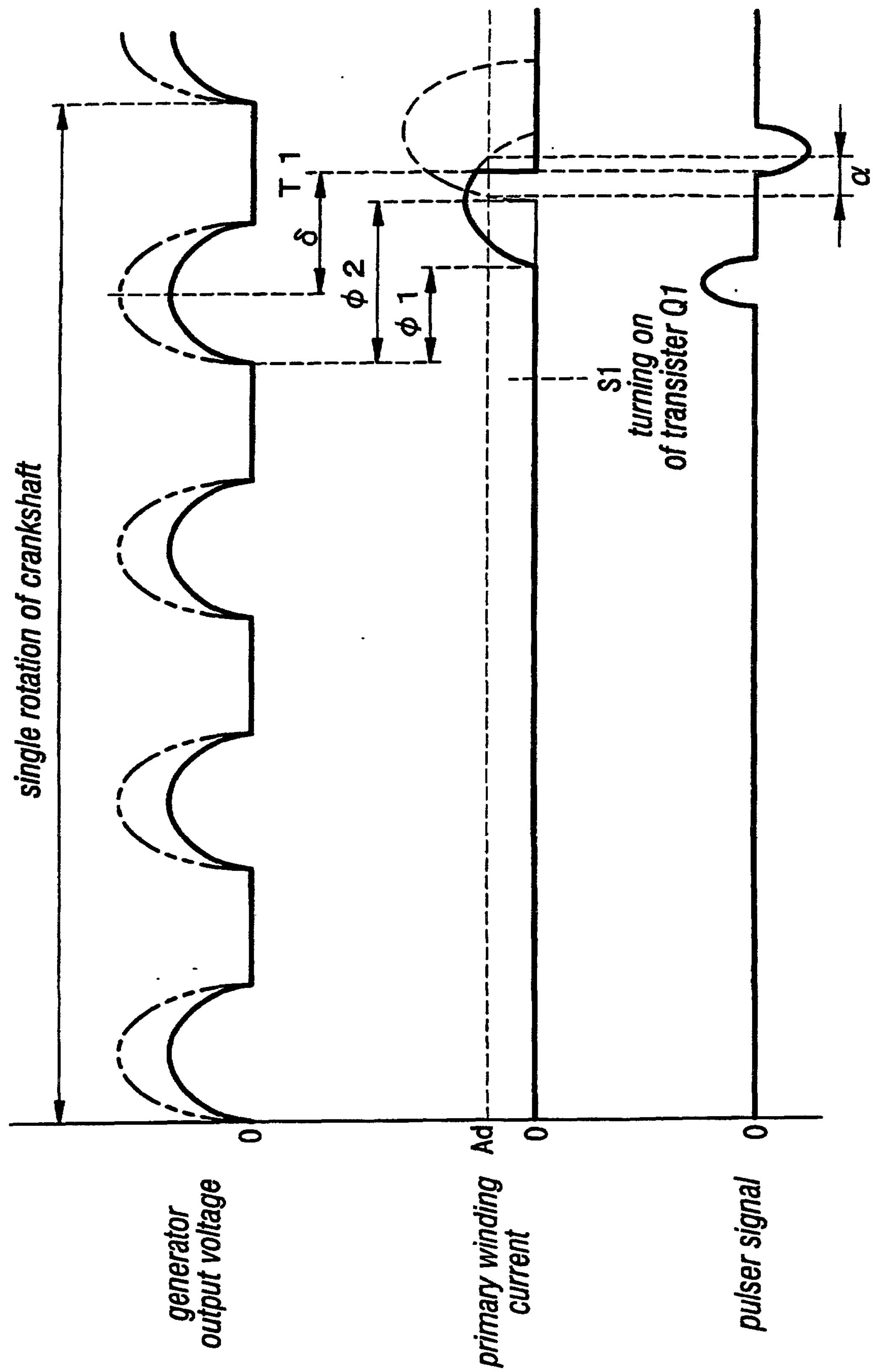

single rotation of crankshaft
generator output voltage
primary winding current
pulser signal
0
Ad
0
0
T 1
δ
ϕ 2
ϕ 1
S1 turning on of transister Q1
α

Fig. 4

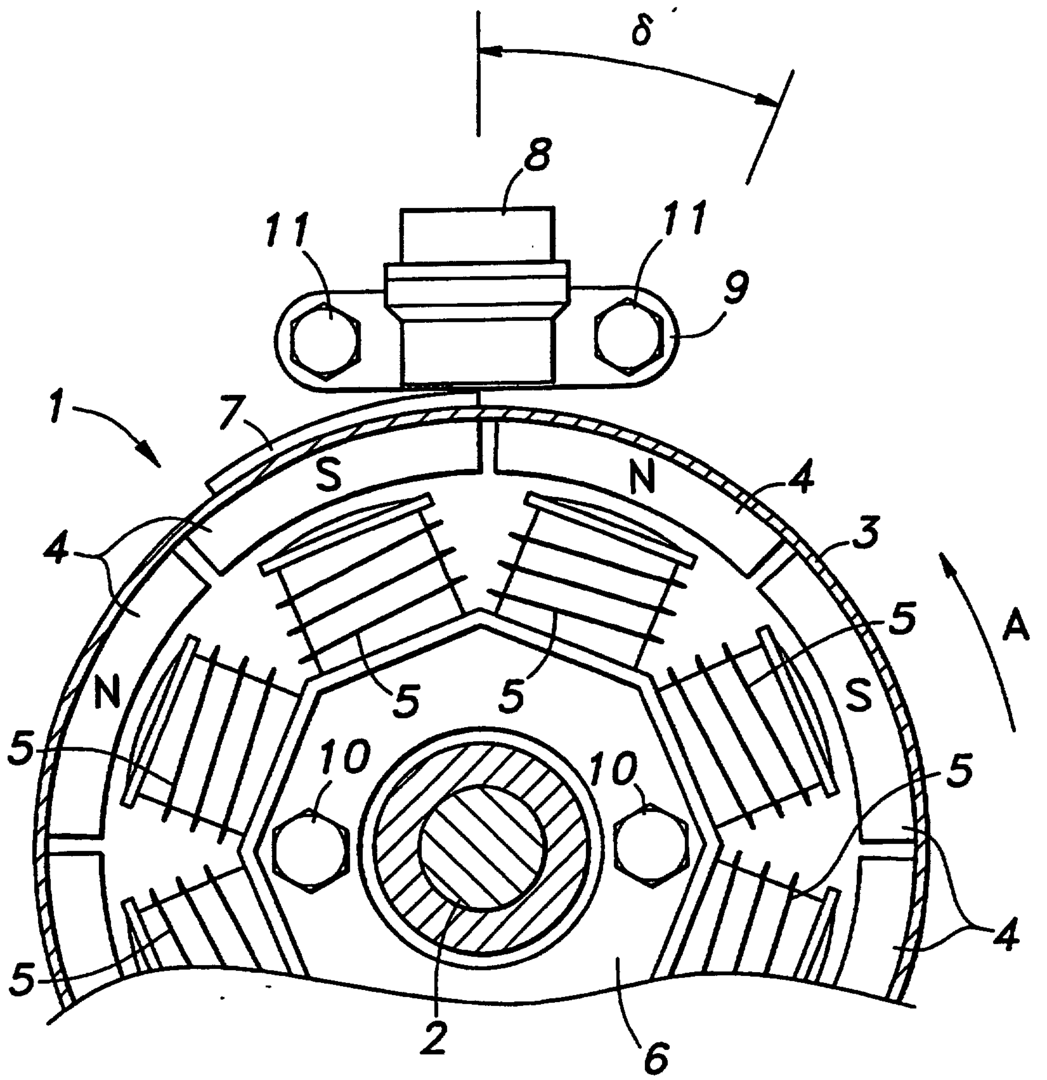


Fig. 5

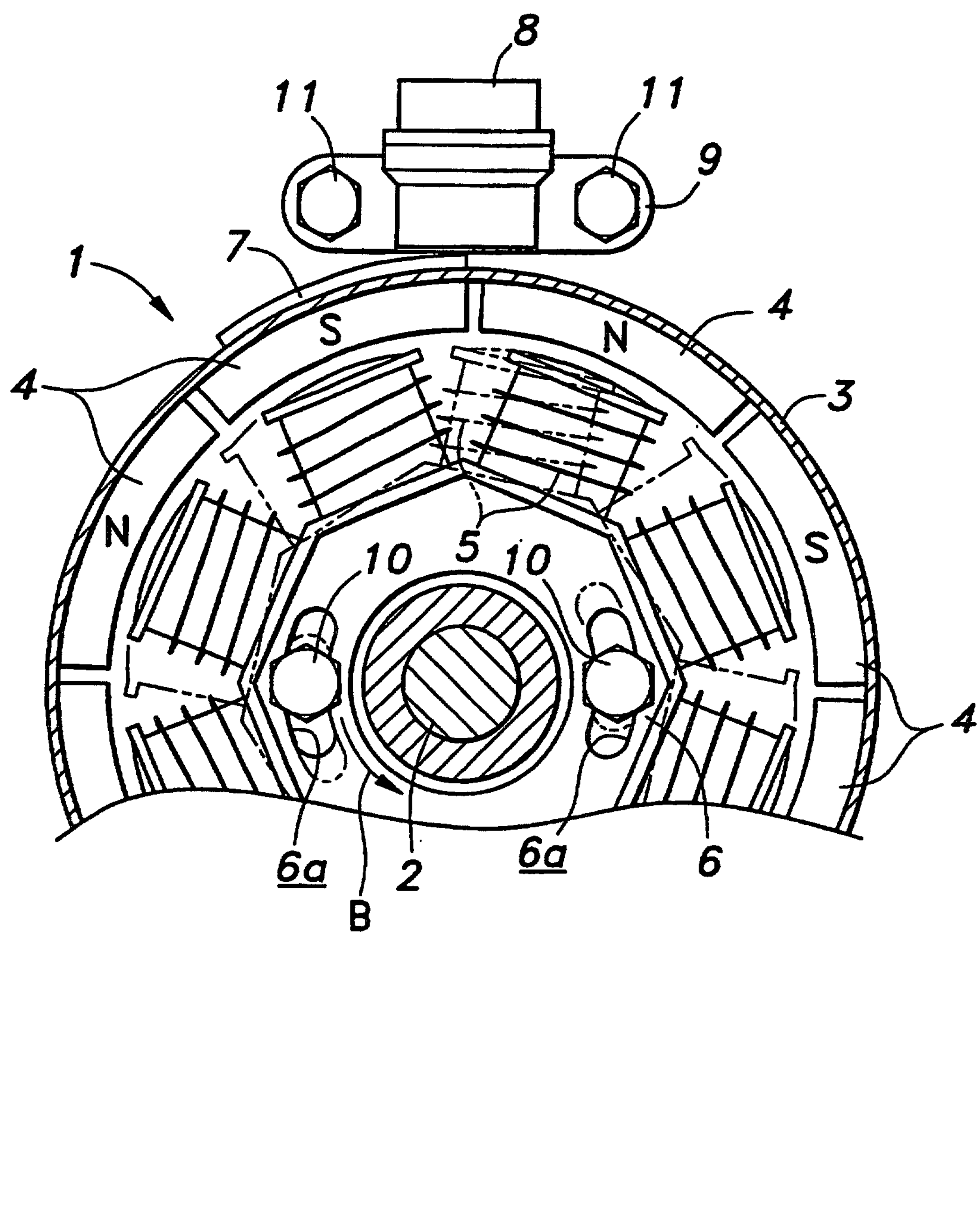
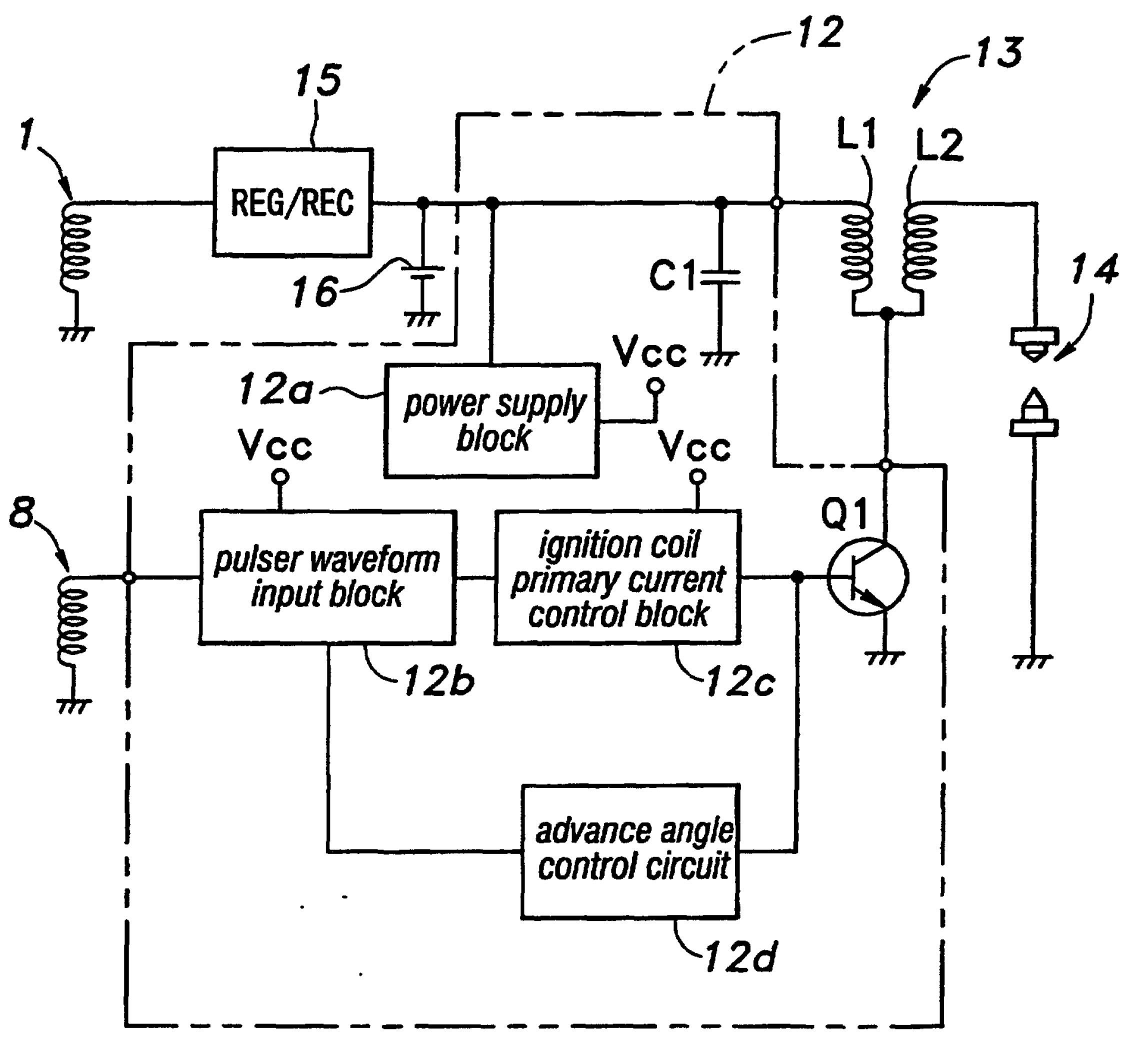


Fig. 6



12
13
15
1
REG/REC
L1
L2
16
C1
14
Vcc
12a
power supply block
Vcc
Vcc
8
Q1
pulser waveform input block
ignition coil primary current control block
12b
12c
advance angle control circuit
12d

Fig. 7

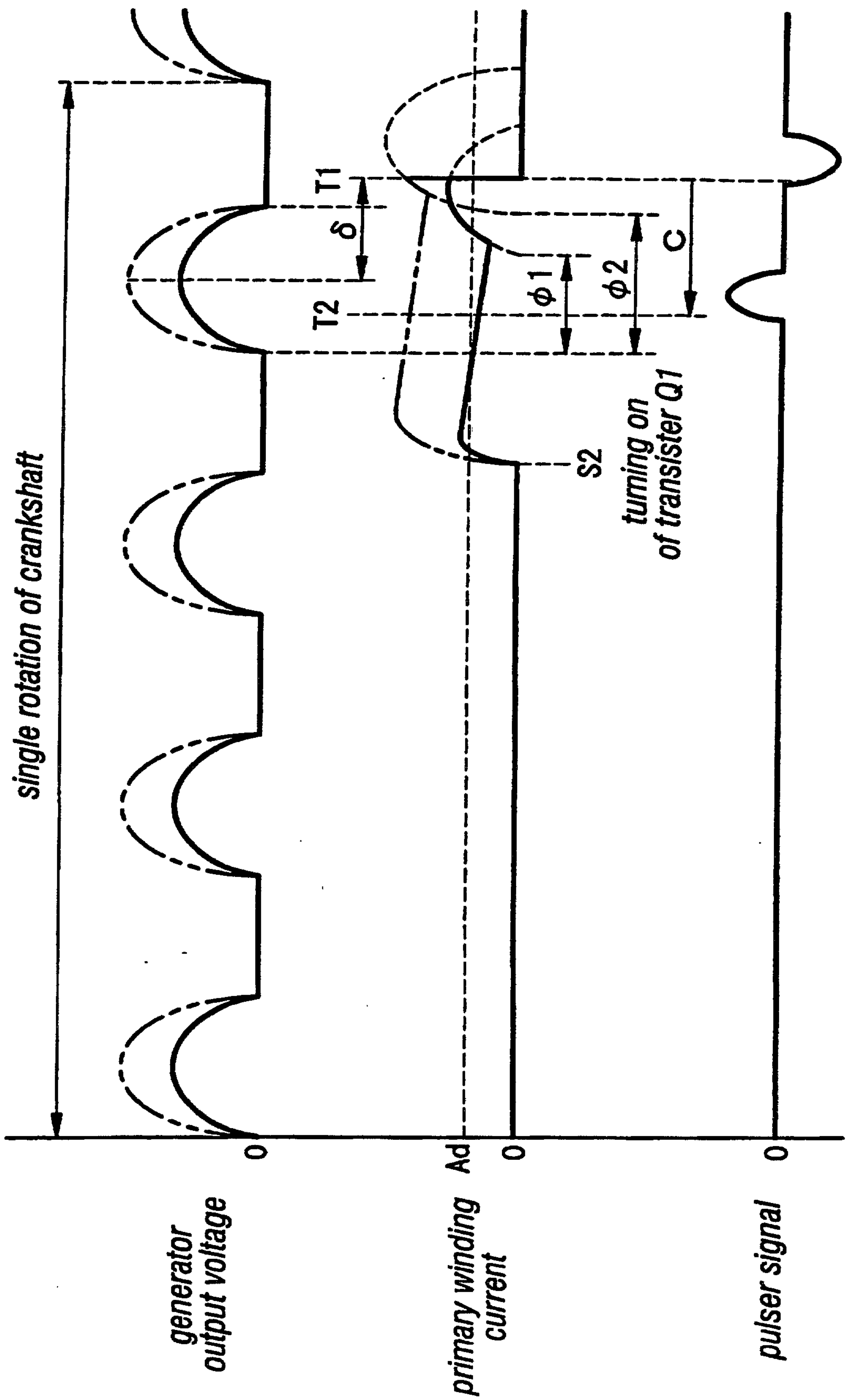

single rotation of crankshaft
generator output voltage
primary winding current
pulser signal
0
Ad
0
0
T1
T2
δ
ϕ1
ϕ2
C
S2
turning on of transister Q1

Fig. 8

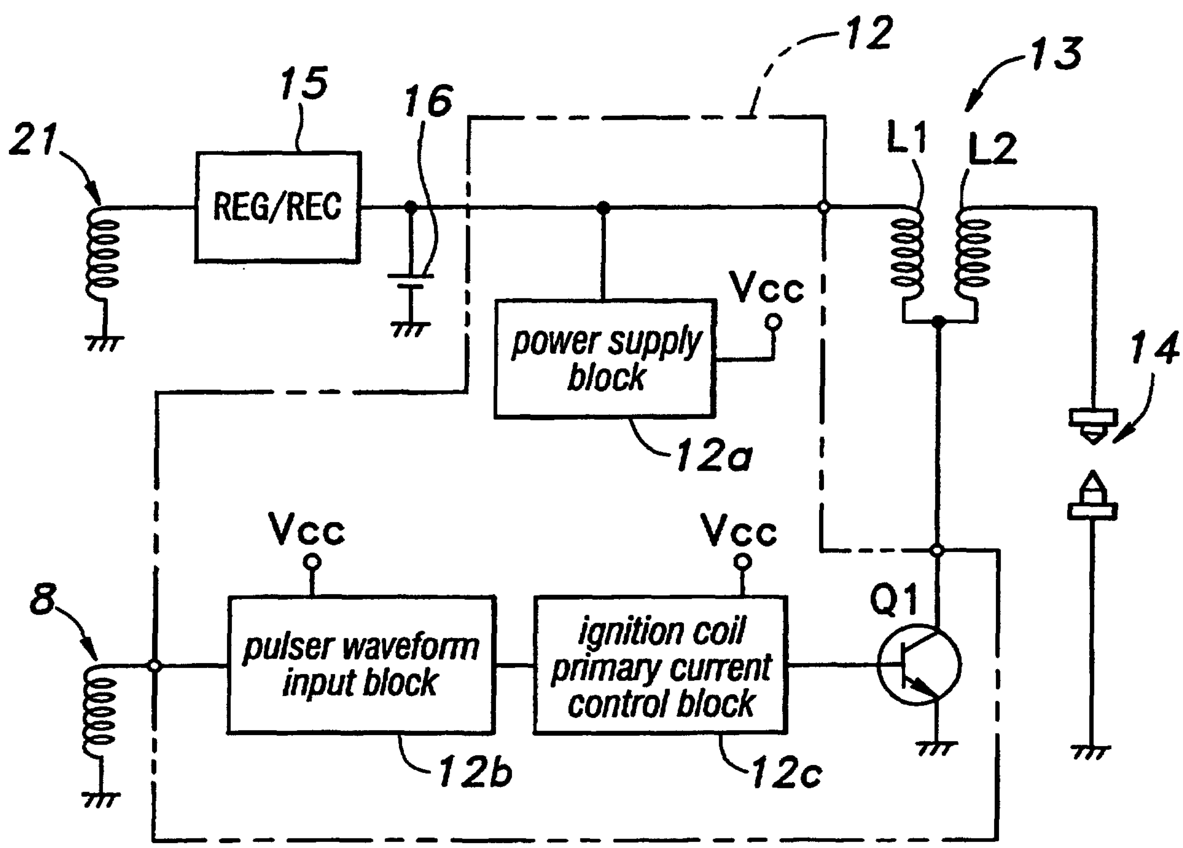
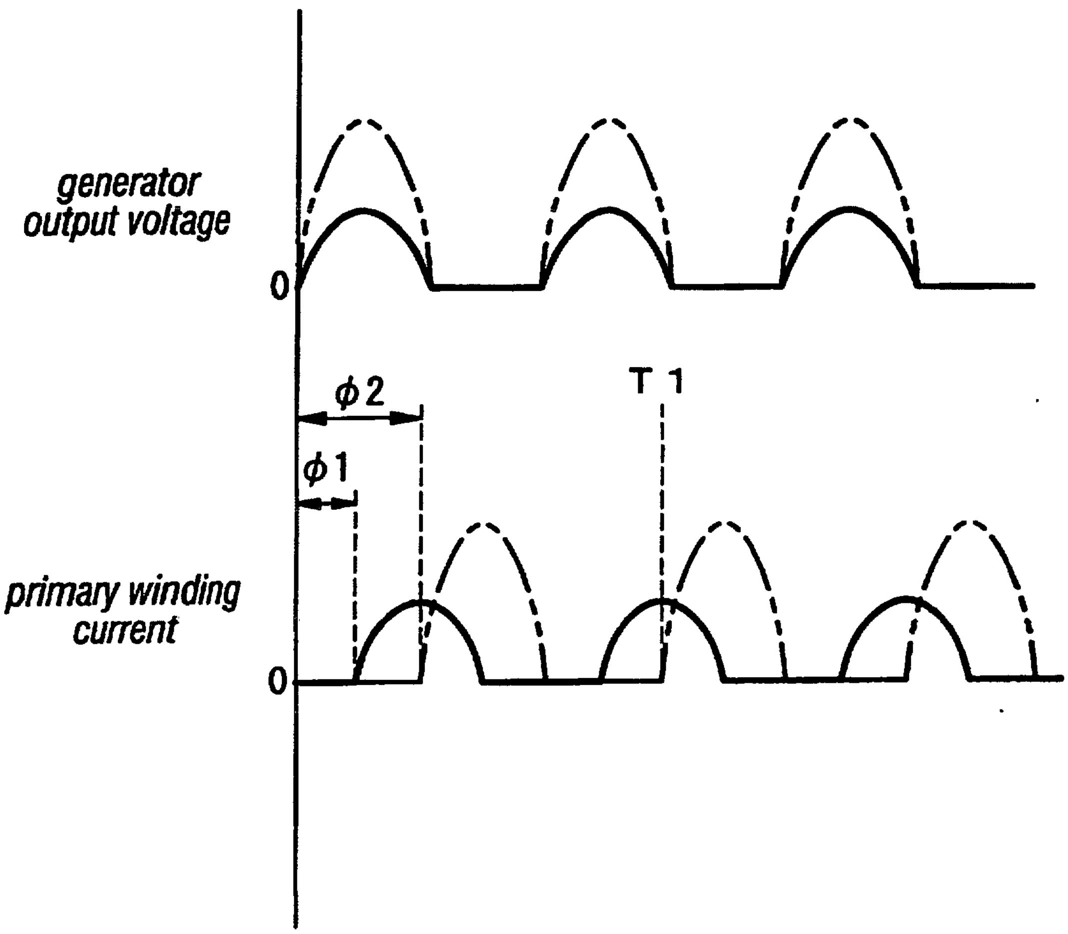

12
13
15
16
21
REG/REC
L1
L2
Vcc
power supply block
14
12a
Vcc
Vcc
8
Q1
pulser waveform input block
ignition coil primary current control block
12b
12c

Fig. 9


generator output voltage
0
φ2
φ1
T1
primary winding current
0