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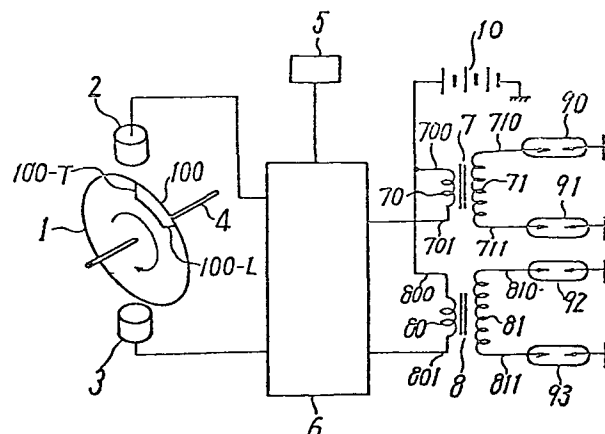
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(54) DEVICE FOR CONTROLLING IGNITION TIMING.

(57) A leading angle control system of low voltage distribution type in which there is no high voltage distribution by means of a distributor. This system provides an ignition reference signal having a predetermined angular duration not on the basis of the rotational position of the rotary shaft of a distributor but on the basis of the position of a crankshaft through a plurality of proximity switches, thereby eliminating an error between the position of the crankshaft and the rotational position of the engine. Thus, this system can accurately and stably control the ignition timing of the engine to effect high practical value.


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SPECIFICATION

TITLE MODIFIED

see front page

TITLE OF THE INVENTION

IGNITION TIMING CONTROL APPARATUS

TECHNICAL FIELD

This invention relates to an ignition timing control apparatus for an engine.

BACKGROUND ART

For the purpose of controlling the ignition timing of engines, it has come to use a centrifugal advance mechanism and a vacuum advance mechanism disposed within the distributor mechanically coupled to engines. However, it is said that only the abovementioned mechanical control is insufficient and the electronic control is indispensable for the demands for motor vehicles of these days that harmful exhaust gases decrease and the operating performance and fuel characteristics are improved. General electronically controlled ignition control apparatus control the ignition timing by having, as one input, a reference position sensor disposed within the distributor and further, as the other input, another sensor for sensing the operating status of engines, for example, a negative pressure in the suction manifold or like, calculating electrically the ignition timing and intermitting the primary current through the ignition coil. In this case a high voltage generated on the secondary side of the ignition coil is distributed among individual cylinders through a high voltage distribution

mechanism for the distributor as usual. In this system, as the reference ignition signal has been obtained from a position of rotation of the rotary shaft of the distributor, there is the possibility of causing an error between it and the position of rotation of the engine and also the distributor is still required for the purpose of distributing a high voltage regardless of an advance mechanism being disused.

DISCLOSURE OF THE INVENTION

The present invention relates to an advance control system of a low voltage distribution system without the high voltage distribution effected through a distributor and makes it possible to control an ignition timing highly stably with an extremely high accuracy by obtaining reference ignition signals with predetermined angle widths from positions of a crank shaft through a plurality of access switches but not from positions of rotation of a rotary shaft of a distributor. Thus the practical merit is extremely great.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a structural view illustrating an embodiment of the present invention; and

Figs. 2, 3 and 4 are diagrams of waveforms explaining the operation of the apparatus shown in Fig. 1.

BEST MODE FOR CARRYING OUT THE INVENTION

Fig. 1 is a structural view illustrating an embodiment of the present invention. In Fig. 1 (1) is a rotary member mounted to a crank shaft (4) for a four-cylinder four cycle engine (not shown) and having a portion (100) with a different electrical property on one part of its periphery. (2) and (3) are access switches mounted at positions symmetric with respect to the center of the rotary member (1) and disposed so as to generate outputs having pulse widths corresponding to the angle width of the portion (100) having the different electrical property at the periphery of the rotary member (1) in synchronization with the rotation of the rotary member (1). (5) is a negative pressure sensor for measuring a pressure in a suction manifold for the engine. (6) is an ignition control device having, as inputs, signals provided from the access switches (2) and (3) and the negative pressure sensor (5) and effecting the supply and interruption of currents to ignition coils (7) and (8) at proper timings. The ignition coils (7) and (8) have primary windings (70) and (80) and secondary windings (71) and (81) respectively. The primary winding (70) or (80) is connected at one end (700) or (800) to that side of an electric source (10) not connected to ground and the other end (701) or (801) to the ignition control device (6). The secondary windings (71) and (81) of the ignition coils (7) and (8) have output terminals (710), (711), (810) and (811) connected to ignition plugs (90), (91), (92) and (93) respectively. In Fig. 1 it is assumed that an ignition sequence is in

the order of the ignition plugs (90), (91), (92) and (93). When the rotary member (1) is rotated in the direction of the arrow as shown in Fig. 1, electrical signals provided from the access switches (2) and (3) have waveforms such as shown in Fig. 2. If the tailing edge (100-T) of the portion with the different electrical property formed on the rotary member (1) is now set to a reference ignition position (for example, an upper dead point) of each cylinder, then points P_{90} , P_{91} , P_{92} and P_{93} coincide with the upper dead points of the cylinders corresponding to the ignition plugs (90), (91), (92) and (93) respectively. Accordingly if the primary current through the ignition coil (7) is interrupted, for example, at the point P_{90} then a high voltage is generated across the secondary winding (71) and the corresponding cylinder is ignited through the ignition plug (90). In this case the high voltage is also generated on the ignition plug (91), but that cylinder corresponding to the ignition plug (91) is in its exhaust stroke at that time point. Therefore, an electric discharge occurs at a low voltage because a pressure within the cylinder is low. For this reason, the greater part of the high voltage generated across the secondary winding (71) of the ignition coil (7) is applied to the ignition plug (90) to supply to the ignition plug (90) energy required for an ignition. Also the reverse affair occurs at the point P_{91} in Fig. 2. That is, the point P_{91} is equal to the upper dead point of that cylinder corresponding to the ignition plug (91) and a greater part generated across the secondary winding (71) of the ignition coil (70) is applied to the ignition plug

(91). Also a similar affair is also said with respect to the points P_{92} and P_{93} in Fig. 2. Thus, by interrupting the primary currents through the ignition coils (7) and (8) at the tailing edges of the electrical signals provided from the access switches (2) and (3) respectively, high voltages can be applied to the four ignition plugs (90), (91), (92) and (93) in the proper order. In the actual engines, the ignition timing is not fixed to the upper dead point as described above and it is required to cause the ignition at the proper timing in accordance with the operating status (the number of revolution, loading etc.) of the engines. In the embodiment of Fig. 1 the ignition control device (6) is used for this purpose. Namely the ignition control device (6) forms inputs of the reference position signal provided from the access switches (2) and (3), a signal for the number of revolution of the engine obtained by measuring the period of the reference position signals and a signal from the other sensor (the negative pressure sensor (5) in Fig. 2) for sensing the operating status of the engine, calculates the proper ignition position and controls currents through the ignition coils (7) and (8). That is, ignition signals are generated at points Q_{90} , Q_{91} , Q_{92} and Q_{93} leading tailing edges P_{90} , P_{91} , P_{92} and P_{93} of signal waveforms provided from the access switches (2) and (3) by angles of θ_A as shown in Fig. 3 and interrupt the primary current through the ignition coil (7) or (8). In Fig. 3 the angle θ_A is an angle calculated and controlled by the ignition control device (6) and called generally an advance angle. It is generally required to control the ignition timing to

a position leading the reference ignition position (a temporally faster position) but in Fig. 3, for example, it is impossible to control the point Q_{91} by referring to the point P_{91} lagging behind the point Q_{91} and the control is effected as a delay time (or an angle) from the point P_{90} or P_{91} leading the point P_{91} . In this case, a difference of at most 180° in angle of the crank shaft exists between the P_{90} and the point P_{91} and it is extremely difficult to control the point Q_{91} with a good accuracy. This is conspicuous particularly with the engine rotated non-smoothly. Also with the rotation of the engine varied abruptly, an abnormal advance is caused to stop the engine. In the extreme case the engine may be broken. Another object of the present invention is to eliminate such objections. In Fig. 1 the tailing edge (100-T) of the portion (100) having the different electrical property and disposed on the rotary member (1) is determined so as to correspond to the reference ignition position as described above, but a leading edge (100-L) is determined so as to correspond to a maximum advance required for the engine or a position leading the maximum advance by a constant magnitude. From this it is possible to avoid the abovementioned objections. In this case, the relationship between the signal waveforms provided from the access switches (2) and (3) and the ignition signal outputted from the ignition control device 6 is substantially as shown in Fig. 4. In Fig. 4 θ_M is of a magnitude of the maximum advance or a magnitude larger a constant angle than it. In the relationship between the waveforms such as shown in Fig. 4, the ignition timings Q_{90} , Q_{91} , Q_{92} and Q_{93} can

be controlled as delays from the R_{90} , R_{91} , R_{92} and R_{93} by the ignition control device (6) respectively. Thus the control accuracy is sharply improved. Further, by limiting the ignition timings Q_{90} , Q_{91} , Q_{92} and Q_{93} so as not to advance beyond the R_{90} , R_{91} , R_{92} and R_{93} respectively, an abnormal advance can be prevented even with the rotation changed abnormally. Thus the great effect is present in the stable operation of the engine. Further, as the access switches (2) and (3) one can use the oscillation type sensing the access of a metal, or the Hall element type sensing the access of a magnetic material or the like.

As described above, the present invention relates to an advance control system of a low voltage distribution system without a high voltage distribution effected through a distributor and makes it possible to control the ignition timing highly stably with an extremely accuracy by providing reference ignition signals with predetermined angle widths from positions of a crank shaft through a plurality of access switches but not from positions of rotation of a rotary shaft of a distributor. Therefore the practical merit is extremely great.

INDUSTRIAL APPLICABILITY

The present invention is not restricted to an ignition timing control apparatus having a negative pressure sensor adopted as a sensor for sensing the operating status of an engine but it is equally applicable to ignition timing control apparatus inputted with a signal from the sensor for a temperature of cooling water, the atmospheric pressure,

the air temperature or the like to control the ignition timing. Also regarding the number of cylinders of an engine there is no limitation and one can cope with six- or eight-cylinder engines by increasing the number of access switches and increasing the number of ignition coils. That is, three access switches and three ignition coils may be used with six-cylinder engines and four access switches and four ignition coils may be used with eight-cylinder engines thereby to realize similar affairs as in the four-cylinder engine.

CLAIMS

(1) An ignition timing control apparatus consisting of a rotary member mounted to a crank shaft for an engine, a portion having a different electrical property and disposed on one part of said rotary member through a constant angle relative to a direction of rotation, access switches disposed so as to sense the portion with the difference electrical property on said rotary member, the number of said access switches equaling one half the number of cylinders of the engine, at least one sensor disposed so as to sense the operating state of said engine, an ignition timing control circuit inputted with outputs from said plurality of access switches and said at least one sensor, and a plurality of ignition coils connected to said ignition timing control circuit.

(2) An ignition timing control apparatus according to claim (1), wherein a trailing edge of the portion having the different electrical property with respect to the direction of rotation of said rotary member is set to a reference ignition position of each cylinder.

(3) An ignition timing control apparatus according to claim (2), wherein an electrical signal provided from said reference ignition position is changed in accordance with the operating status of the engine.

(4) An ignition timing control apparatus according to claim (1), wherein said ignition timing circuit has inputs formed of reference position signals provided from said

access switches, a signal for the number of rotation of the engine obtained by measuring the period of the reference position signals and an output signal from the sensor for sensing the operating status of the engine.

(5) An ignition timing control apparatus according to claim (2), wherein a leading edge of said portion with the different electrical property corresponds to a maximum advance angle required for the engine or a position leading it by a constant magnitude.

(6) An ignition timing control apparatus according to claim (3), wherein the ignition timing is set by a position leading a position of the electrical signal corresponding to said reference ignition position by a predetermined angle calculated by said ignition timing control circuit.

(7) An ignition timing control apparatus according to claim (1), wherein said access switch senses the access of a metal.

(8) An ignition timing control apparatus according to claim (1), wherein said access switch senses the access of a magnetic material.

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FIG. 1

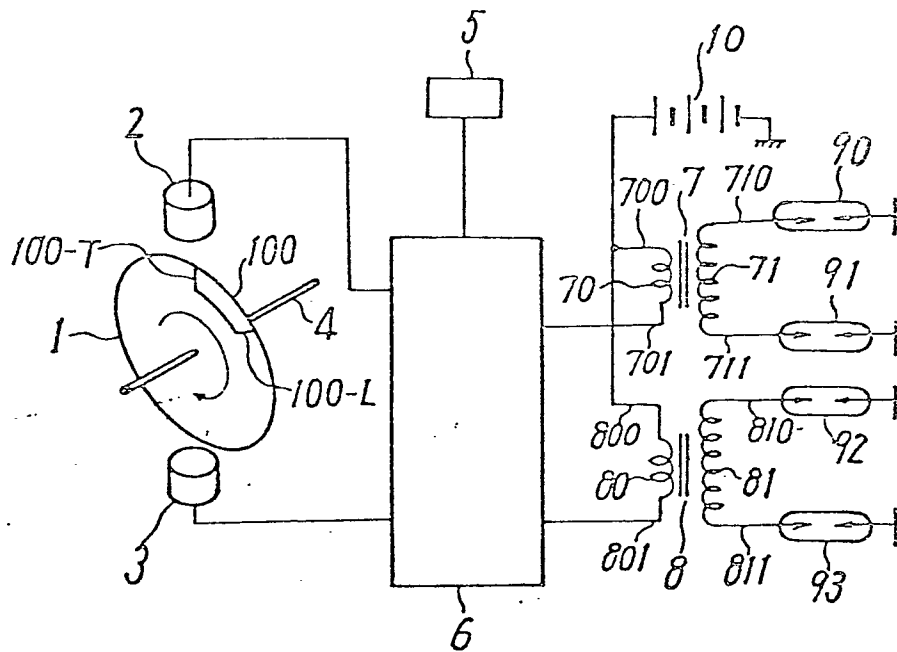
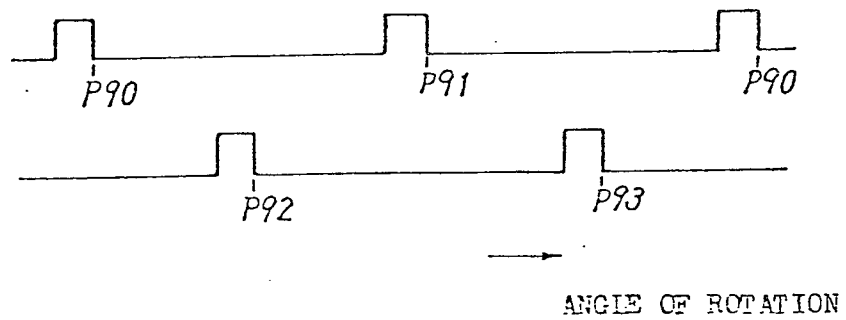


FIG. 2

OUTPUT FROM (2)

OUTPUT FROM (3)



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FIG. 3

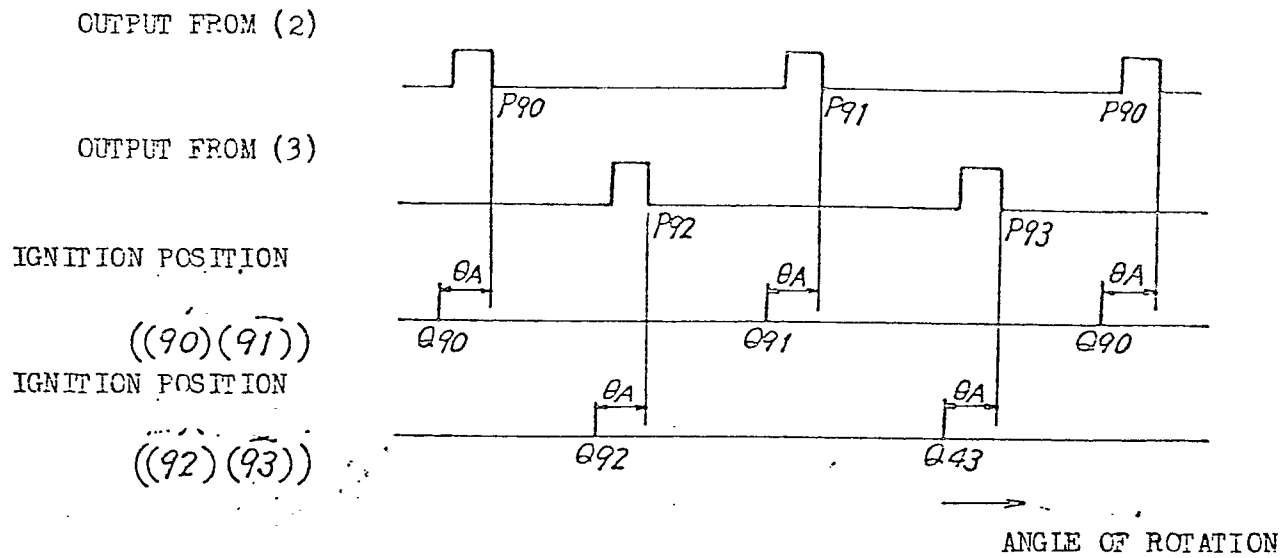
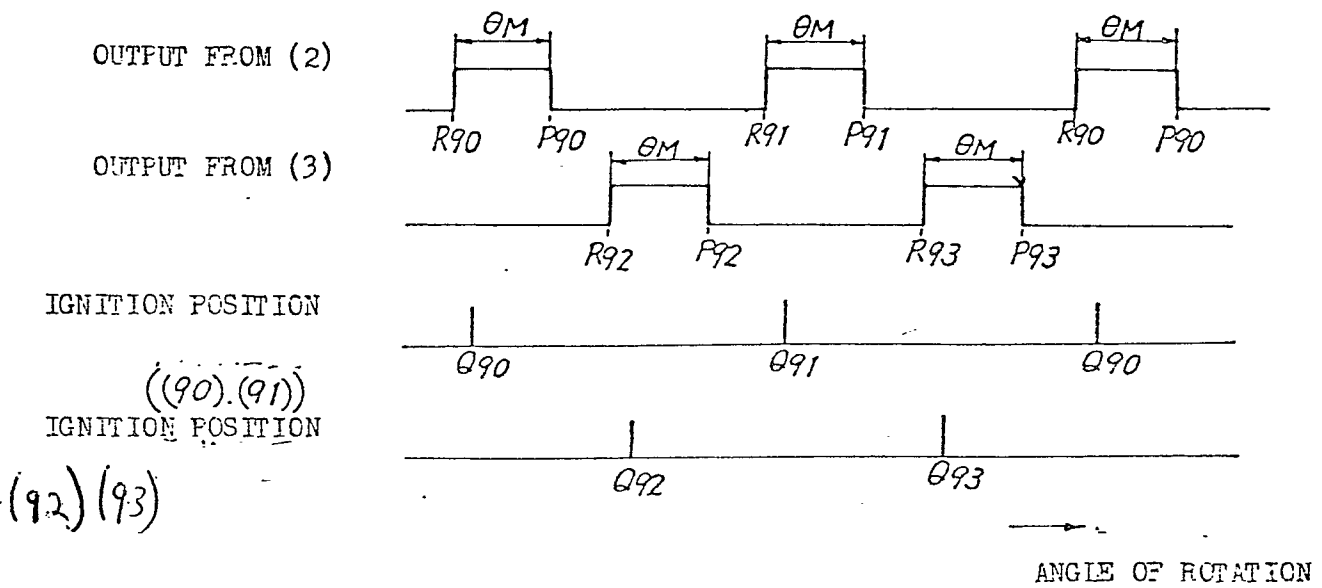


FIG. 4



INTERNATIONAL SEARCH REPORT

International Application No PCT/JP80/00177

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all) ³ According to International Patent Classification (IPC) or to both National Classification and IPC		
Int. Cl. ³ Fo2P 5/04		0033748
II. FIELDS SEARCHED		
Minimum Documentation Searched ⁴		
Classification System	Classification Symbols	
I P C	Fo2P 5/00, Fo2P 3/00	
Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched ⁵		
Jitsuyo Shinan Koho		1965 - 1980
Kokai Jitsuyo Shinan Koho		1974 - 1980
III. DOCUMENTS CONSIDERED TO BE RELEVANT ¹⁴		
Category *	Citation of Document, ¹⁶ with indication, where appropriate, of the relevant passages ¹⁷	Relevant to Claim No. ¹⁸
X	JP, A, 51-10231, 1976-1-27 Whole sentence, Hitachi, Ltd.	1, 2, 3, 4, 5, 6, 8
X	DT, A, 2,512,166, 1976-10-14 Whole sentence, Robert Bosch G.m.b.H.	1, 2, 3, 5, 6
A	JP, A, 53-68330, 1978-6-17 Whole sentence, Hitachi, Ltd.	1, 8
A	JP, A, 53-70230, 1978-6-22 Fig. 3, NIPPONDENSO CO., LTD.	1, 8
A	JP, A, 49-111048, 1974-10-23 Whole sentence, Nippon Jidosha Buhin Sogo Kenkyusho Kabushiki Kaisha	3, 6
A	GB, A, 1,420,814, 1976-1-14 Whole sentence, Rhuminission Ltd.	2, 3, 5, 6
* Special categories of cited documents: ¹⁵ "A" document defining the general state of the art "E" earlier document but published on or after the international filing date "L" document cited for special reason other than those referred to in the other categories "O" document referring to an oral disclosure, use, exhibition or other means "P" document published prior to the international filing date but on or after the priority date claimed "T" later document published on or after the international filing date or priority date and not in conflict with the application, but cited to understand the principle or theory underlying the invention "X" document of particular relevance		
IV. CERTIFICATION		
Date of the Actual Completion of the International Search ²		Date of Mailing of this International Search Report ³
August 29, 1980 (29.08.80)		September 22, 1980 (22.09.80)
International Searching Authority ¹		Signature of Authorized Officer ²⁰
Japanese Patent Office		

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