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(54) Internal combustion engine stroke identification system

System zur Erkennung des Arbeitstakts der Kolben in einer inneren Brennkraftmaschine

Système d'identification du temps de course de piston d'un moteur à combustion interne

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EP-A- 204 220 **EP-A- 204 221**
EP-A- 0 319 496 **WO-A-89/03937**
GB-A- 2 217 782 **US-A- 4 365 602**
US-A- 4 625 704 **US-A- 4 932 379**

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Description

The present invention relates to a system for identifying the strokes of an internal combustion engine, particularly during startup and with special reference to an electronic ignition system.

Internal combustion engine electronic ignition systems are known to feature an electronic control system for determining spark advance on the basis of signals received from various sensors (principally engine speed and stroke sensors). If said systems are also electronic injection types, on the basis of further signals (intake air pressure and temperature), the control system determines, for example, air density inside the manifold and engine speed, and calculates, via interpolation on respective memorised maps, the stroke of the engine and fuel injection time to the injectors. Said electronic ignition system employs angle references fitted on to the drive and distributor shafts to enable the control system to identify the stroke of each cylinder on the engine (intake, compression, expansion, exhaust).

Current stroke identification systems employ angle references on the drive shaft, equal in number to the cylinders on the engine, and consisting, for example, of equally spaced projecting teeth. Said references are detected by a first sensor arranged facing them and which, every two references, and via the control system enables an ignition command. Said system also requires a further stroke sensor for detecting the angle of an auxiliary shaft turning at half the speed of, but in strict time with, the drive shaft, and consisting, for example, of the camshaft or similar. In the event of a fault on the stroke sensor, the electronic ignition system becomes totally ineffective, thus resulting in stoppage of the engine, which can only be restarted by repairing the stroke sensor.

US-A-4.625.704 discloses an electronic ignition system comprising a computer, preferably a micro-processor, which receives input signals representative of both the engine speed and the rotational position of the engine crank shaft. The computer also receives input signals representative of the voltage level of the power supply for battery as well as an input signal representative of the spark advance. Based on its input signals, the computer generates an output signal which electrically connects, through a power switch, the primary coil of the ignition to a power source.

Patent application EP-A-319.496 discloses a method for achieving elevated charging of an ignition capacitor in a capacitive type ignition system for an internal combustion engine.

This method solves the problem of charging the ignition capacitor during the engine starting sequence in which the battery voltage falls down and varies sinusoidally in correlation to the compression strokes of the engine.

The aim of the present invention is to provide an internal combustion engine stroke identification system

designed to overcome the above drawback, i.e. which enables the engine to be started even in the event of a fault on the stroke sensor.

An internal combustion engine stroke identification system for an internal combustion engine comprising:

a fuel supply member;
an electronic ignition system featuring a distributor and a drive shaft;
first sensor means for detecting predetermined angular positions of a drive shaft and outputting a first pulsing signal (S);
a battery supplying a voltage to said engine;
second sensor means for detecting predetermined angular positions of the shaft of said distributor and outputting a second pulsing signal (C);
processing means receiving the signals (S,C) generated by said first and said second sensor means; said processing means being able to identify the stroke of the internal combustion engine is known from EP-A-204 221.

With the above aim in view, the present invention is characterized by the fact that said processing means comprises:

- sampling means for sampling the voltage of said battery when starting up said engine, said voltage being modulated in dependence on the compression strokes of the engine;

said sampling means being able to sample said voltage in correspondence of pulses (S) of said first signal;

- memorising means for memorising said sampled voltages;
- detecting means for detecting an error condition caused by a loss of at least one pulse of said second signal (C);

said error condition being detected when the number of consecutive pulses (S) received from said first sensor means reaches a predetermined limit number;
said error condition causing a loss of information in the stroke identification;

- comparing means, which are selected in the case that an error is detected, for comparing memorised samples of said voltage;

said comparing means being able to compare at least a first and a second adjacent sample;
said comparing means being able to select a first calculating means or a second calculating means depending on the result of the comparison of said at least first and second sample;

said first and said second calculating means setting respectively first and second angular relations between top dead centre position of a cylinder of said engine and pulses of said first signal (S).

A preferred, non-limiting embodiment of the present invention will be described by way of example with reference to the accompanying drawings, in which:

Fig.1 shows a schematic view of an electronic injection system for an internal combustion engine featuring the engine stroke identification system according to the present invention;

Fig.2 shows a schematic view of certain components on the Fig.1 system;

Fig.3 shows an operating block diagram of the system according to the present invention;

Fig.4 shows a schematic view of a number of signals on the system according to the present invention.

The system according to the present invention may be used on engines featuring an electronic ignition system with or without an electronic injection system. In the example shown, the engine also features an electronic injection system, i.e. a certain type of fuel supply, but, as will become apparent in the following description, the system according to the present invention also applies in the case of fuel supplied by an ordinary carburetor, providing, of course, provision is made for an electronic ignition system.

Fig.1 shows a schematic view of an electronic injection system for an internal combustion engine 101, conveniently a four-cylinder engine, shown partially in cross section. Said system comprises an electronic control system 102 in turn comprising, in substantially known manner, a microprocessor 103 and memories containing maps relative to various operating conditions of engine 101. Control system 102 also comprises a first counter 104; an updatable memory register 105; an addressable-cell memory register 106; and a second counter 109. Control system 102 receives signals from a sensor 107 for detecting the speed of engine 101 and located opposite a pulley 108 fitted on to a drive shaft 111; a sensor 112 for detecting the stroke of engine 101 and located inside a distributor 113; a sensor 114 for detecting the absolute pressure in the intake manifold 115 of engine 101; a sensor 116 for detecting the air temperature inside manifold 115; a sensor 117 for detecting the water temperature inside the cooling jacket of engine 101; and a sensor 118 consisting substantially of a potentiometer, for detecting the setting of a throttle valve 121 located inside intake manifold 115 and controlled by the accelerator pedal 122. An extra air supply valve 123 is provided parallel to throttle valve 121.

Control system 102 is grounded and connected to a supply battery 124. On the basis of signals supplied to control system 102, engine speed and air density are

used for determining fuel supply as a function of the required mixture strength. Parallel to the above supply line, a second line connects battery 124 to an input port on control system 102. For the reasons described later on, said second line presents, in series, a voltage divider 125 and an analog-digital converter 126. Control system 102 controls the opening time of electroinjectors 127 located inside manifold 115, close to the intake valve of each cylinder, for controlling fuel supply to the various cylinders on engine 101, and controls fuel injection timing for commencing fuel supply in relation to the stroke (intake, compression, expansion, exhaust) of engine 101. Electroinjector 127 is supplied with fuel via a pressure regulator 128 sensitive to the pressure inside intake manifold 115, and having a fuel inlet conduit 131 connected to a pump (not shown), and a return conduit 132 to a tank (not shown). Finally, control system 102 is connected to an ignition pulse control unit 133 connected to distributor 113.

With reference to Fig.2, pulley 108 presents four projecting teeth 134 equally spaced at 90° intervals, and sensor 107 is arranged facing the passage of teeth 134, at such an angle as to detect passage, for example, at +10° and +100° in relation to the top dead center position of each cylinder. Said angles may of course range from +20° to +0° and from +110° to +90°. The sequence of signals (S) supplied by sensor 107 as drive shaft 111 rotates is shown in Fig.4a. Again with reference to Fig. 2, sensor 112 is arranged facing a disc 135 secured angularly to the shaft of distributor 113, and having two projecting teeth 136 ninety degrees apart. In particular, sensor 112 is located within the cylinder 3 range of distributor 113, and at such an angle that, when one tooth 134 is arranged facing speed sensor 107, the first tooth 136 on disc 135 lags 27.5° in relation to the axis of sensor 112. The sequence of signals (C) supplied by sensor 112 (Fig.4b) for each complete cycle of engine 101 presents a first signal 55° behind the foregoing signal from sensor 107 and, in the example shown, 135° ahead of the top dead center position of cylinder 3. The second signal supplied by sensor 112 as the second tooth 136 moves past it is 135° ahead of the top dead center position of cylinder 4, and 180° behind the first signal from sensor 112, in that, each complete turn of disc 135 corresponds to two turns of drive shaft 111 and, consequently, pulley 108. Operation of the system for identifying the strokes of engine 101 is described in the aforementioned EP-A-204 221, corresponding to Italian Patent n.1184958 entitled "Internal combustion engine stroke identification system" filed by the present Applicant on 4.6.1985, issued on 28.10.1987.

As already stated, in the event of a fault on stroke sensor 112, the electronic ignition system becomes totally ineffective and engine 101 stops, and can only be restarted by repairing sensor 112. As explained in more detail later on, by sampling the voltage of battery 124 during startup, the system according to the present invention provides for identifying successive top dead

center positions, but not the compression stroke cylinder. Control system 102 provides, albeit randomly, for controlling fuel injection. If injection relates to other than an intake stroke cylinder, the respective intake valve, being closed, retains the fuel inside manifold 115. Via unit 133, control system 102 also provides for controlling ignition in the compression stroke cylinder. An essential characteristic of distributor 113, in fact, is the ability to identify the compression stroke cylinder, by virtue of the distributor shaft being angularly connected to disc 135 and therefore having a precise reference in relation to pulley 108 and, consequently, drive shaft 111. As already stated, control system 102 provides for controlling ignition and, in the case of electronic injection systems, also injection. In the case of normal carburetors, fuel supply is regulated by the carburetors themselves.

With reference to Figs 4d and 4e, laboratory tests have shown that, when starting up engine 101, the voltage V_b of battery 124 supplying an auxiliary electric starting motor drops for as long as said starting motor is being supplied, i.e. from instant (t_1) at which the starting motor commences startup of engine 101, to instant (t_2) at which engine 101 is actually started up. Closer analysis of said voltage drop has shown that the battery voltage modulates (δV_b) in relation to a mean value V_{bm} calculated, naturally, between t_1 and t_2 . As said modulation consists in the resistance offered by the compression stroke pistons, it may safely be said that each δV_b value corresponds to a compression stroke cylinder. In other words, during startup, the battery itself may provide signals enabling control system 102 to identify successive top dead center positions, which signals are supplied to microprocessor 103 by divider 125 and converter 126.

Operation of the system for identifying the strokes of engine 101 will be described with reference to Fig.3. As shown in Fig.3, from a start block 151 the system goes on to block 152, which provides for initializing microprocessor 103. Block 152 then goes on to block 153 which enables the S and C signal observation channels. Block 153 then goes on to block 154 which, via an S and C signal recognition routine, checks the signals are present and that they actually relate to sensors 107 and 112. Block 154 then goes on to block 155 which, if the signal received by microprocessor 3 is from sensor 107, goes on to block 156, and, if it is from sensor 112, goes on to block 157. Block 156 provides for reading the battery voltage and extracting the peak values, after which, it goes on to block 158 and from there to block 161. Block 158 provides for memorising the battery voltage reading in a table, and block 161 for incrementing counter 104 by one unit, thus constantly updating the number of S signals received consecutively. Counter 104 is of course reset in block 152 each time the procedure is initiated. Block 161 goes on to block 162 which compares the number of S signals updated in block 161 with the maximum number. If the number of S signals equals the maximum number in block 162, this goes on to block

163. Conversely, block 162 goes on to block 157, which enters the S and C signals sequentially into counter 109. Block 157 then goes on to block 164, which determines whether the sequence of S and C signals is sufficient to recognize the strokes of engine 101. If it is not, block 164 goes back to block 154; if it is, block 164 goes on to block 165. Block 163 provides for adding the third and fifth and the fourth and sixth battery voltage readings, as well as for comparing the two sums. If the first sum is greater than or equal to the second, block 163 goes on to block 166. Conversely, block 163 goes on to block 167. Blocks 166 and 167 inform microprocessor 103 that the next S signal will be received respectively 100° and 10° prior to the top dead center position. Modulation of the battery voltage in Fig.4e is shown to be perfectly sinusoidal in relation to the V_{bm} value. In actual fact, however, it consists of a sequence of small dips in which the value of one dip may even be greater than the peak values preceding the adjacent one. It was therefore decided to add the readings of two successive peaks and two successive adjacent dips. Two blocks could of course have been used in place of block 163, one for comparing the third and fourth readings, and the other for comparing the fifth and sixth readings. If the third reading is greater than or equal to the fourth, the first block goes on to block 167. Conversely, the first block goes on to the second block which, if the fifth reading is lower than the sixth, goes on to block 166 and, if it is not, goes on to block 167. The very first battery voltage readings are ignored in that voltage modulation has been found to be normalized better as of the third reading. Blocks 166 and 167 go on to block 165 which initializes counter 109 in accordance with the S and C signal sequence (Fig. 4c). Block 165 then goes on to loop block 168 in which control system 102 controls the electronic ignition system. The S and C signal sequence memorised in counter 109 is employed in a service routine in block 168 which provides for actually controlling electronic ignition.

Counter 104 is incremented one unit for each S signal and reset for each C signal, which means it can count from 0 to the maximum number of S signals received successively between one C signal and the next. In the example shown of a four-cylinder engine, two teeth 136, a predetermined angular position of sensors 107 and 112, and a rotation speed of disc 135 equal to half that of pulley 108, the maximum number of S signals receivable is 5 assuming the counter starts from 0. Counter 104 is of course also zeroed whenever the maximum number of S signals is reached. The time sequence of the output value from counter 109 is shown in Fig.4c. Counter 109 is incremented one unit for each signal received from sensors 107 and 112, and can count from 0 to 9. When the maximum value (9) is reached, the next signal from sensor 107 sends the counter back to 0 in that the same signal cycle from sensors 107 and 112 and the same stroke cycle of engine 101 is repeated. The output value of 0 to 9 on counter 109 therefore iden-

tifies the strokes of engine 101, as described in EP-A-204 220, corresponding to Italian Patent n. 1184957 entitled "Startup fuel supply system for an internal combustion engine comprising an electronic injection system" filed on 4.6.1985 by the present Applicant, issued on 28.10.1987.

Once the strokes of engine 101 have been identified, block 168 provides for sequentially supplying the ignition pulses via unit 133, while distribution to the various cylinders is performed by distributor 113. In the case of electronic injection systems, fuel is supplied as described in said Italian Patents n. 1184957 and n. 1184958, if no fault is present on sensor 112, and in generally random manner, as described previously, if sensor 112 is defective.

The advantages of the present invention will be clear from the foregoing description.

In particular, it provides for overcoming malfunctioning of the stroke sensor prior to starting the engine, by sampling the voltage of the vehicle battery when operating the starter and during synchronization, the purpose being to identify which pair of battery voltage readings relates to a respective top dead center position. For this purpose, it has been certified that a dip in the modulation of the voltage corresponds to a compression stroke cylinder. By comparing (in block 163) the sampled battery voltages, the pair of teeth 134 relative to the lowest voltage readings can be said to be representative of top dead center position references. A sequence of signals may thus be defined for generating the electronic ignition pulses.

To those skilled in the art it will be clear that changes may be made to the identification system as described and illustrated herein without, however, departing from the scope of the present invention as defined in the appended claims.

In particular, the system according to the present invention may be applied to any engine featuring an electronic ignition system, regardless of whether fuel supply is controlled electronically, as on electronic injection systems, or by means of a normal carburetor. It should be stressed that the system according to the present invention also provides for identifying the top dead center position in lieu of other coding methods, such as a fifth reference located close to one of the four basic references (134), and which is used solely for identifying the two basic references close to the top dead center position. This latter solution involves a number of drawbacks, such as difficulty in discriminating between the fifth and basic reference, due to the very small distance between the two, thus resulting in a limitation of the maximum rpm speed obtainable. The system according to the present invention may be employed for improving the performance of systems featuring only two angle references, and at no extra cost for installing additional devices over and above those already provided.

Claims

1. An internal combustion engine stroke identification system of an internal combustion engine comprising:

a fuel supply member;
 an electronic ignition system featuring a distributor (113) and a drive shaft (111);
 first sensor means (107) for detecting predetermined angular positions of a drive shaft (111) and outputting a first pulsing signal (S);
 a battery supplying (124) a voltage to said engine;
 second sensor means for detecting predetermined angular positions of the shaft of said distributor (113) and outputting a second pulsing signal (C);
 processing means (102) receiving the signals (S,C) generated by said first and said second sensor means;
 said processing means (102) being able to identify the stroke of the internal combustion engine, characterised by the fact that said processing means comprises:

- sampling means (156) for sampling the voltage of said battery when starting up said engine, said voltage being modulated in dependence on the compression strokes of the engine;

said sampling means being able to sample said voltage in correspondence with pulses (S) of said first signal;

- memorising means (158) for memorising said sampled voltages;
- detecting means (162) for detecting an error condition caused by a loss of at least one pulse of said second signal (C);

said error condition being detected when the number of consecutive pulses (S) received from said first sensor means (107) reaches a predetermined limit number;
 said error condition causing a loss of information in the stroke identification;

- comparing means (163), which are selected in the case that an error is detected, for comparing memorised samples of said voltage;

said comparing means (163) being able to compare at least a first and a second adjacent sample;
 said comparing means (163) being able to select a first calculating means (166) or a second calculating means (167) depending on the

result of the comparison of said at least first and second sample;

said first and said second calculating means (166, 167) setting respectively first and second angular relations between top dead centre position of a cylinder of said engine and pulses of said first signal (S).

2. A system according to claim 1, characterised by the fact that said processing means (102) comprise means (155) for discriminating between said first and second signals (S, C) generated and, upon identifying a signal (S) sent by said first sensor means (107), enabling said sampling means (156), said memorising means (158) and said detecting means (162).
3. A system as claimed in claim 2, characterised by the fact that said detecting means (162) comprises a first counter (104) which is incremented (161) by one unit for each consecutive pulse detected of said first signal (S);

the content of said first counter (104) being reset when the system is initiated and the engine is started up.
4. A system as claimed in one of the foregoing claims, characterised in that a voltage divider (125) and an analog to digital converter (126) are series connected and disposed between said battery and an input of said processing means (102).

Patentansprüche

1. Verbrennungskraftmaschinentakt-Identifikationssystem für eine Verbrennungskraftmaschine mit:

einem Kraftstoffversorgungsteil;
einem elektronischen Zündsystem mit einem Verteiler (113) und einer Antriebswelle (111);
einem ersten Sensor (107) zum Erfassen von vorbestimmten Winkelstellungen einer Antriebswelle (111) und zum Ausgeben eines ersten pulsformigen Signals (S);
einer Batterie (124), welche der Maschine eine Spannung liefert;
einem zweiten Sensor zum Erfassen von vorbestimmten Winkelstellungen der Welle des Verteilers (113) und zum Ausgeben eines zweiten pulsformigen Signals (C);
Verarbeitungsmitteln (102), welche die von dem ersten und dem zweiten Sensor erzeugten Signale (S, C) empfangen;
wobei die Verarbeitungsmittel (102) in der Lage sind, den Takt der Verbrennungskraftmaschine zu identifizieren, dadurch gekennzeichnet, daß

die Verarbeitungsmittel enthalten:

- ein Abtastmittel (156) zum Abtasten der Spannung der Batterie beim Starten der Maschine, wobei die Spannung in Abhängigkeit von den Kompressionshüben der Maschine moduliert wird;

wobei das Abtastmittel in der Lage ist, die Spannung in Übereinstimmung mit Impulsen (S) des ersten Signals abzutasten;

- ein Speichermittel (158) zum Speichern der abgetasteten Spannungen;
- ein Erfassungsmittel (162) zum Erfassen eines Fehlerzustandes, der durch einen Verlust von wenigstens einem Impuls des zweiten Signals (C) hervorgerufen ist;

wobei der Fehlerzustand erfaßt wird, wenn die Anzahl von vom ersten Sensor (107) erfaßten, aufeinanderfolgenden Impulsen (S) einen vorbestimmten Grenzwert erreicht;

wobei der Fehlerzustand einen Verlust von Information bei der Taktidentifizierung bewirkt;

- ein Vergleichsmittel (163), das in dem Fall, daß ein Fehler erfaßt wird, ausgewählt wird, um die gespeicherten Abtastwerte der Spannung zu vergleichen;

wobei das Vergleichsmittel (163) in der Lage ist, wenigstens einen ersten und einen zweiten benachbarten Abtastwert zu vergleichen;

wobei das Vergleichsmittel (163) in der Lage ist, in Abhängigkeit von dem Ergebnis des Vergleichs wenigstens des ersten und des zweiten Abtastwertes ein erstes Rechenmittel (166) oder ein zweites Rechenmittel (167) auszuwählen;

wobei das erste und das zweite Rechenmittel (166, 167) eine erste bzw. eine zweite Winkelbeziehung zwischen der oberen Totpunktstellung eines Zylinders der Maschine und Impulsen des ersten Signals (S) festsetzen.

2. System nach Anspruch 1, dadurch gekennzeichnet, daß die Verarbeitungsmittel (102) ein Mittel (155) zum Unterscheiden zwischen dem ersten und dem zweiten Signal (S, C) enthalten, welches bei einer Identifizierung eines von dem ersten Sensor (107) gesendeten Signals (S) das Abtastmittel (156), das Speichermittel (158) und das Erfassungsmittel (162) freigibt.
3. System nach Anspruch 2, dadurch gekennzeichnet, daß das Erfassungsmittel (162) einen ersten Zähler (104) enthält, der für jeden von erfaßten aufeinander-

derfolgenden Impulsen des ersten Signals (S) um eine Einheit erhöht wird (161);

wobei der Inhalt des ersten Zählers (104) zurückgesetzt wird, wenn das System gestartet und die Maschine angelassen wird. 5

4. System nach einem der vorhergehenden Ansprüche, dadurch gekennzeichnet, daß ein Spannungsteiler (125) und ein Analog-Digital-Umsetzer (126) in Reihe geschaltet und zwischen der Batterie und einem Eingang der Verarbeitungsmittel (102) angeordnet sind. 10

Revendications 15

1. Un système d'identification de course d'un moteur à combustion interne pour un moteur à combustion interne comprenant: 20

un élément d'alimentation de carburant;
un système d'allumage électronique comportant un distributeur (113) et un arbre d'entraînement (111); 25
un premier moyen capteur (107) pour détecter des positions angulaires prédéterminées d'un arbre d'entraînement (111) et produire en sortie un premier signal d'impulsions (S);
un accumulateur (124) fournissant une tension audit moteur; 30
un deuxième moyen capteur pour détecter des positions angulaires prédéterminées de l'arbre dudit distributeur (113) et produire en sortie un deuxième signal d'impulsions (C); 35
un moyen de traitement (102) recevant les signaux (S,C) générés par ledit premier et ledit second moyens capteurs;
ledit moyen de traitement (102) étant apte à identifier la course du moteur à combustion interne, caractérisé en ce que ledit moyen de traitement comprend: 40

- un moyen d'échantillonnage (156) pour échantillonner la tension dudit accumulateur lors de la mise en marche dudit moteur, ladite tension étant modulée en fonction des courses de compression du moteur; 45
- ledit moyen d'échantillonnage étant apte à échantillonner ladite tension en correspondance avec des impulsions (S) dudit premier signal; 50
- un moyen de mémorisation (158) pour mémoriser lesdites tensions échantillonnées;
- un moyen détecteur (162) pour détecter une condition d'erreur provoquée par une perte d'au moins une impulsion dudit deuxième signal (C); 55

ladite condition d'erreur étant détectée lorsque le nombre d'impulsions consécutives (S') reçues à partir dudit premier moyen capteur (107) atteint un nombre limite prédéterminé, ladite condition d'erreur provoquant une perte d'information dans l'identification de la course;

- des moyens de comparaison (163) qui sont choisis dans le cas où une erreur est détectée pour comparer les échantillons mémorisés de ladite tension;

lesdits moyens de comparaison (163) étant aptes à comparer au moins un premier et un deuxième échantillon contigus;
ledit moyen de comparaison (163) étant apte à sélectionner un premier moyen de calcul (166) ou un deuxième moyen de calcul (167) en fonction du résultat de la comparaison au moins dudit premier et deuxième échantillons;
ledit premier et ledit deuxième moyens de calcul (166, 167) établissant respectivement des premières et deuxièmes relations angulaires entre la position de point mort haut d'un cylindre dudit moteur et des impulsions dudit premier signal (S).

2. Un système selon la revendication 1, caractérisé en ce que lesdits moyens de traitement (102) comprennent un moyen (155) pour discriminer entre lesdits premier et deuxième signaux (S,C) générés et, lors de l'identification d'un signal (S) envoyé par ledit premier moyen capteur (107), valider ledit moyen d'échantillonnage (156), ledit moyen de mémorisation (158) et ledit moyen de détection (162).

3. Un système selon la revendication 2, caractérisé en ce que ledit moyen de détection (162) comprend un premier compteur (104) qui est incrémenté (161) d'une unité pour chaque impulsion consécutive détectée dudit premier signal (S);

le contenu dudit premier compteur (104) étant réinitialisé lorsque le système est initialisé et le moteur est démarré.

4. Un système selon l'une des revendications précédentes, caractérisé en ce qu'un diviseur de tension (125) et un convertisseur analogique-numérique (126) sont reliés en série et disposés entre ledit accumulateur et une entrée dudit moyen de traitement (102).

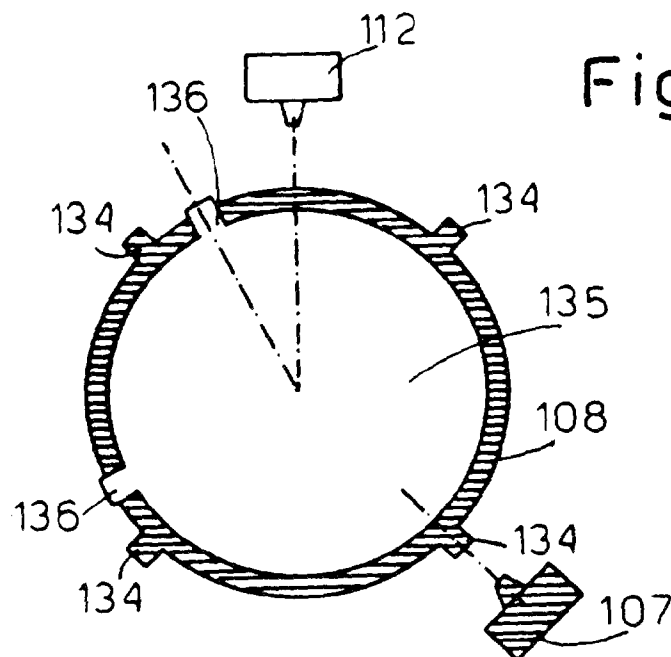
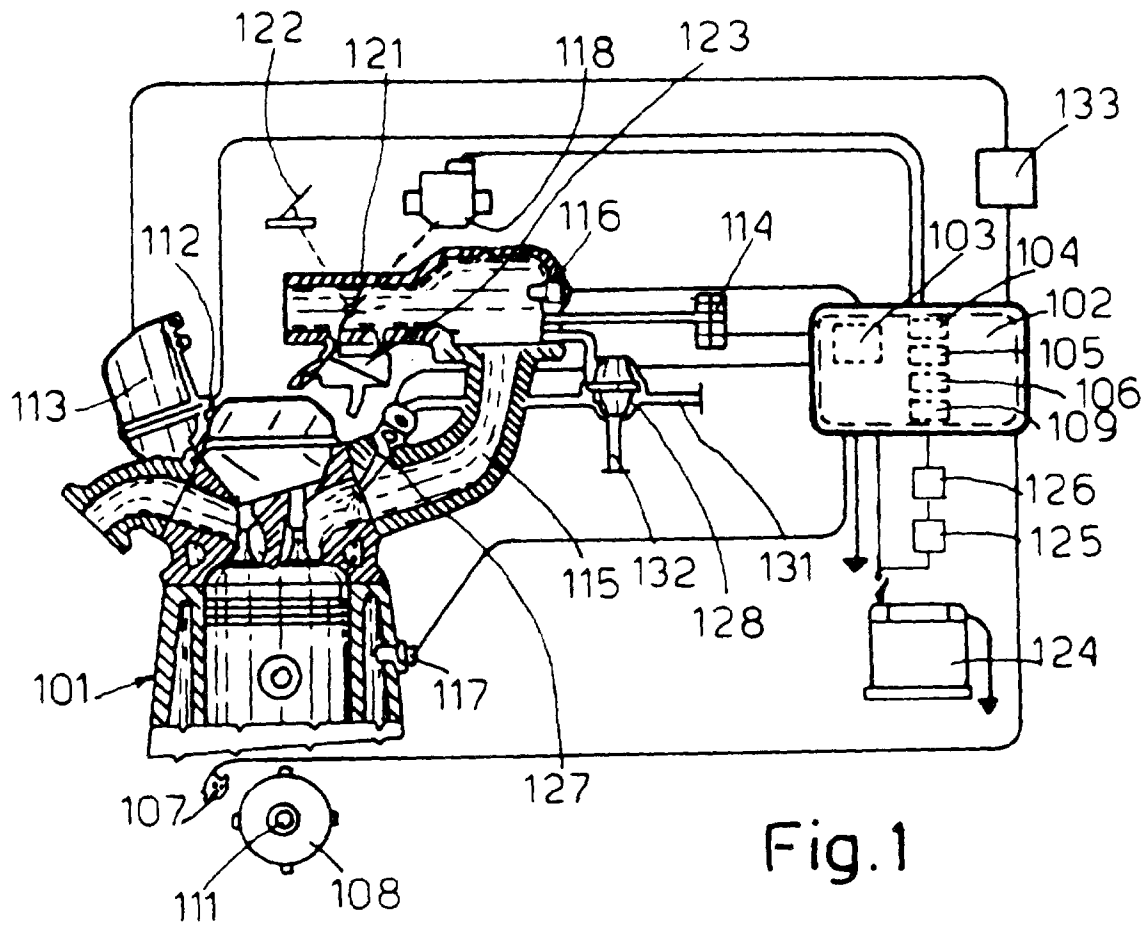
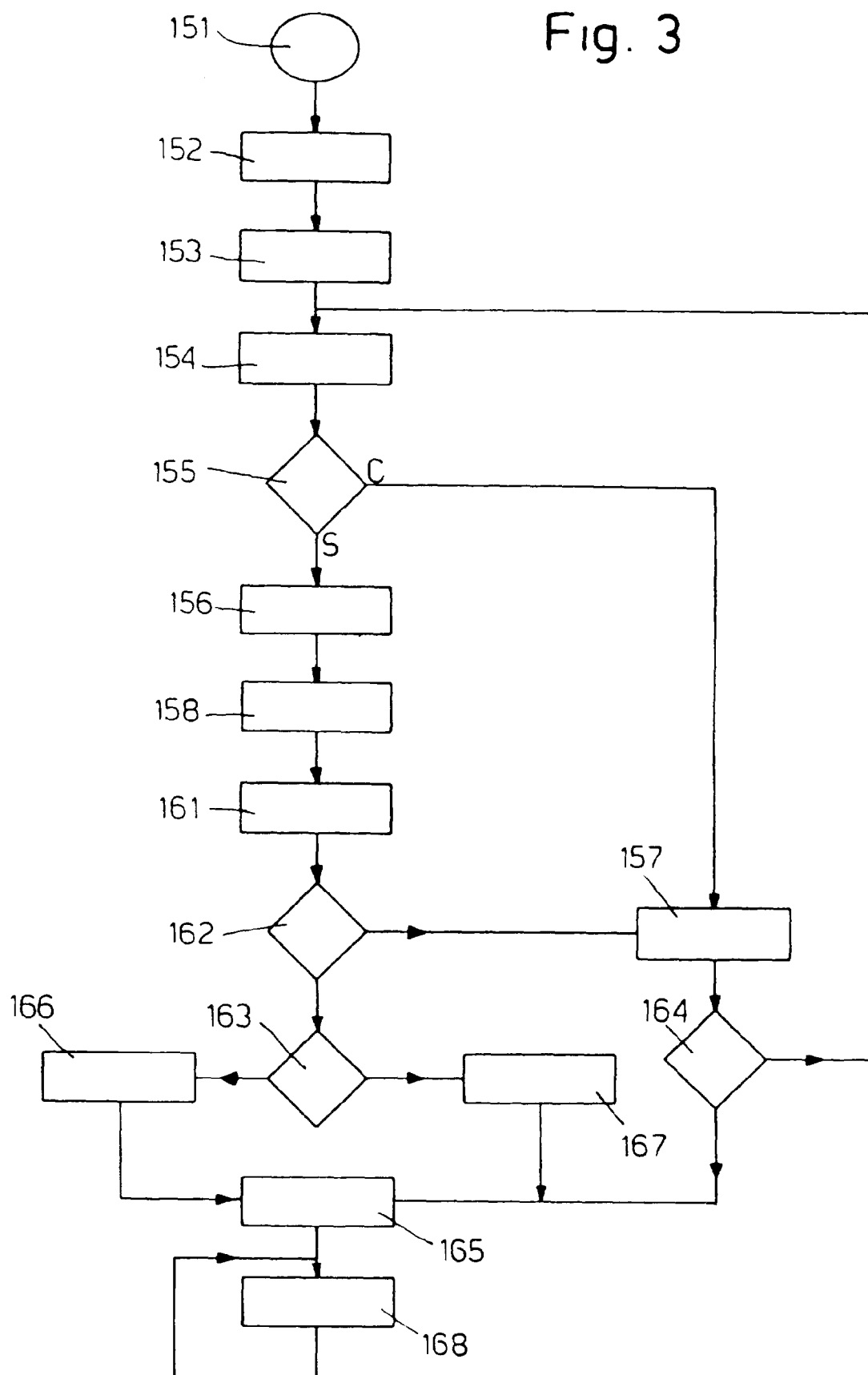


Fig. 3



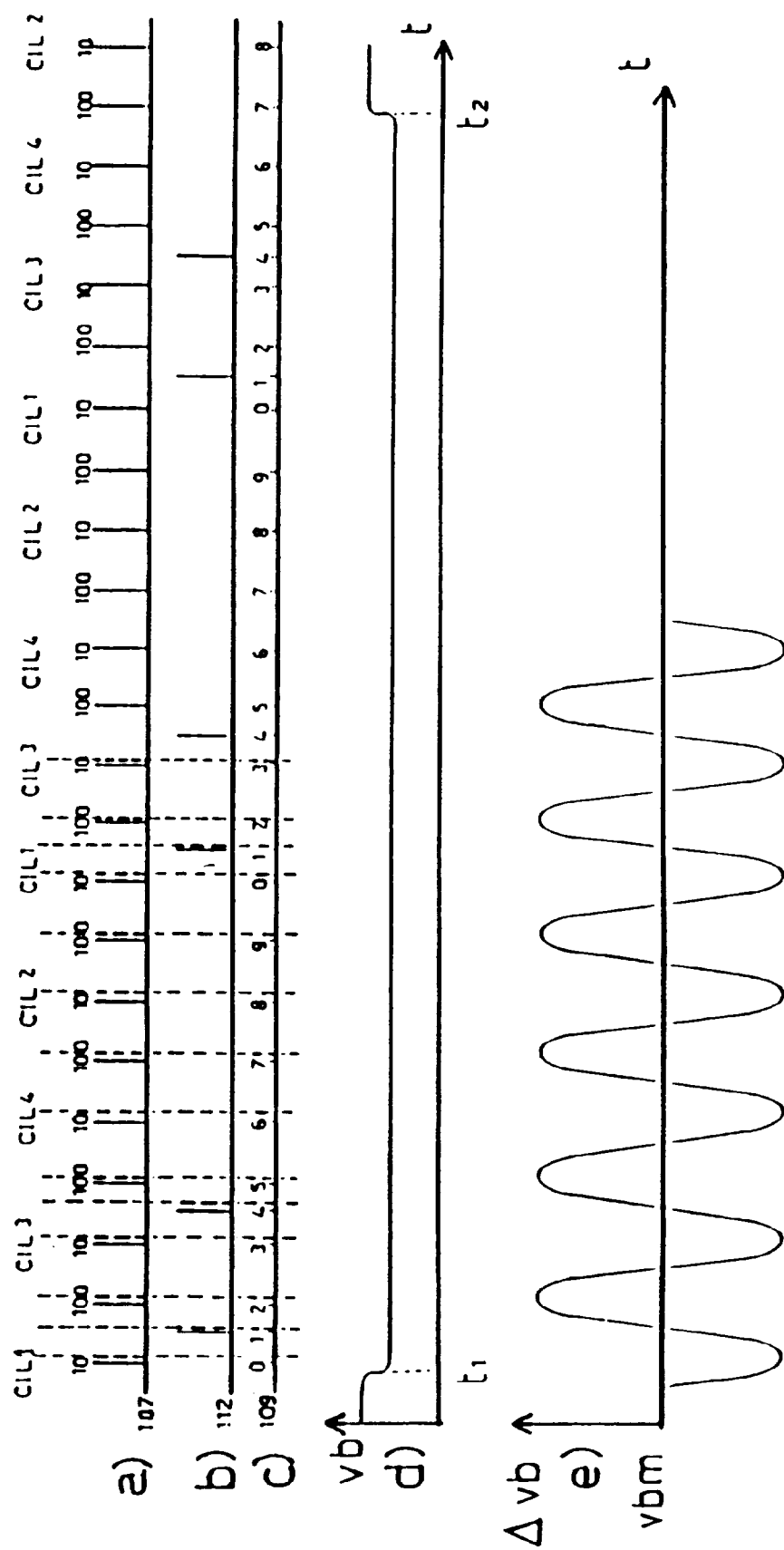


Fig. 4