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- **Ticli, Lucio**
95037 San Giovanni la Punta (Catania) (IT)
- **Martorana, Rosario**
98123 Messina (IT)
- **Barone, Mario**
95043 Militello in Val di Catania (IT)

(71) Applicant: **STMicroelectronics S.r.l.**
20041 Agrate Brianza (Milano) (IT)

(74) Representative: **Botti, Mario**
Botti & Ferrari S.r.l.,
Via Locatelli, 5
20124 Milano (IT)

(72) Inventors:
 • **Di Cola, Eusebio**
98168 Messina (IT)

(54) **Electronic device architecture for determining the operating phase of an internal combustion motor**

(57) The invention relates to an electronic device architecture for determining the operating phase of an internal combustion motor (2), of the type structured for cooperating with an electronic motor control unit (ECU) and inputting a signal issued from a sensor (8) of a phonic wheel (7) associated with a camshaft (4) of the motor (2).

This device (1) has the task of computing the operating phase by analysing the signal from the sensor of the camshaft phonic wheel (7), so as to release the electronic motor control unit (ECU) from monitoring the phonic wheel signal, in order to lighten its computational load, and to enable the processing of signals from a variety of phonic wheels commonly used in the automotive industry.

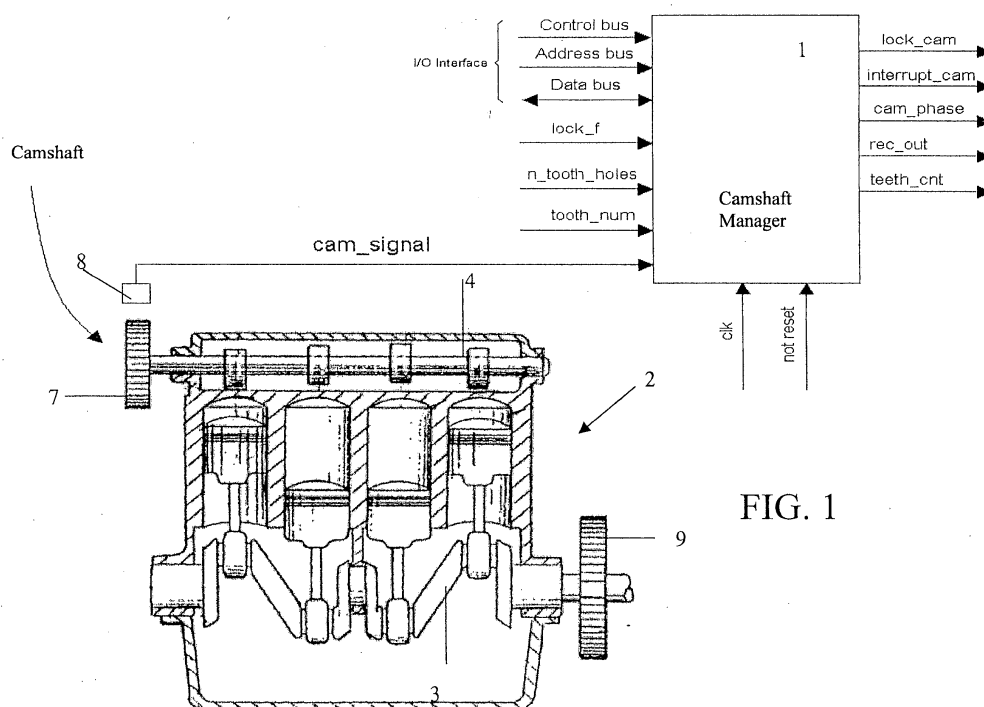


FIG. 1

DescriptionField of Application

5 **[0001]** The present invention relates to an electronic device architecture for automatically determining the operating phase of an internal combustion motor or engine.

[0002] In particular, but not limited to, the invention relates to a device of the above-referred type applied on a direct injection four-stroke motor with automatic determination of the driving shaft angular position and of the motor operating phase, but the following description covering this field of application is for convenience of explanation only.

Prior Art

15 **[0003]** As is well known in this technical field, the use of electronic units for managing the injection in modern automotive motors is now common practice. An example of this is provided by the European Patent Application 01830645.6 to the same Applicant.

[0004] Their use has become necessary to keep certain motor parameters under control so as to bring the motor emissions within the close limits set by law in many of the industrialized countries.

20 **[0005]** In order to comply with such restrictive law, the leading automotive companies are increasing the production of direct injection motors so as to decrease pollutants released in the environment, as well as to improve the performance of the motors. However, these motors require a more complex and sophisticated control system.

[0006] Recently introduced multiple-injection systems, wherein the parameters to be controlled are characterized by more pressing specifications of time, make the use of a certain number of different types of sensors, whose signals are always processed by current control units, a necessity.

25 **[0007]** Thus, these units, commonly known as ECUs (Electronic Control Units), are asked to provide control functions of increasing complexity.

[0008] In the automotive industry field it is common practice to use ECUs equipped with a TPU (Time Processor Unit) type of co-processor which is structured to process signals issuing from a sensor of a driving shaft phonic wheel and from a sensor of a camshaft phonic wheel, all this with the aim of determining the angular position of the driving shaft and the operating phase of the motor.

30 **[0009]** A lot of parameters must be taken into consideration to best carry out the injection process under the control of an ECU or a TPU. This implies an enormous computational load both for the ECU and for the TPU.

[0010] In fact, both these units have to manage a large number of signals having different priority levels. In all cases, these signals have to be managed by software routine activated by interrupt signals, as regards the ECU, and by the occurrence of certain events, as regards the TPU.

35 **[0011]** In any case, a discrepancy is bound to exist between an ideal time for the injection and the real time when the injection is actually carried out. This results in incorrect combustion generating a larger amount of pollutants than intended.

40 **[0012]** The underlying technical problem of this invention is to provide an electronic device for automatically determining the operating phase of an motor, which device should have appropriate structural and functional features so as to enable automatic computation of such operating phase by directly analysing the signal from the camshaft phonic wheel.

Summary of the Invention

45 **[0013]** The solution idea on which the invention is based is one of providing a hardware module which can be used as a peripheral unit to the ECU, so that the computing load can be reduced. This hardware module has the task of calculating the operating phase of the motor, by analysing the signal from a phonic wheel sensor of a motor camshaft.

50 **[0014]** Briefly, the solution idea of the invention is that of releasing the ECU from continually monitoring the signal from the phonic wheel of the camshaft, so as to lighten the computing load on the ECU and enable the processing of signals that issue from a plurality of phonic wheels most commonly employed in the automotive field. This allows the ECU to serve a number of different motors.

[0015] On the basis of this solution idea, the technical problem is solved by an electronic device for automatically determining the operating phase of an internal combustion motor as previously indicated, and as defined in the characterizing part of Claim 1.

55 **[0016]** The features and advantages of the device according to the invention should become apparent from the following description of an embodiment thereof, given by way of non-limitative example with reference to the accompanying drawings.

Brief Description of the Drawings**[0017]**

Figure 1 shows schematically an endothermic injection motor associated with an electronic device for determining the motor operating phase, according to the invention.

Figure 2 is a schematic detail view of the device according to the invention.

Figure 3 shows schematically a digital signal issuing from a phonic wheel associated with the motor camshaft linked to the digital signal issuing from a phonic wheel associated with the driving shaft.

Figure 4 is a diagram of a state machine illustrative of the operation of the device of Figure 2.

Figures 5 and 6 show, on their relevant diagrams with a common time base, a series of digital signals generated by the device of Figure 2, indicating the operating phase of the motor in connection with the camshaft phonic wheel signal and the driving shaft phonic wheel signal.

Detailed Description

[0018] With reference to the drawings, the architecture of an electronic device embodying the invention is globally shown with 1 in schematic form. This electronic device is useful to determine the operating phase of an engine or motor 2, specifically but not limited to, a direct-injection four-stroke cycle motor with automatic determination of the driving shaft angular position and of the operating phase. The motor 2 comprises a driving shaft 3 in combination with a phonic wheel 9, and a camshaft 4 combined with a phonic wheel 7.

[0019] The device 1 is associated with an ECU, not shown because of the same kind as ECUs that are conventionally used in automotive applications for controlling this type of motor ignition and/or injection. The device 1 is represented in Figure 1 by the block "Camshaft Manager".

[0020] The device 1 is primarily aimed at releasing the ECU from monitoring the motor operating phase.

[0021] The device 1 has the task of processing electric signals indicating the motor operating phases. The device 1 is input a signal from a sensor 8 of a phonic wheel 7 made rotatively rigid with a camshaft 1 of the motor 2.

[0022] The operating phases of a four-stroke are characterized by the movement of the piston in the cylinder, which is managed by the driving shaft 3, and by the position of the valves, which are managed by the camshaft 4. The piston moves toward the motor both with all the valves closed (compression phase or stroke) and with the exhaust valve open (exhaust phase). The opposite movement of the piston takes place either with all the valves closed (combustion/expansion phase or power stroke) or with the intake valve open (intake phase). Within one turn of the driving shaft, the piston completes both one movement toward the head both the opposite, because its connection to the driving shaft is established by a connecting rod. At the same time, the camshaft completes a half turn to manage the valves as appropriate.

[0023] Thus, the rotation ratio between the camshaft and the driving shaft is 1:2. The timing period for the injection to be actuated is between the compression and combustion/expansion phases, and corresponds to one driving shaft revolution. In order to identify this period, the camshaft 4 is provided with a phonic wheel 7 having a predetermined number of teeth allocated on the circumference of the wheel 7. Since the teeth have no standard distribution, the device 1 can be programmed by storing the particular profile of the camshaft phonic wheel 4.

[0024] This signal is input to the device 1 along with a signal indicating the driving shaft angular position. From the elaboration of this signal, the "Camshaft Manager" device 1 generates a phase signal suitable for each phonic wheel 7 rotation.

[0025] Briefly, the invention provides a hardware module which is input both a signal from a sensor 8 of the phonic wheel 7 of the camshaft 4 and a signal indicating the driving shaft angular position, and outputs a series of signals from which the operating phase of the motor can be obtained, given a reference point.

[0026] The device 1 may also be located next to controllers of units arranged on variable timing motors, since the modules inside the device can be programmed by inserting the desired timing variation between the camshaft signal and the driving shaft angular position signal.

[0027] A basic diagram in Figure 1 illustrates how the invention is applied.

Figure 3 shows the signal generated by the sensor of the driving shaft phonic wheel compared with the signal from the camshaft phonic wheel. It can be seen in Figure 3 how the profile of the cam signal changes for two successive rotations of the driving shaft.

[0028] The main function of the "Camshaft Manager" device 1 is to recognize the motor operating phase by analysing

the phonic wheel signal relating to the driving shaft angular rotation.

[0029] The "Camshaft Manager" device 1 comprises three modules 5, 6 and 10, also called "dec_camma", "cams_shaft" and "pend_camma", whose interconnections are shown in Figure 2.

[0030] The "dec_camma" module 5 performs the task of providing a standard interface toward the controller of the ECU such that the controller itself can manage the "Camshaft Manager" device 1. Such a management is actuated by properly forcing the value of a set of internal registers of the "dec_camma" module 5.

[0031] The values of said registers represent the configuration parameters of the second "cams_shaft" module 6, forming the heart of the whole system. While normal operating phase, this module 6 forces the values of a second set of registers inside the first "dec_cam" module 5, from which the internal state and the results of the second "cams_shaft" module 6 can be found.

[0032] A general diagram of the hardware architecture of the device 1 is shown in Figure 2.

[0033] Table 1 below shows the I/O input and output signals of the device 1.

Table 1:

Signals	Description
Input	
Control_bus	Standard communication interface.
Address_bus	
Data_bus (I/O)	Data_bus is bidirectional.
cam_signalSignal	generated by the circuit of the camshaft sensor.
lock_f	Indicates that the driving shaft phonic wheel reference is found.
n_tooth_holes	Total number of teeth and holes of the driving shaft phonic wheel.
tooth_num	Tooth counter for the crankshaft phonic wheel.
Output	
lock_cam	Indicates that the motor operating phase is found.
cam_phase	Indicates the motor operating phase.
rec_out	Desired camshaft profile.
teeth_cnt	Indicates the driving shaft angular position after one rotation of the camshaft.
interrupt_cam	Interrupt signal.

[0034] The set of signals **lock_cam**, **cam_phase** and **rec_out** allows, whenever the motor operating phase to be found in connection with the driving shaft position, denoted **tooth_num**. The signal **teeth_cnt** is generated to indicate the driving shaft angular position in connection with one complete rotation of the camshaft; like **tooth_num**, it is a counter of the teeth of the driving shaft phonic wheel, except that it is reset every two driving shaft rotations.

[0035] The third "pend_camma" module 10 functions to generate an interrupt toward the controller of the injection unit of the motor, once the error signals generated by "cams-shaft" are input. Concurrently with the interrupt being generated, the relevant internal register of "dec_camma" is set, and from this the type of error generated by "cams_shaft" can be found.

[0036] The whole architecture 1 is structurally independent, and can be formed as an integrated circuit on a supporting board and standard bus interconnection. The motor ECU may also find place on this board.

[0037] Of course, there is no reason for the modules 5, 6 and 10, the device 1, and the ECU not to be formed in a common-shared integrated circuit of the system-on-chip variety, still retaining its operational independence.

[0038] Table 2 below shows the registers provided in the first "dec_camma" module 5, which can be read and/or written by means of the standard interface:

Table 2

Register	Description
Output to "cams_shaft"	
start	Starts the state machine implemented in "cams_shaft"

Table 2 (continued)

Register	Description
Output to "cams_shaft"	
stop	Stops the state machine implemented in "cams_shaft" and brings it back to its initial state ready to start again.
mem_cam_changes1	Table of <i>size1</i> items, containing the number-of-tooth values of the driving shaft phonic wheel where transitions occur on the cam signal during the driving shaft rotation relevant to phase zero.
profile 1	Indicates the expected value of the cam profile stored in <i>mem_cam_changes1</i> .
size 1	Indicates the number of items stored in the <i>mem_cam_changes1</i> and <i>profile1</i> tables.
mem_cam_changes2	Table of <i>size1</i> items, containing the number-of-tooth values of the driving shaft phonic wheel where transitions occur on the cam signal during the driving shaft rotation relevant to phase one.
profile2	Indicates the expected value of the cam profile stored in <i>mem_cam_changes2</i> .
size2	Indicates the number of items stored in the <i>mem_cam_changes2</i> and <i>profile2</i> tables.
mem_cam_r	Table of <i>sizer</i> items, containing the number-of-tooth values of the driving shaft phonic wheel where transitions occur for the reconstructed cam signal.
profiler	Indicates the expected value of the cam profile stored in <i>mem_cam_r</i> .
sizer	Indicates the number of elements stored in the <i>mem_cam_r</i> and <i>profiler1</i> tables.
delta	Indicates the width of the interval around the timing moment when the system is expecting a tooth of the camshaft phonic wheel.
offset_out	Indicates the extent that the cam signal has to be shifted with respect to the driving shaft phonic wheel signal.
a_ns	Indicates whether the shift has to occur in the forward or the backward direction.
cfg_phase	Indicates if the teeth counter of the driving shaft phonic wheel is to be shifted.
Output to "pend_camma"	
mask_inter	Mask of the interrupts.
Input from "cams_shaft"	
error_at	Indicates the number of the tooth where the last error occurred.
teeth_cnt	Indicates the driving shaft angular position as phonic wheel teeth counter from 1 to 2* (n_tooth_holes).
cam_phase	Indicates the motor phase.
lock_cam	Indicates that the motor operating phase is found.
stato_out	Indicates the current state of the "cams_shaft" state machine.
rec_out	Desired camshaft profile.
Input from "pend_cams"	
pending	Indicates the type of error occurred.

[0039] The second "cams_shaft" module 6 functions to find the motor operating phase, and to signal it properly in connection with the driving shaft 3 angular position. The phase is found by monitoring the signal from the camshaft sensor 8 (**cam_signal**) and the signal indicating the driving shaft angular position (**tooth_num**).

[0040] An example of the camshaft signal linked to the driving shaft signal is given in Figure 3. The signal

fonica_signal is the signal generated by the sensor of the driving shaft phonic wheel. In the example of Figure 3, the driving shaft phonic wheel 9 has ten teeth and two holes. The distribution of the teeth of the phonic wheel 7 of the camshaft 4 generates a different number of pulses for the two driving shaft rotations relating to the rotation of the camshaft.

[0041] The third "pend_camma" module 10 functions to generate an interrupt signal toward the controller of the ECU.

[0042] Briefly, the third "pend_inter" module 10 functions to generate an interrupt signal toward the controller of the ECU when a signal is input to the "dec_camma" module 5 which indicates the type of error occurred. The module 10 in turn generates a signal for module 5 to set properly the "pending" register, from whose reading the ECU controller then identifies the type of error so as to decide the action to be taken accordingly.

[0043] Let us now see the operation of the "cams_shaft" module 6 in greater detail.

[0044] The input "cams_shaft" signals are those shown in Table 2 under 'Output toward "cams_shaft"' section, plus **camsignal**, **lock_f** signals, and **tooth_num** signals among the input signals to the "Camshaft Manager" device 1. The output signals are those shown in Table 2 under 'Input from "cams_shaft"' section, plus the **alert** signal indicating the type of error likely to occur.

[0045] Shown in Figure 4 is the state machine 11 describing the behaviour of the "cams_shaft" module 6.

[0046] The initial state of the state machine 11 is called "idle", and is attained when starting and/or resetting the system. By activating the **start** signal, the state machine enters the "waiting x lock" state (transition T_1), and awaits the activation of the **lock_f** signal, indicating that the **tooth_num** signal is supplying the right driving shaft angular position values.

[0047] As the **lock_f** signal is activated, the state machine enters the "check_cm" state (transition T_2), where the motor operating phase is found.

[0048] This is done by simultaneously analysing the *mem_cam_changes1-profile1* and *mem_cam_chanes2-profile2* tables according to the value of the **tooth_num** signal at each instant. By way of example, the above tables are defined as follows:

Table 3

Phase 0		Phase 1	
mem_cam_changes1	profile 1	mem-cam_changes2	profile2
2	1	14	1
3	0	15	0
		16	1
		17	0

[0049] The table for Phase 0 will contain the transitions of the **cam_signal** signal during the first driving shaft rotation, and the table for Phase 1 will contain the transitions of the **cam_signal** signal during the second driving shaft rotation.

[0050] The values of the columns indicated as *mem_cam_changes1* and *mem_cam_changes2* should be entered in ascending order. The phonic wheel of the driving shaft 3 considered in the example of Figure 1 has twelve teeth (two of which are missing to mark the reference). As is known, for each revolution of the camshaft 4 this wheel makes two, so that twelve should be subtracted from the number indicated in *mem_cam_change2* in order to identify the correct tooth, given that the **tooth_num** signal will indicate numbers from one to twelve.

[0051] Two pointers always indicates the item that must be examined in each table according to the current value of the **tooth_num** signal. From the transition to the "check_cm" state, the two pointers, indicating the first item in each table, are updated in such a way that they point to the first item that contains a tooth number larger than or equal to that being indicated by the **tooth_num** signal.

[0052] At each variation in the **tooth_num** signal on both tables a in parallel it is controlled that the item pointed to by the value of the current pointer contains the value indicated by **tooth_num**. If it does, it is further checked that the item pointed to by the other pointer does not contain the same tooth number value (added to the total number of teeth and holes), or, if so, that it does not contain the same transition value.

[0053] If the above condition is verified, the state machine 11 enters the "locked" state (transition T_3), otherwise the "check_cm" state is maintained until the condition is met. In the "locked" state, it is continually checked that the transitions of the **cam_signal** signal follow one another correctly and at the time points stored in the tables. The process is continued from the table that has caused the transition toward the "locked" state from the "check_cm" state, alternately between the two tables to track the stored profile.

[0054] In this state, a filtering process of sort may also be carried out on the **cam_signal** signal, by using the **delta** signal, which indicates the width of an interval around the tooth number where the transition is expected. The transition

toward the "diff" state (transition T_4) occurs when, inside the time window being examined, the **cam_signal** signal does not track the profile stored in the tables.

[0055] In this case, the value of **tooth_num** at which the error has occurred is indicated. In the "diff" state it is indicated that the phase can no longer be tracked properly, and that the state machine goes back to the "idle" state (transition T_5). During the stay in the "locked" state, the motor phase is indicated by the **cam_phase** signal, as shown in Figure 5.

[0056] Another feature of the "cams_shaft" module is that a camshaft signal can be obtained from the **rec_out** output signal, with the arbitrary profile stored in the **profiler** and the **mem_cams_r** tables, in relation to the **tooth_num** signal. An example is given in the following Table 4, where the signal denoted *rec_out* has the herebelow profile:

Table 4

mem_cam_r	profiler
6	1
7	0
9	1
10	0
13	1
14	0
19	1
20	0

[0057] Thanks to the features previously described, the device 1 can be applied to any motor type equipped with a camshaft phonic wheel, and can be adapted for any type of phonic wheels employed in the automotive industry.

[0058] All this is thanks to the extensive configurability of the parameters of modules 5, 6 and 10 which make the device of this invention the more flexible and re-usable in different applications as possible.

Claims

1. An electronic device architecture for determining the operating phase of an internal combustion motor (2), of the type structured to cooperate with an electronic motor control unit (ECU) and inputting a signal issued from a sensor (8) of a phonic wheel (7) associated with the motor (2) camshaft (4); **characterized in that** it comprises:

a first I/O interface module (5) incorporating a plurality of registers and receiving signals from said motor control unit (ECU);

a second module (6) connected bidirectionally to the first module (5) and inputting the signal issued from said sensor (8) to identify a camshaft (4) reference and to supply the operating phase of the motor;

a third module (10) adapted to issue an interrupt signal toward said unit (ECU) according to an error signal incoming from said second module (6).

2. A device according to Claim 1, **characterized in that** the registers of said first module (5) can be accessed both while reading and writing from said unit (ECU) via a standard interface.

3. A device according to Claim 1, **characterized in that** the search for the reference and the following calculation of the camshaft position (4) are carried out in said second module (6) by continually monitoring the signal (cam_signal) from the sensor (8) of the camshaft phonic wheel (7).

4. A device according to Claim 1, **characterized in that** a second set of registers, inside the first module (5), contain data about the internal state and the results of the second module (6).

5. A device according to Claim 1, **characterized in that** once an interrupt signal is generated, a relevant internal register of the first module (5) is also updated, from which the type of error caused by the second module (6) can be found.

6. A device according to Claim 1, **characterized in that** the registers included in said first module (5) are:

start	Starts the state machine implemented in "cams_shaft"
Stop	Stops the state machine implemented in "cams_shaft" and brings it back to its initial state ready to start again.
mem_cam_changes1	Table of <i>size1</i> items, containing the number-of-tooth values of the driving shaft phonic wheel where transitions occur on the cam signal during the driving shaft rotation corresponding to phase zero.
profile 1	Indicates the expected value of the cam profile stored in <i>mem_cam_changes1</i> .
size 1	Indicates the number of items stored in the <i>mem_cam_changes1</i> and <i>profile1</i> tables.
mem_cam_changes2	Table of <i>size1</i> items, containing the number-of-tooth values of the driving shaft phonic wheel where transitions occur on the cam signal during the driving shaft rotation corresponding to phase one.
profile2	Indicates the expected value of the cam profile stored in <i>mem_cam_changes2</i> .
size2	Indicates the number of items stored in the <i>mem_cam_changes2</i> and <i>profile2</i> tables.
mem_cam_r	Table of <i>sizer</i> items, containing the number-of-tooth values of the driving shaft phonic wheel where transitions occur for the reconstructed cam signal.
Profiler	Indicates the expected value of the cam profile stored in <i>mem_cam_r</i> .
Sizer	Indicates the number of items stored in the <i>mem_cam_r</i> and <i>profiler1</i> tables.
Delta	Indicates the width of the interval around the time point when the system is expecting a tooth of the camshaft phonic wheel.
offset_out	Indicates the extent that the cam signal has to be shifted from the driving shaft phonic wheel signal.
a_ns	Indicates whether the shift has to occur in the forward or the backward direction.
cfg_phase	Indicates if the teeth counter of the driving shaft phonic wheel has to be shifted.

7. A device according to Claim 6, **characterized in that** the second set of registers of said first module is updated by said second module (6) are the following:

error_at	Indicates the number of the tooth where the last error occurred.
teeth_cnt	Indicates the driving shaft angular position as phonic wheel teeth counter from 1 to 2* (n_tooth_holes).
cam_phase	Indicates the motor phase.
lock_cam	Indicates that the motor operating phase is found.
stato_out	Indicates the current state of the "cams_shaft" state machine.
rec_out	Desired camshaft profile.

8. A device according to Claim 1, **characterized in that** said second module (5) constantly checks the pulses of the signal (cam_signal) from said sensor (8), and it evolves according to a state machine (11) on the basis of a table correlating the profile of a driving shaft (3) phonic wheel (9) with the camshaft phonic wheel (7).

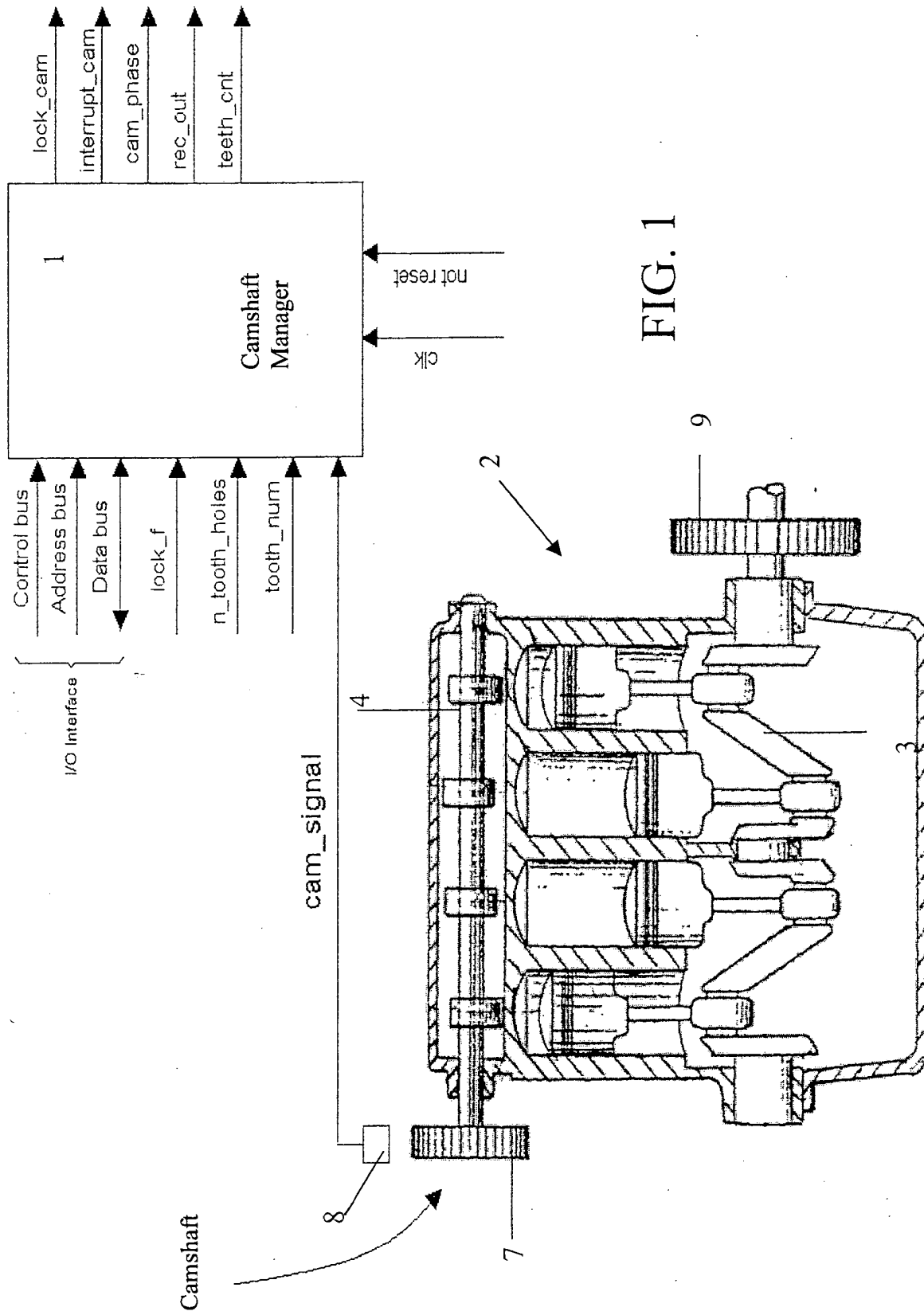
9. A device according to Claim 8, **characterized in that** the format of said correlation table is, according to the example of Figure 3, the following:

Phase 0		Phase 1	
mem_cam_changes1	profile 1	mem-cam_changes2	profile2
2	1	14	1

(continued)

Phase 0		Phase 1	
mem_cam_changes1	profile 1	mem-cam_changes2	profile2
3	0	15	0
		16	1
		17	0

and includes a first table for Phase 0, containing the transitions of said signal (cam_signal) during the first rotation of the driving shaft (3), and a table for Phase 1 containing the transitions of the signal (cam_signal) during the second rotation of the driving shaft (3).



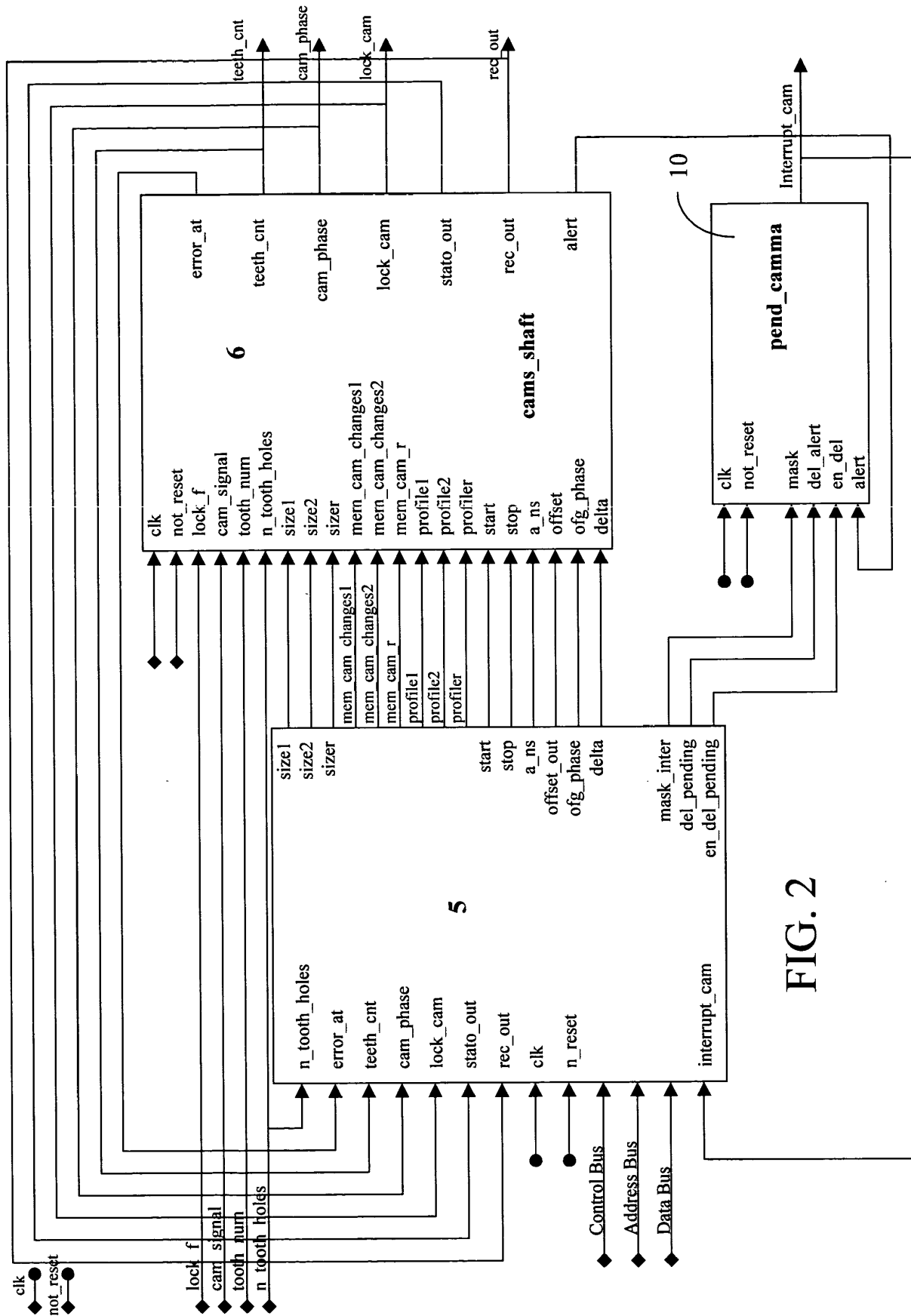


FIG. 2

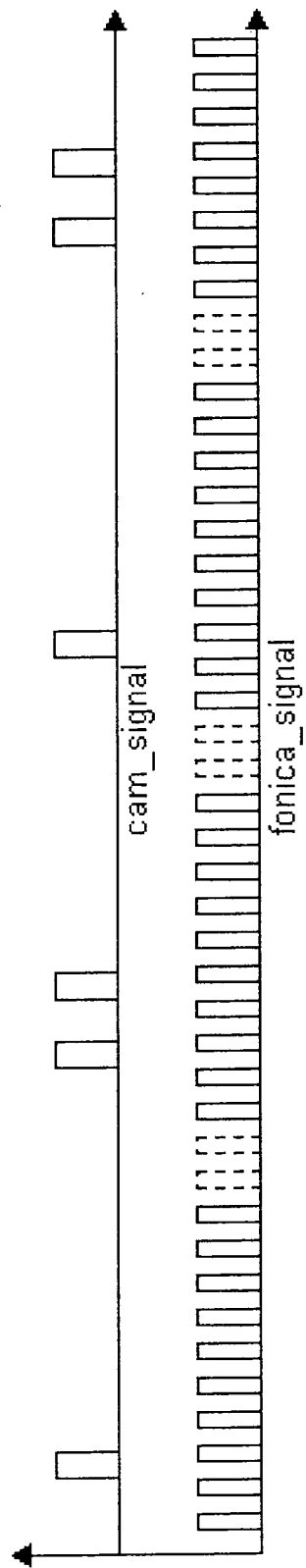


FIG. 3

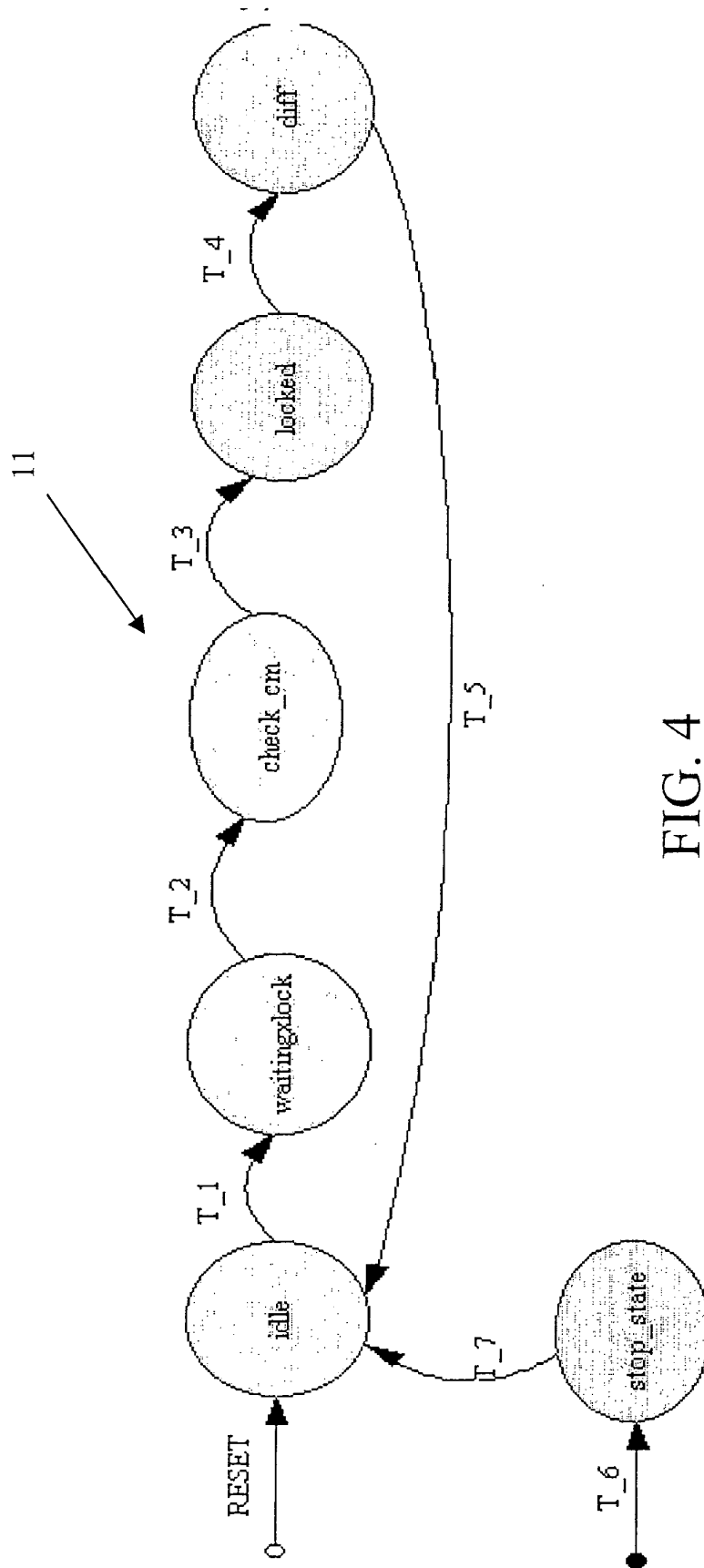


FIG. 4

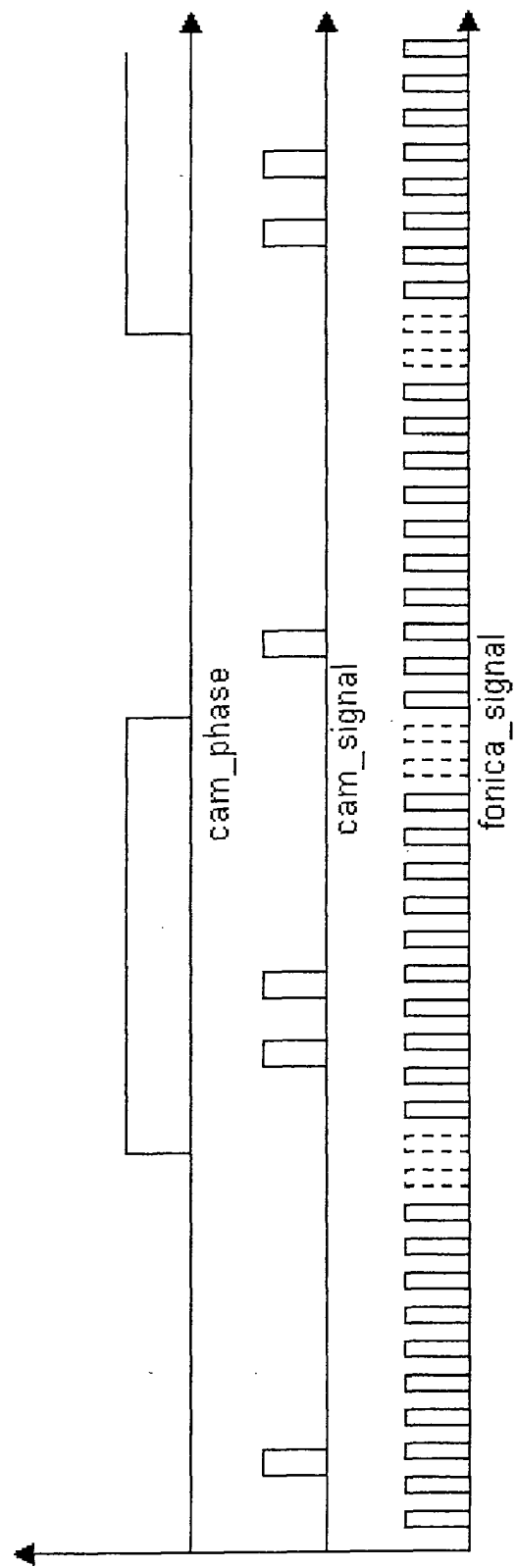


FIG. 5

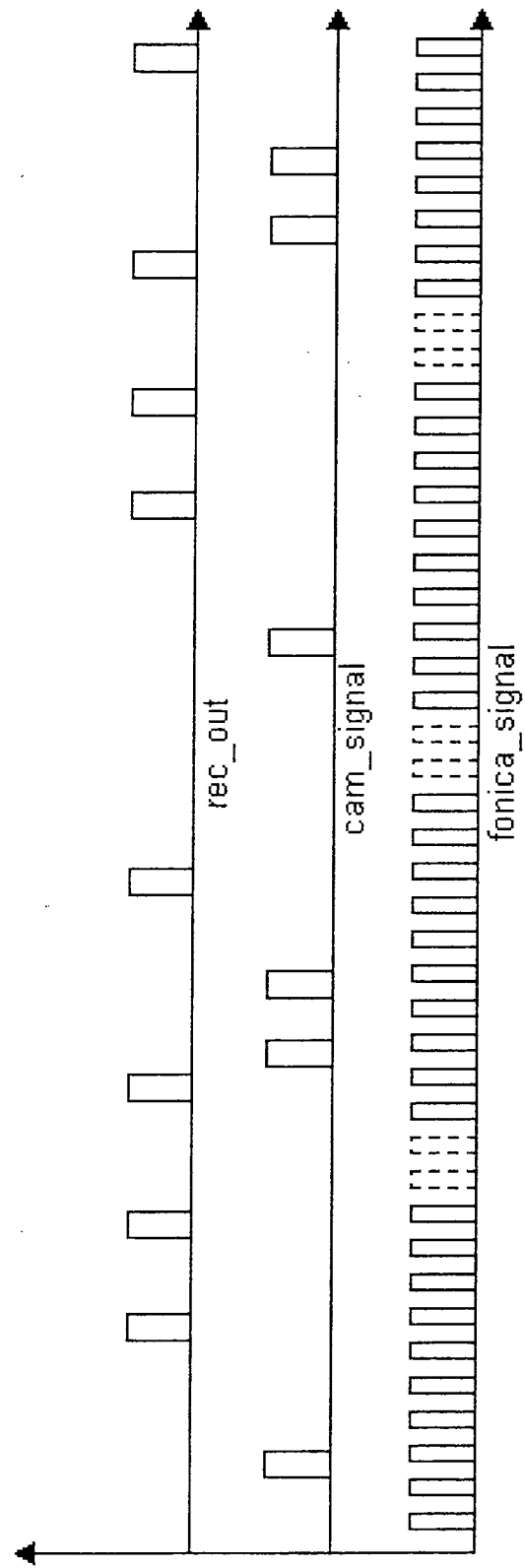


FIG. 6



European Patent
Office

EUROPEAN SEARCH REPORT

Application Number
EP 02 42 5726

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.7)
A	US 5 548 995 A (PAO HSIEN C ET AL) 27 August 1996 (1996-08-27) * column 6, line 26 - column 8, line 22; figures 1-6 *	1-9	F02D41/34 F02D41/22
A	--- PATENT ABSTRACTS OF JAPAN vol. 006, no. 192 (P-145), 30 September 1982 (1982-09-30) & JP 57 101903 A (NISSAN MOTOR CO LTD), 24 June 1982 (1982-06-24) * abstract *	1	
A	--- DE 43 13 331 A (BOSCH GMBH ROBERT) 27 October 1994 (1994-10-27) * the whole document *	1-9	
A	--- US 5 794 592 A (FUKUI WATARU) 18 August 1998 (1998-08-18) * column 11, line 30 - column 13, line 34; figures 6,9 *	1-3,8,9	
A	--- DE 199 55 513 A (BOSCH GMBH ROBERT) 23 May 2001 (2001-05-23) * the whole document *	1,3,8	TECHNICAL FIELDS SEARCHED (Int.Cl.7) F02D G06F G01P F02P
The present search report has been drawn up for all claims			
Place of search MUNICH		Date of completion of the search 30 April 2003	Examiner Aign, T
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

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This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
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