(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 0 694 686 A1

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
31.01.1996 Bulletin 1996/05

(51) Int. Cl.[6]: **F02D 41/24**

(21) Application number: **95111276.2**

(22) Date of filing: **18.07.1995**

(84) Designated Contracting States:
DE ES FR GB SE

(30) Priority: **19.07.1994 IT BO940339**

(71) Applicant: **MAGNETI MARELLI S.p.A.**
I-20145 Milano (IT)

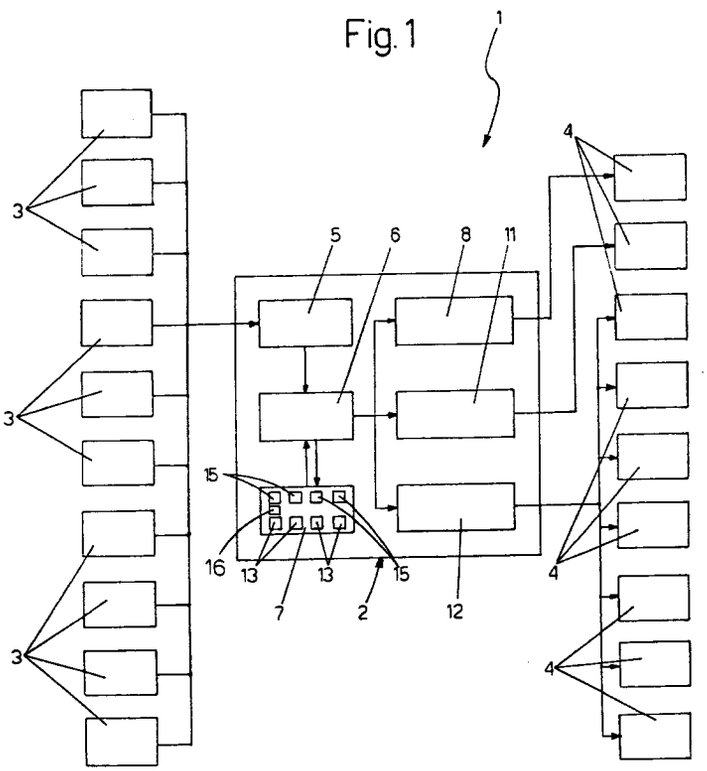
(72) Inventor: **Nanni, Massimiliano**
I-40139 Bologna (IT)

(74) Representative: **Jorio, Paolo et al**
I-10121 Torino (IT)

(54) Method and means for processing vehicle parameters for the control of systems and functional units mounted on a vehicle

(57) The method comprises detecting vehicle signals by means of sensors, comparing the value (H) of a signal with a value (K) of a cell (14) in a table (13) defined by a plurality of cells in which values (K) are stored, adopting as the starting cell in which to make the first comparison the cell relating to an index (Ip) defined in the previous cycle and stored in a memory (15), comparing the value (H) of the signal with the value (K) of the cell (14) immediately preceding (subsequent to) the starting cell (14) if value (H) is less (greater) than the value (K) of starting cell (14) and so on to decrease (increase) index (I) until cell (14) having the value (K) closest to value (H) is identified, storing the index (I) of the identified cell as a new index (Ip), calculating a quantity called the ratio (R) on the basis of value (H), value (K) of the identified cell and value (K) of the cell immediately preceding the identified cell, and using index (I) and ratio (R) as data for calculating the control signals to be sent to systems and functional units (4).

Fig.1



EP 0 694 686 A1

Description

This invention relates to a method of processing vehicle data for the control of systems and functional units mounted on a vehicle.

This invention also relates to means implementing the above-mentioned method.

Systems of the above-mentioned type currently used in vehicles have a plurality of sensors which detect the above-mentioned vehicle, system and functional unit parameters, and a central electronic unit which processes the incoming signals to control the operating systems and functional units. The central unit comprises an analog-digital converter which converts the analog signals received from the sensors into digital signals, and a memory block in which a table defined by a vector of values defined and ordered in increasing order is present for every parameter found. Substantially every table has a plurality of numbered cells, each of which stores a value which is greater than the value stored in the immediately preceding cell. Whenever a signal is received from a sensor, the central unit, after converting it, checks which cell in the table stores the value closest to the converted signal. This check consists of comparing the converted signal with the stored value, starting from the first cell, until the cell storing the value closest to the value of the converted signal is identified. Once this cell has been identified, the central unit uses two parameters, called "index" and "ratio" to process the data, where by index is meant the value of the cell number and by ratio is meant a value calculated on the basis of the value of the converted signal, the value stored in the cell identified and the value stored in the cell immediately preceding the cell identified.

The main disadvantage of the method described above lies in the long times which are required in order to identify the cell storing the value closest to the value for the converted signal. It should be remembered in fact that whenever a signal is received the comparison between the value of the signal and the values stored in the table must always be made starting from the first cell. It is obvious that, if in the limit the value stored in the table closest to the signal value is to be found in the last cell, then in order to identify this cell it is necessary to make as many comparisons as there are cells. Long times for identification of the correct cell require long times for sending control signals to operating systems and functional units. It will be understood therefore that the control signal arrives late, i.e. when, after changes in driving conditions, the operating systems and functional units require a different control signal.

The object of this invention is to provide a method for processing vehicle parameters for the control of systems and functional units mounted on vehicles which is faster than existing methods.

A further object of this invention is to provide means implementing the above-mentioned method.

According to this invention provision is made for a method of processing vehicle parameters for the control of systems and functional units mounted on a vehicle characterised in that it comprises:

detecting, through sensors, the above-mentioned vehicle parameters, such as the value of the fuel pressure, the value of the temperature of the air drawn along the air intake manifold, the value of the temperature of the fluid in a cooling circuit, the angular position of a butterfly valve installed in the inlet manifold, the speed of the vehicle, the existence of knock in the vehicle's engine, the value of the electrical voltage of the vehicle's battery, the stoichiometric composition of the vehicle's exhaust gases, and others,

converting, using a converter, the analog signals received from the said sensors into digital signals,

comparing the value of the said digital signal with a value stored in a cell in a table which has a plurality of said cells, each of which stores a corresponding value, each table representing a vector of a plurality of stored values defined and ordered in increasing order according to a serial index, adopting, as the starting cell for the first comparison between the value of the said signal and the value stored in the said cell, the said cell corresponding to an index identified in the immediately preceding functional cycle and stored in a memory,

adopting the index of the said starting cell as a new index where the value of the said signal is close to the value stored in the said starting cell,

comparing the value of the said signal with the value stored in the said cell immediately preceding the said starting cell, if the value of the said signal is less than the value stored in the said starting cell and so on, to reduce the index until the said cell storing the value closest to the value of the said signal is identified,

comparing the value of the said signal with the value stored in the said cell immediately following the said starting cell, if the value of the said signal is greater than the value stored in the said starting cell, and so on, so as to increase the index until the said cell storing the value closest to the value of the said signal is identified,

storing the index for the said identified cell in the said memory as a new index,

calculating a parameter called ratio on the basis of the value of the said signal, the value stored in the said identified cell and the value stored in the said cell immediately preceding the said identified cell,

using the index and the ratio as data to calculate the control signals which are to be passed to the said systems and functional units, and

controlling the said systems and functional units via control blocks on the basis of the calculated control signals.

On the basis of this invention there is also provided means for processing vehicle parameters for the control of systems and functional units mounted on a vehicle, comprising:

a plurality of sensors capable of detecting the aforesaid vehicle parameters such as the value of the fuel pressure, the value of the temperature of the air drawn along an inlet manifold, the value of the temperature of the fluid in a cooling circuit, the angular position of a butterfly

valve installed in the air intake manifold, the speed of the vehicle, the existence of knock in the vehicle's engine, the value of the electrical voltage of the vehicle's battery, the stoichiometric composition of the vehicle's exhaust gases, and others,
a converter capable of converting the analog signals detected by the said sensors into digital signals,
a central data processing unit,
a memory block having a plurality of tables, one for each parameter detected by the said sensors, which has a plurality of cells, each of which stores a corresponding value, each table representing a vector for a plurality of stored values defined and ordered in increasing order in accordance with a serial index,
blocks controlling the said systems and functional units, characterised in that it comprises:
means for comparing the value of the said signal with a value stored in a cell adopted as the starting cell in which the first comparison is to be performed, corresponding to an index identified in the immediately preceding functional cycle and stored in the memory,
means for comparing the value of the said signal with the value stored in the said cell immediately preceding the said starting cell if the value of the said signal is less than the value stored in the said starting cell, and so on, to decrease the index until the said cell storing the value closest to the value of the said signal is identified,
means for comparing the value of the said signal with the value stored in the said cell immediately following the said starting cell if the value of the said signal is greater than the value stored in the said starting cell, and so on, to increase the index until the said cell storing the value closest to the value of the said signal is identified,
means for storing the index of the said identified cell in the said memory as a new index,
means for calculating a parameter called ratio on the basis of the value of the said signal, the value stored in the said identified cell and the value stored in the said cell immediately preceding the said identified cell,
means for calculating the control signals which are to be sent to the said systems and functional units, using the index and the ratio as data, and
means for controlling the said systems and functional units via the said control blocks on the basis of the calculated control signals.

For a better understanding of this invention a preferred embodiment will now be described with reference to the appended drawings in which:

Figure 1 is a block diagram of the system constructed in accordance with the dictates of this invention,
Figure 2 is a functional diagram of the system in Figure 1, and
Figure 3 is a block diagram of some components of the system in Figure 1.

According to what is shown in Figure 1, 1 indicates as a whole a system for the processing of vehicle parameters for the control of systems and functional units mounted on a vehicle.

System 1 comprises:
an electronic central unit 2,
a plurality of sensors 3 capable of detecting the aforesaid vehicle parameters such as the value of the fuel pressure, the value of the temperature of the air drawn along the intake manifold, the value of the temperature of the fluid in a cooling circuit, the angular position of a butterfly valve installed in the air intake manifold, the speed of the vehicle, the existence of knock in the vehicle's engine, the value of the electrical voltage of the vehicle's battery, the stoichiometric composition of the vehicle's exhaust gases, and others, and
a plurality of systems and functional units 4 such as e.g. an electronic ignition system, an electronic injection system, the actuator unit for idling conditions, the fuel circulating pump, the engine cooling system, the passenger space air conditioning system, the system for enabling warning light signals, the anti-theft system, the drive device for the butterfly valve mounted in the air intake system, the system performing diagnoses on the said systems and functional units listed above, and valves and other functional units within the passenger space or in the engine compartment which are or are not dedicated to the vehicle's engine.

Central unit 2 comprises:
an analog-digital converter 5 capable of converting the analog signals detected from sensors 3 into digital signals,
a central data processing unit 6,
a memory block 7,
a block 8 controlling electronic ignition system 4,
a block 11 controlling electronic injection system 4, and
a block 12 controlling other operating systems and functional units 4.

With reference to Figures 1 and 3, memory block 7 comprises a plurality of tables 13, one for each parameter detected by sensors 3. Each table 13 is defined by a plurality of cells 14 each of which stores a corresponding value K. Each table 13 represents a vector for a plurality of vectors K defined and ordered in increasing order in accordance with a serial index I. Substantially every table 13 has a plurality of numbered cells 14 each of which stores a value K which is greater than the value K stored in the immediately preceding cell 14. Each table 13 is associated with a cell 15 which stores the index Ip relating to the index of cell 14 in which the value K closest to the value H of the signal received has been identified in the previous cycle.

With reference to Figure 2, 100 indicates as a whole an operational scheme for system 1 used whenever a signal is received from one of sensors 3. In particular, each sensor 3 is associated with an operating system 100. A starting block 101 leads to a block 102 in which a check is made to see whether the index Ip stored in cell 15 is smaller than or equal to the index In relating to the maximum number of the cells 14 in table 13. If this is the case block 102 leads to a block 103, while if it is

not the case block 102 leads to a block 104. In block 103 the index Ip is taken as the index I, while in block 104 the index In is taken as the index I.

Blocks 103 and 104 lead to a block 105 in which a check is made to see whether the value H of the signal is less than or equal to the value K(I), i.e. the value K stored in cell 14 which has the serial index I. If this is the case block 105 leads to a block 106, while if it is not the case block 105 leads to a block 107. In block 106 a check is made to see whether index I is equal to 1. If this is the case block 106 leads to a block 108, while if it is not the case block 106 leads to a block 111. In block 108 a parameter R called ratio is taken to have a value of zero. Block 108 then leads to an output block 112. In block 111 a check is made to see whether the value H of the signal is greater than the value K(I-1), i.e. the value K stored in cell 14 immediately preceding the one which has the serial index I. If this is the case block 111 leads to a block 113, while if it is not the case block 111 leads to a block 114 in which the index of cell 14 immediately preceding that in which the serial index was I is adopted as the new index I. Block 114 then leads to block 106.

In block 107 a check is made to see whether index I is equal to index In. If this is the case block 107 leads to block 108, while if it is not the case block 107 leads to a block 115 in which the index of cell 14 immediately following the one whose serial index was I is adopted as the new index I. Block 115 leads to a block 116 in which a check is made to see whether the value H of the signal is less than or equal to the value K(I). If this is the case block 116 leads to block 113, while if it is not the case block 116 returns to block 107. In block 113 value R is calculated using the mathematical expression:

$$R = \{K(I) - H\}/\{K(I) - K(I-1)\}$$

In use, in order to calculate the control signals for operating systems and functional units 4 for each parameter detected by sensors 3, index I and ratio R are used as processing data, where by index I is meant the numerical position of cell 14 storing the value K closest to the value H for the signal. The comparison which is performed in blocks 105, 111 and 116 consists of checking the difference between the values H and K for each parameter.

The method according to this invention comprises:
detecting the said vehicle parameters using sensors 3,
converting the analog signals detected by sensors 3 into digital signals using converter 5,
comparing the value H of the digital signal with a value K stored in a cell 14 which is adopted as a starting cell 14 in which the first comparison is made, starting cell 14 corresponding to the index Ip identified in the immediately preceding functional cycle and stored in cell 15,
adopting the index Ip of starting cell 14 as the new index I where value H is close to value K stored in that starting cell 14;
comparing value H with the value K stored in cell 14 immediately preceding starting cell 14 if value H is less than value K stored in starting cell 14, and so on, so as to decrease index I until cell 14 storing value K closest to value H is identified,
comparing value H with value K stored in cell 14 immediately following starting cell 14, if value H is greater than value K stored in starting cell 14, and so on, so as to increase index I until cell 14 storing value K closest to value H is identified,
storing the index I in identified cell 14 in cell 15 as the new index Ip,
calculating ratio R according to the above expression, using index I and ratio R as data for calculating control signals which are to be sent to operating systems and functional units 4, and
controlling operating systems and functional units 4 through control units 8, 11 and 12.

What is achieved by implementing this invention is clear from what has been described above.

In particular there is provided a method for processing data which makes it possible to identify extremely quickly the cell 14 storing value K closest to value H of the signal sent by sensor 3. The speed with which cell 14 is identified is due to the fact that the first comparison of value H is made with value K stored in a starting cell 14 corresponding to the index Ip identified in the immediately preceding functional cycle. Because the signals detected by sensors 3 frequently vary little from one cycle to another, it is obvious that there will be sufficiently few comparisons to identify cell 14 storing value K closest to value H. Specifically, the main advantage of the method according to this invention comprises adopting not first cell 14 in table 13, but the cell identified in the previous cycle, as starting cell 14. A greater speed of identification of cell 14 makes it possible to send control signals to the operating systems and functional units at a faster speed and as a consequence these operating systems and functional units follow changes imposed upon them by the control signals more promptly and effectively. Substantially an overall improvement is achieved in both function and performance in all operating systems and functional units mounted on the vehicle.

Finally it is clear that method and means 1 described and illustrated here may be modified or subjected to variants without thereby going beyond the scope of the protection of this invention.

Claims

1. Method for processing vehicle parameters for the control of systems and functional units (4) mounted on a vehicle, characterised in that it comprises:
detecting, via sensors (3), the aforesaid vehicle parameters, such as the value of the fuel pressure, the value of the temperature of the air drawn along the intake manifold, the value of the temperature of the fluid in a cooling circuit, the angular position of a butterfly valve installed in the air intake manifold, the speed of the vehicle, the existence of knock in the vehicle's engine, the value of the electrical voltage of the vehicle's battery, the stoichiometric com-

position of the vehicle's exhaust gases, and others, converting, via a converter (5), the analog signals detected by the said sensors (3) into digital signals, comparing the value (H) of the said digital signal with a value (K) stored in a cell (14) of a table (13) which has a plurality of said cells (14) each of which stores a corresponding value (K), each table (13) representing a vector for a plurality of stored values (K) defined and ordered in increasing order in accordance with a serial index (I),
adopting the said cell (14) corresponding to an index (Ip) identified in the immediately preceding functional cycle stored in a memory (15) as the starting cell (14) for making the first comparison between the value (H) of the said signal and the value (K) stored in the said cell (14),
adopting the index (Ip) of the said starting cell (14) as the new index (I) if the value (H) of the said signal is close to the value (K) stored in the said starting cell (14),
comparing the value (H) of the said signal with the value (K) stored in the said cell (14) immediately preceding the said starting cell (14) if the value (H) of the said signal is less than the value (K) stored in the said starting cell (14), and so on, to decrease the index (I) until the said cell (14) storing the value (K) closest to the value (H) of the said signal is identified,
comparing the value (H) of the said signal with the value (K) stored in the said cell (14) immediately following the said starting cell (14) if the value (H) of the said signal is greater than the value (K) stored in the said starting cell (14), and so on, to increase the index (I) until the said cell (14) storing the value (K) closest to the value (H) of the said signal is identified,
storing the index (I) of the said identified cell (14) in the said memory (15) as the new index (Ip),
calculating a quantity known as ratio (R) on the basis of the value (H) of the said signal, the value (K) stored in the said identified cell (14) and the value (K) stored in the said cell (14) immediately preceding the said identified cell (14),
using the index (I) and the ratio (R) as data for calculating the control signals which are to be sent to the said systems and functional units (4), and
controlling the said systems and functional units (4) through control blocks (8, 11 and 12) on the basis of the calculated control signals.

2. Means for processing vehicle parameters for the control of systems and functional units (4) mounted on a vehicle, comprising:
a plurality of sensors (3) capable of detecting the aforesaid vehicle parameters such as the value of the fuel pressure, the value of the temperature of the air drawn along an intake manifold, the value of the temperature of the fluid of a cooling circuit, the angular position of a butterfly valve located in the air intake manifold, the speed of the vehicle, the existence of knock in the vehicle's engine, the value of the electrical voltage of the vehicle's battery, the stoichiometric composition of the vehicle's exhaust gases, and others,
a converter (5) capable of converting the analog signals found by the said sensors (3) into digital signals,
a central data processing unit (6),
a memory block (7) having a plurality of tables (13), one for each parameter detected by the said sensors (3), which have a plurality of cells (14) each of which store a corresponding value (K), each table (13 representing a vector for a plurality of values (K) stored, defined and ordered in increasing order on the basis of a serial index (I), blocks (8, 11 and 12) controlling the said systems and functional units (4),
characterised in that it comprises:
means for comparing the value (H) of the said signal with a value (K) stored in a cell (14) adopted as the starting cell (14) for the first comparison, this corresponding to an index (Ip) identified in the immediately preceding functional cycle and stored in a memory (15),
means for comparing the value (H) of the said signal with the value (K) stored in the said cell (14) immediately preceding the said starting cell (14) if the value (H) of the said signal is less than the value (K) stored in the said starting cell (14), and so on, to reduce the index (I) until the said cell (14) storing the value (K) closest to the value (H) of the said signal is identified,
means for comparing the value (H) of the said signal with the value (K) stored in the said cell (14) immediately following the said starting cell (14) if the value (H) of the said signal is greater of the value (K) stored in the said starting cell (14), and so on, to increase the index (I) until the said cell (14) storing the value (K) closest to the value (H) of the said signal is identified,
means for storing the index (I) of the said identified cell (14) in the said memory (15) as the new index (Ip),
means for calculating a quantity known as ratio (R) on the basis of the value (H) of the said signal, the value (K) stored in the said identified cell (14) and the value (K) stored in the said cell (14) immediately preceding the said identified cell (14),
means for calculating the control signals which are to be sent to the said systems and functional units (4), using the index (I) and the ratio (R) as data, and
means for controlling the said systems and functional units (4) via the said control blocks (8, 11 and 12) on the basis of the calculated control signals.

Fig. 1

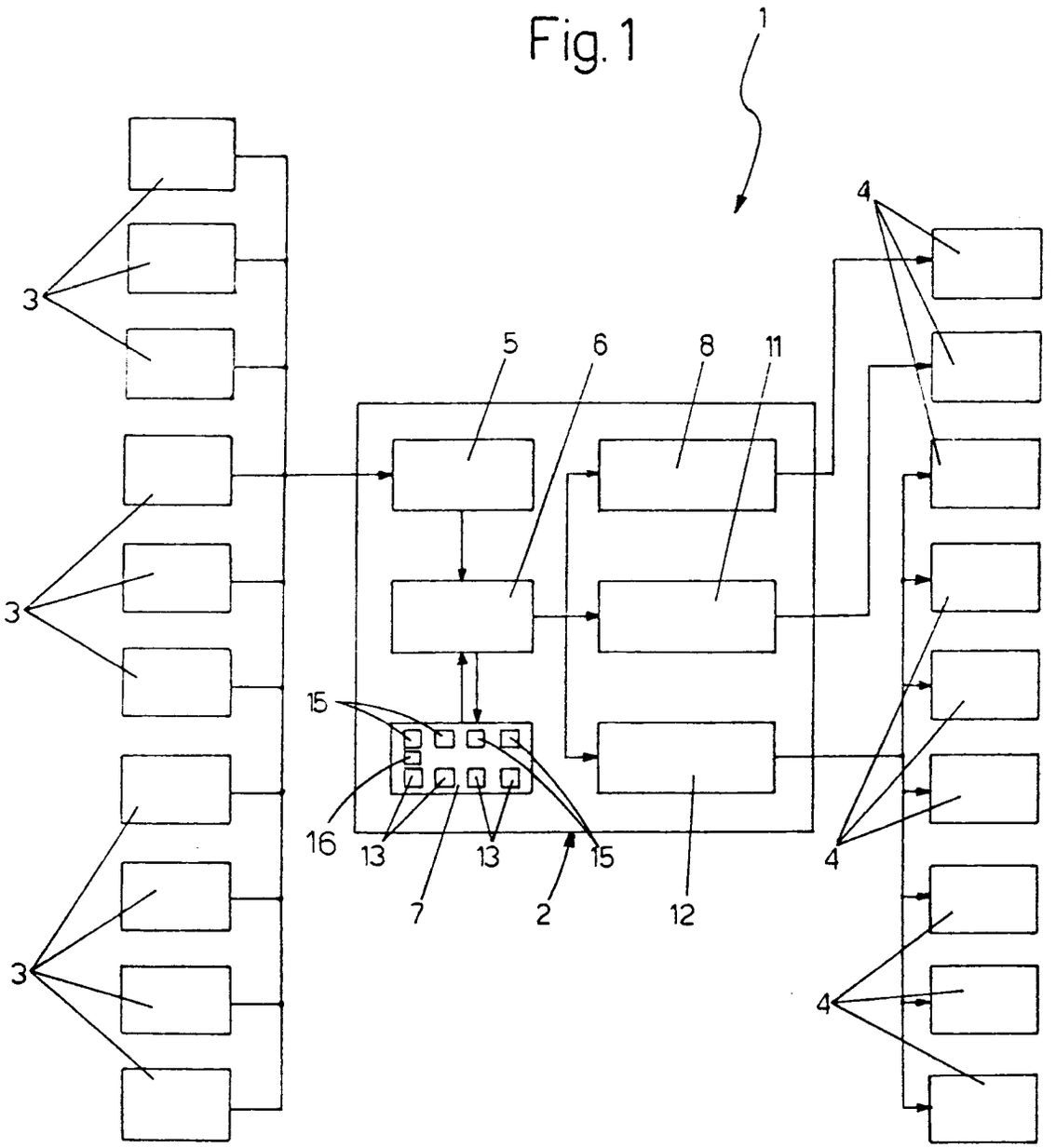


Fig. 2

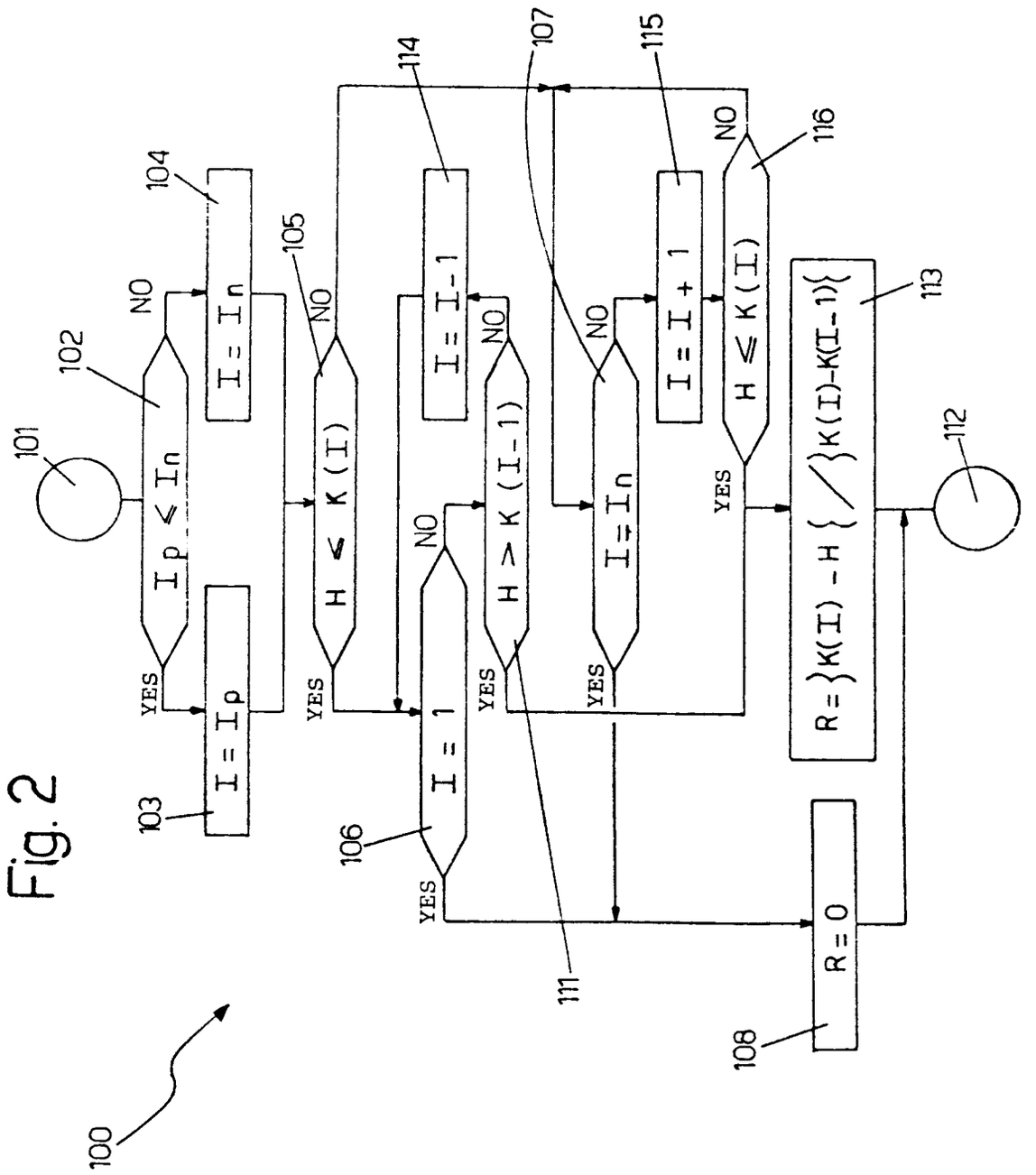
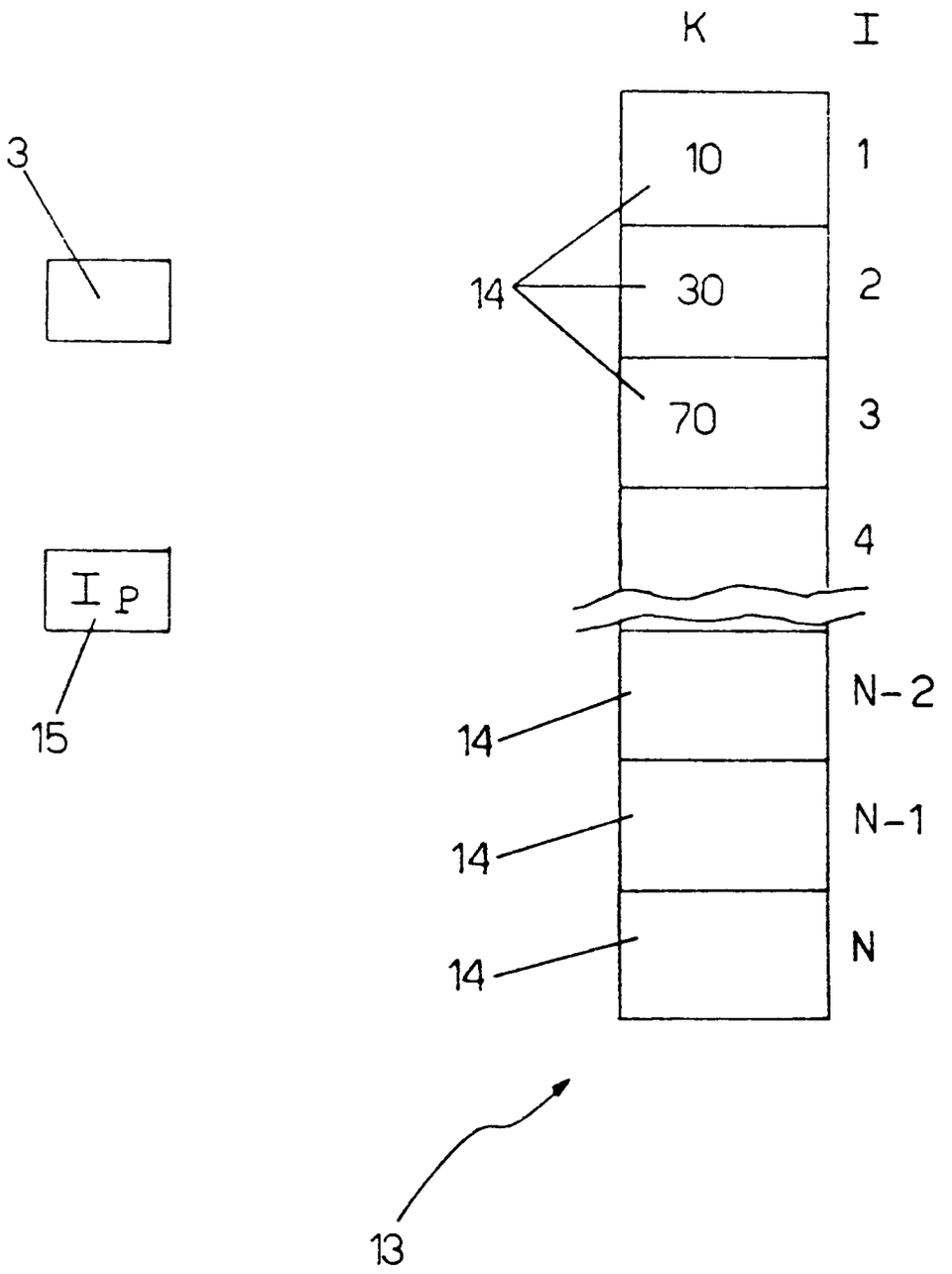

100
101
102
Ip ≤ In
NO
YES
103
I = Ip
104
I = In
105
H ≤ K(I)
NO
YES
106
I = 1
NO
YES
107
H > K(I-1)
NO
YES
108
R = 0
111
114
I = I-1
115
I = In
NO
YES
116
I = I+1
H ≤ K(I)
NO
YES
112
113
R = }K(I) - H { / }K(I)-K(I-1){

Fig. 3



European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 95 11 1276

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.6)
X	US-A-4 987 544 (HONDA ET AL.) 22 January 1991 * column 1, line 55 - column 2, line 8 * * column 4, line 34 - column 11, line 5; figures *	1,2	F02D41/24
A	GB-A-2 046 950 (HONDA GYKEN KOGYO KABUSHIKI KAISHA) 19 November 1980 * the whole document *	1,2	
A	EP-A-0 445 329 (SIEMENS AKTIENGESELLSCHAFT) 11 September 1991 * the whole document *	1,2	
			TECHNICAL FIELDS SEARCHED (Int.Cl.6)
			F02D

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	23 October 1995	Moualed, R

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

EPO FORM 1503 03.82 (P04C01)