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(54) **Appliance for calibration of carbon monoxide in a vehicle provided with an injection system.**

(57) The appliance (1) may be used to advantage to carry out the calibration of carbon monoxide in a vehicle provided with an injection system (2) which makes available, at its own output, an alternative square wave signal whose path is a function of the titre of the air-fuel mixture.

The appliance (1) is provided with means (5) of calculating the percentage value of the duty cycle of the aforementioned alternative signal, and with means (6) of displaying the result of this calculation numerically and/or in the form of a histogram.

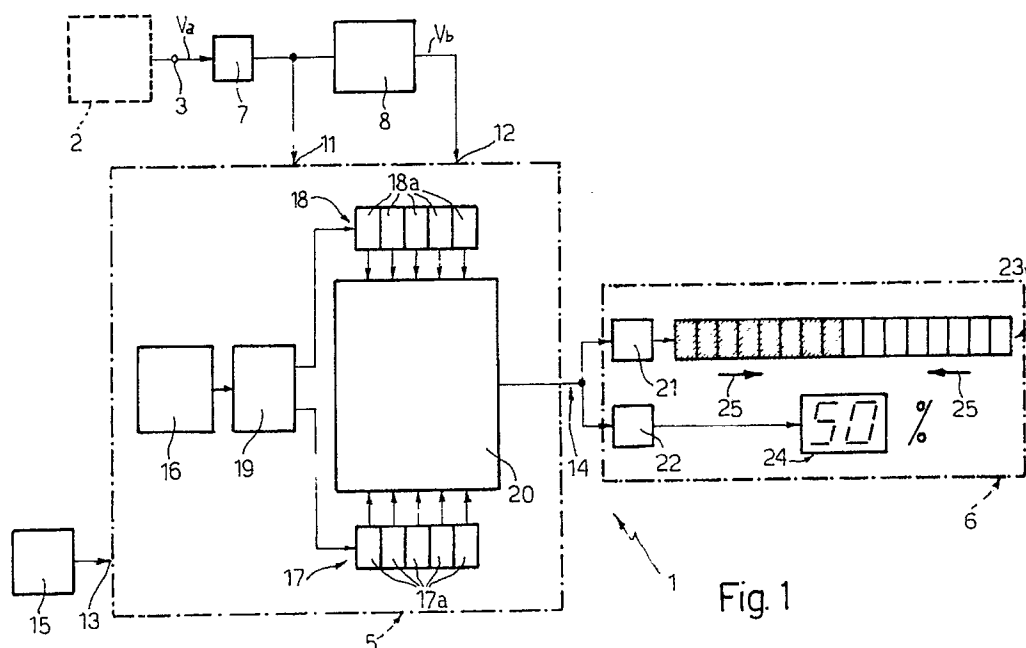


Fig. 1

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"APPLIANCE FOR CALIBRATION OF CARBON MONOXIDE IN A VEHICLE PROVIDED WITH AN INJECTION SYSTEM"

The present invention relates to an appliance for calibrating carbon monoxide in a vehicle provided with an injection system.

The present invention relates more particularly to an appliance which can be used to advantage for carrying out the calibration of carbon monoxide in a vehicle provided with an injection system of a known type which makes available, at its own output, an alternative square wave signal whose path is a function of the titre of the air-fuel mixture.

As is well known it is ultimately necessary, due to problems relating to dispersal of production, to carry out a check on each vehicle for the presence of carbon monoxide in the exhaust gases with the engine running at minimum speed. Where the read carbon monoxide value is not within the prescribed limits, arrangements must be made to correct it using suitable means of adjustment (by-pass screw, potentiometer, etc.).

For vehicles not provided with a catalytic converter, the exhaust gases are sampled directly from the exhaust pipe located downstream from the ordinary exhaust box, and the percentage of carbon monoxide is read by means of a suitable instrument.

For vehicles which are fitted with the catalytic converter, and hence also electronic injection systems, the gases which escape from the exhaust pipe are no longer significant for this purpose; it is therefore necessary to provide a gas outlet upstream from the catalytic converter, with a consequent increase in costs and difficulties in connecting the carbon monoxide measuring instrument.

By suitably connecting to earth, in some injection systems, the terminals of the injection system which are normally connected to the throttle valve position sensor, it is possible to obtain a square wave signal whose path is a function of the titre. Particularly where the basic calibration of the injection is weak, the voltage level will result mainly in a high logic value, and vice versa, whereas if the engine operates stoichiometrically, the wave form exhibits a duty cycle which is roughly equal to 50%, but with a highly variable frequency.

In the aforementioned injection systems the signal is recorded ultimately by an instrument provided with an index and connected to a self-diagnosis terminal in the injection system. Because of the slowness of the signal the reading time lasts several tenths of a second, and the stoichiometric operation of the engine is achieved when the sums of the holding times of the instrument in terms of high and low logic levels are almost equal.

The evaluation, and hence the regulation of the carbon monoxide which is achieved in this case by acting on a potentiometer is therefore subjective and frequently difficult because of the variations in the frequency of the signal examined.

The object of this invention is to provide an appliance which enables the carbon monoxide to be calibrated to a minimum value by a method which is simple, fast and not excessively expensive.

The aforementioned object is achieved by the present invention in that it relates to an appliance which can be used to calibrate carbon monoxide in a vehicle provided with an injection system of the type capable of making available, at its own output, an alternative square wave signal whose path is a function of the titre of the air-fuel mixture, characterised in that it comprises means for calculating the percentage value of the duty cycle of the said alternative signal, and means for displaying the result of the said calculation numerically and/or in the form of a histogram.

For a clearer understanding of the present invention a preferred embodiment is described in the following merely by way of a non-exhaustive example, with reference to the attached drawing, in which:

figure 1 is a block diagram of an appliance designed according to the present invention; and figure 2 illustrates the path of two wave forms of electrical signals sampled from predetermined points in the diagram in figure 1.

With particular reference to figure 1, an appliance which can be used to advantage to calibrate carbon monoxide in a vehicle provided with an injection system 2 of known type, is denoted in its entirety by 1, which appliance makes available, at an output terminal 3, an alternative square wave signal (V_a in figure 2a), whose path is a function of the titre of the air-fuel mixture.

Appliance 1 comprises essentially a unit 5 for calculating the percentage value of the duty cycle of the aforementioned alternative signal V_a , and means 6 for displaying the result of this calculation.

More particularly terminal 3 is connected, by means of a decoupling circuit 7, to a frequency duplicator circuit 8, which generates, at its own output, a signal V_b having the path illustrated in figure 2b.

The outputs of circuits 7 and 8 are connected to respective inputs 11, 12 of calculation unit 6, which is provided with a further input 13, to which is transmitted a signal generated by an oscillator 15.

Unit 5 is provided with a counter 16 capable of counting the duration of the periods of time during which signal Va remains at a high level (period T1) and a low level (period T0). The output signal of counter 16 is transmitted, at times t1 or t3, and at time 2, to memory units 17, 18, respectively, by means of commutator circuit 19, so that the duration of period T0 is stored in memory 17, and the duration of period T1 is stored in memory 18.

Memory units 17 and 18 should preferably consist of staggered (scaled) registers provided with several memory locations 17a, 18a (for example, five locations for each memory unit 17,18). In this manner the last five items of data relating to the durations of the aforementioned periods of time T0, T1, are held in the memory so that the insertion of a new item of data determines the cancellation of the data contained in the respective longer memory.

Memory locations 17a, 18a are provided with parallel outputs which are connected to the respective inputs of a calculation block 20, which carries out the calculation of the ratio of the period of time T1 to the sum of periods $T1 + T0$, and multiplies the value obtained by 100. This calculation is carried out on all the corresponding memory locations (there are five in this case), and the mean value of the result obtained is then calculated.

The result of this processing is made available to an output 14 of unit 5, and is displayed, by means of control circuits 21, 22, in a linear VDU (visual display unit) 23 and in a numeric VDU 24, or the dot matrix type, respectively.

The indication supplied by VDU 23 generates a histogram which makes it possible to identify, by means of a couple of reference arrows 25, a range of permitted values for obtaining good adjustment of the engine, from the point of view of the carbon oxide content in the exhaust gases, to the minimum value.

The operation of appliance 1 has already been explained in detail in the preceding part of the description, but for a clearer understanding the principal steps are now recapitulated, with particular reference to figure 2.

First of all, any switching of signal Va activates a procedure in calculation unit 5, which is capable of distinguishing a rising front (time t1, t3) from a descending front (time 2).

The measuring procedure is only initiated in conjunction with a rising front, according to the sequence described as follows:

- time t1: start of counting the period of time T1 by means of counter 16;
- time t2: storage of period of time T1 in memory unit 18, resetting counter 16, start of

counting the period of time T2 by means of counter 16;

- time t3: storage of period of time T2 in memory unit 17, resetting counter 16, calculation of the ratio of T1 to $(T1 + T2)$, start of a new cycle.

The result displayed in VDU 6 is that which is obtained, as already mentioned, from the floating mean value of five consecutive readings. It is obvious that where signal Va is permanently stable at a high or low logic level, no switching would be obtained, and hence there would be no indication in unit 6, but this event would already signal the presence of a fault or the complete decalibration of the injection system.

From an examination of the characteristics of the appliance designed according to the present invention, the advantages which the latter affords are evident.

In fact it is obvious how appliance 1 renders the measurement free from evaluations of the subjective type, thereby overcoming, extremely effectively, the dispersion (variation) of values between one measurement and the next (due to the variation in frequency of the tested signal), due to the calculation method used (floating mean from five counting cycles). This method provides the operator with an indication which is sufficiently stable in time, and an indication which can therefore be correctly evaluated.

Claims

1. Appliance which can be used to carry out the calibration of the carbon monoxide in a vehicle provided with an injection system of the type capable of making available at its own output an alternative square wave signal whose path is a function of the titre of the air-fuel mixture, characterised in that it comprises means for calculating the percentage value of the duty cycle of the said alternative signal, and with means for displaying the result of the said calculation numerically and/or in the form of a histogram.
2. Appliance according to claim 1, characterised in that the said means of calculation comprise a counter (16), which counts the period of time (T1) during which the said alternative signal is maintained at a high level, and the period of time (T0) during which the said alternative signal is maintained at a low level, storage means (17, 18) in which are stored the values relating to the said periods of time (T1, T0), and means (20) for evaluating the ratio of one (T1) of the said periods of time and the sum $(T1 + T0)$ of

the said periods of time.

3. Appliance according to claim 2, characterised in that each of the said means of storage (memory means) (17, 18) is provided with a plurality of memory locations (17a, 18a) capable of storing the respective values of the said period of time (T1, T0), recorded consecutively; the said means of evaluation (20) carrying out a calculation of the mean value of the said ratio on an identical number of values of the said periods of time (T1, T0) stored in the said memory locations (17a, 18a).
4. Appliance according to any of the preceding claims, characterised in that the said means of display comprise at least linear visual display unit (23) and/or one numeric visual display unit with the said duty cycle.

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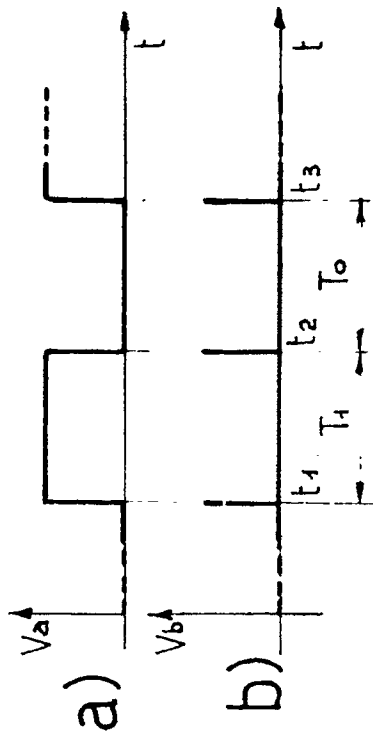


Fig.2

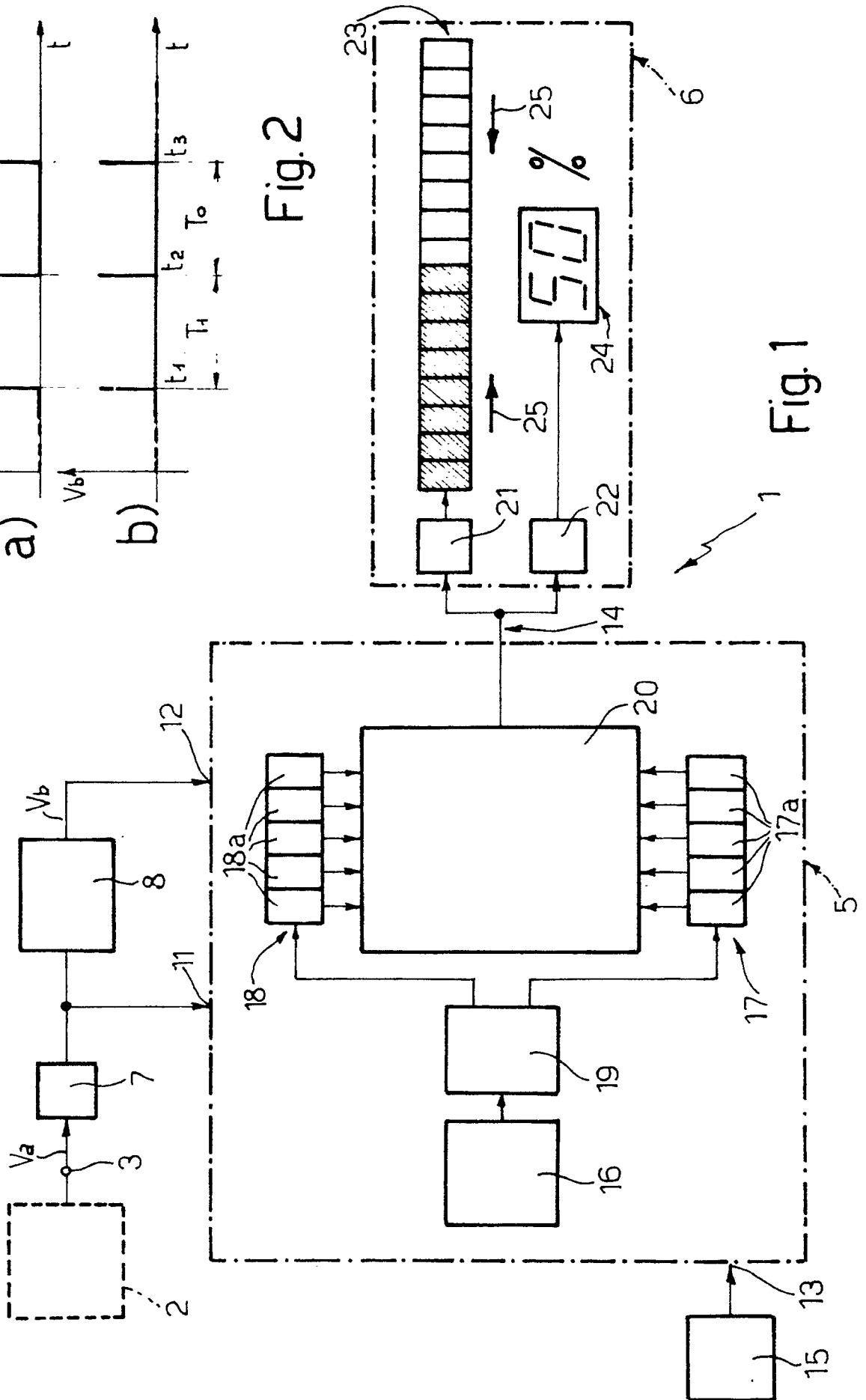


Fig.1



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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.5)
X	FR-A-2 465 222 (SOCIETE P.G.E.P. PROFESSIONNAL GENERAL ELECTRONIC PRODUCTS) * page 1, line 22 - page 3, line 34 ** figures 1, 2 * - - -	1	F 02 D 41/14 G 01 M 15/00
A	PATENT ABSTRACTS OF JAPAN vol. 7, no. 177 (M-233) 05 August 1983, & JP-A-58 079644 (TOYOTA JIDOSHA K.K.) 13 May 1983, * the whole document * - - -	1,2	
A	US-A-7 383 41 (US PHILIPS CORP.) * figures 2, 4, 5 ** column 1, line 63 - column 3, line 22 @ column 4, lines 11 - 66 @ column 10, line 14 - column 11, line 12 * - - -	1,3	
A	EP-A-0 008 199 (BECKMAN INSTRUMENTS) * page 2, lines 20 - 37 ** page 9, line 26 - page 10, line 9 ** page 15, line 18 - page 16, line 8 ** figures 4, 5 * - - -	1	
A	DE-A-3 025 985 (K.DUNGS) * page 3, paragraph 1 ** page 4, paragraph 4 - page 5, paragraph 1 ** page 6, paragraph 4 - page 7, paragraph 1 @ figure * - - -	1,2	
A	PATENT ABSTRACTS OF JAPAN vol. 9, no. 46 (M-360) 27 February 1985, & JP-A-59 185855 (NIHON DENSHI KIKI K.K.) 22 October 1984, * the whole document * - - -	1	
A	EP-A-0 277 826 (LUCAS INDUSTRIES) * column 1, line 59 - column 2, line 41 ** column 4, line 9 - column 5, line 42 ** figures 1-4 * - - - -/-	1-3	
The present search report has been drawn up for all claims			
Place of search The Hague		Date of completion of search 21 February 91	Examiner LAPEYRONNIE P.J.F.
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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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.5)
A	US-A-3 957 372 (UNITED TECHNOLOGIES CORP.) * figures 1, 3, 7 * column 1, line 43 - column 2, line 4 * column 4, line 39 - column 5, line 22 * -----	1,4	
			TECHNICAL FIELDS SEARCHED (Int. Cl.5)
The present search report has been drawn up for all claims			
Place of search		Date of completion of search	Examiner
The Hague		21 February 91	LAPEYRONNIE P.J.F.
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			