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**D E C I S I O N**  
**of 13 January 1994**

**Case Number:** T 0914/91 - 3.2.4

**Application Number:** 86101290.4

**Publication Number:** 0210323

**IPC:** F02D 41/22

**Language of the proceedings:** EN

**Title of invention:**

Failure judgment system for sensors installed in engine

**Patentee:**

Toyota Jidosha Kabushiki Kaisha

**Opponent:**

Robert Bosch GmbH

**Headword:**

Failure judgment system/TOYOTA

**Relevant legal norms:**

EPC Art. 56

**Keyword:**

"Inventive step (acknowledged)"

**Decisions cited:**

-

**Catchword:**

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Boards of Appeal

Chambres de recours

Case Number: T 0914/91 - 3.2.4

**D E C I S I O N**  
of the Technical Board of Appeal 3.2.4  
of 13 January 1994

**Appellant:**  
(Opponent)

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**Representative:**

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**Respondent:**  
(Proprietor of the patent)

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**Decision under appeal:**

Decision of the Opposition Division of the  
European Patent Office dated 24 September 1991 and  
dispatched to the parties on 18 October 1991  
rejecting the opposition filed against European  
patent No. 0 210 323 pursuant to Article 102(2)  
EPC.

**Composition of the Board:**

**Chairman:** C.A.J. Andries  
**Members:** P. Petti  
J.-P.B. Seitz

## Summary of Facts and Submissions

- I. An opposition against the European patent No. 0 210 323 was rejected by the Opposition Division in its decision dispatched on 18 October 1991.

The Opposition Division expressed the view that the ground for opposition did not prejudice the maintenance of the patent as granted, having regard to documents

D1: US-A-4 274 381  
D2: EP-A-0 135 680 and  
D3: GB-A-2 103 845.

- II. The wording of Claim 1 of the patent as granted reads as follows:

"A sensor failure judgement apparatus for an engine, comprising:

first sensor means (9, 14), installed in said engine (1), for detecting a first operational condition and providing a first output signal indicating said first operational condition;

second sensor means (41), installed in said engine or a vehicle in which said engine is installed, for detecting a second operational condition and providing a second output signal indicating said second operational condition; and

first failure judgement means, monitoring said first output signal, for generating a first failure signal and for replacing said first output signal of said first sensor means by a standard value signal if the first failure judgement means detects that said first output signal is outside of a first predetermined range;

said apparatus being characterized by further comprising:

second failure judgement means, monitoring said first output signal and said second output signal, for generating a second failure signal if said second output signal is outside of a range decided by said first output signal; and

failure detection inhibiting means for inhibiting the operation of said second failure judgement means if said first failure judgement means judges that said first sensor means fails."

- III. The Appellant (Opponent) lodged an appeal, received on 30 November 1991, against this decision. On the same day a statement setting out the grounds of appeal was received and the appeal fee was paid.
- IV. Oral proceedings were held on 13 January 1994.
- V. The Appellant essentially argued that the subject-matter of Claim 1 did not involve an inventive step with respect to each of documents D1 to D3.
- VI. The Respondent (Patent Proprietor) contested the Appellant's arguments by arguing that they were based on an *ex post facto* analysis of the prior art documents.
- VII. The Appellant requested that the decision under appeal be set aside and the patent revoked.

The Respondent requested that the appeal be dismissed and the patent be maintained as granted.

## Reasons for the Decision

1. The appeal is admissible.

2. *Interpretation of Claim 1*

2.1 Claim 1 is directed to a "sensor failure judgment apparatus for an engine". It is to be understood from the patent as a whole that such an apparatus is suitable for judging the failure of at least two sensors installed in the engine, whereby a failure of a sensor can occur in all the operating conditions of the engine when the sensors are operative to produce an output signal utilised for the control of the engine.

The apparatus according to Claim 1 comprises a first and a second failure judgment means.

The first failure judgment means, which monitors the output signal of a first sensor, generates a first failure signal if the output signal of the first sensor is outside a range (see Claim 1, column 8, lines 30 to 36). Such a range is "predetermined" (see Claim 1, column 8, line 36), i.e. it is defined by "predetermined" values (see the description of the patent, for instance column 5, lines 16 to 19).

The second failure judgment means, which monitors the output signal of a second sensor, generates a second failure signal if the output signal of the second sensor is outside a range decided by the output signal of the first sensor (see Claim 1, column 8, lines 39 to 43). In other words, the failure of the second sensor is judged by combining the output signals of both sensors whereby the range is not "predetermined" but depends on the value of the output signal of the first sensor.

2.2 There is no reason to follow the argument of the Appellant that according to the process steps 490 and 491 of Figure 6, no ranges but the binary values of 1 and 0 are considered in the claimed apparatus. Apart from the fact that the claims unequivocally define ranges (either a predetermined range or a range decided by the first output signal), the third embodiment also disclosed in the patent in suit, which is disclosed not only in Figure 6 but in the entity of Figures 6, 7 and 8, clearly reveals that the binary values 1 or 0 used in process steps 490 and 491 are only the result of the sub-routines disclosed in Figures 7 and 8 (cf. description, column 6, lines 34 to 53) which continuously verify whether the sensor values are inside predetermined ranges (process steps 600 and 700) and which, apart from generating a standard value, also set a failure flag if the sensor values are outside the corresponding predetermined range.

3. *Comparative analysis of the prior art documents with respect to Claim 1*

3.1 Document D1 (see particularly Figure 1, column 2, line 28 to column 4, line 52) discloses a sensor failure judgment apparatus for an engine comprising:

first sensor means (the engine coolant temperature sensor 18) installed in said engine, for detecting a first operational condition and providing a first output signal indicating said first operational condition;

second sensor means (the additional temperature sensor 24), installed in said engine, for detecting a second operational condition and providing a second output signal indicating said second operational condition; and

a failure judgment means (26), monitoring the first output signal (which is applied to the input terminal 26-1 and to the comparator 28), for generating a failure signal (the output signal of the AND gate 32) and for replacing the first output signal of the first sensor means by a standard value signal (the voltage  $V_0$  developed by the voltage divider 35) if the failure judgment means detects that the first output signal is below a first predetermined value and the second sensor is over a second predetermined value.

The sensor failure judgment apparatus is thus provided with only one failure judgment means (26) which monitors two comparable temperature signals. The failure of the engine coolant temperature sensor (18) is detected when the signal of this sensor is inconsistent with that of the additional sensor, i.e. when the engine coolant temperature sensor (18) indicates a low temperature while the additional temperature sensor (24) indicates a high temperature.

The subject-matter of Claim 1 differs from this prior art in that:

- (a) the first failure signal and the standard value signal replacing the first output signal are generated by the first failure judgment means when the first failure judgment means detects that the first output signal is **outside a first predetermined range;**

and in that the apparatus further comprises:

- (b) a second failure judgment means, monitoring said first output signal and said second output signal, for generating a second failure signal if said

second output signal is outside a range decided by said first output signal; and

(c) failure detection inhibiting means for inhibiting the operation of said second failure judgment means if said first failure judgment means judges that said first sensor means has failed.

3.2 Document D2 (see particularly Figure 1, page 3, line 8 to page 5, line 4) discloses a sensor failure judgment apparatus for an engine comprising:

first sensor means ("Lastsensor" 14) installed in said engine, for detecting a first operational condition and providing a first output signal indicating said first operational condition;

second (13) and third (14) sensor means, installed in said engine, for respectively detecting second and third operational conditions and providing second and third output signals indicating respectively said second and third operational conditions; and

a failure judgment means (18, 19 and 10), monitoring the first output signal, for generating a failure signal and for replacing the first output signal of the first sensor means by a standard value signal if the failure judgment means detects that the first output signal is outside a range.

More particularly, the second and third output signals, which represent respectively the engine revolution speed (n) and the position of the throttle (DK), serve to calculate a reference value signal ( $P_{soll}$ ) which is compared with the output of the first sensor means, representative of the engine load (p).

Neither the second (13) nor the third (14) sensor is associated with a failure judgment means which monitors the signal provided by the sensor and which generates a failure signal if the sensor involved is out of order.

The subject-matter of Claim 1 substantially differs from this prior art by the features (b) and (c) mentioned in section 3.1 above.

3.3 Document D3 (see particularly Figures 1, 2A and 2B) discloses a sensor failure judgment apparatus for an engine comprising:

first sensor means, namely an O<sub>2</sub> sensor (9), installed in said engine, for detecting a first operational condition and providing a first output signal (V) indicating said first operational condition;

second sensor means, namely an engine temperature sensor (14), installed in said engine, for detecting a second operational condition and providing a second output signal (T<sub>w</sub>) indicating said second operational condition;

a third sensor means, namely the atmospheric pressure sensor (10), installed in said engine, for detecting a third operational condition and providing a third output signal (P<sub>A</sub>) indicating said third operational condition;

a first failure detecting arrangement (A) for the O<sub>2</sub> sensor to which (arrangement) a plurality of binary signals is applied (it should be emphasised that the first output signal (V) is not applied to this first failure detecting arrangement), this first failure detecting arrangement (A) being suitable for generating a failure signal if the O<sub>2</sub> sensor is out of order only after being fully activated;

a second failure detecting arrangement (B) for the O<sub>2</sub> sensor to which the second output signal (T<sub>w</sub>) and a plurality of binary signals are applied, this second failure detecting arrangement (B) being operative, soon after the start of the engine if the engine is in its warmed-up condition and as long as the O<sub>2</sub> sensor is not fully activated, for generating a failure signal if the O<sub>2</sub> sensor is not activated within a predetermined time after the moment the second output signal (T<sub>w</sub>) reaches a predetermined value; and

a failure detection inhibiting means for inhibiting the operation of both the first (A) and second (B) failure detecting arrangements if the third output signal (P<sub>A</sub>), representative of the atmospheric pressure, is below a predetermined value (P<sub>Amin</sub>).

The subject-matter of Claim 1 substantially differs from this prior art in that:

- (a') the first failure detecting arrangement or failure judgment means monitors the first output signal, whereby the first failure signal is generated if the first failure judgment means detects that said first output signal is outside a predetermined range;
- (b') the second failure detecting arrangement or failure judgment means monitors (not only the second output signal but also) the first output signal, whereby the generation of the second failure signal occurs if the first failure judgment means detects that said first output signal is outside a range decided by said first output signal;
- (c') the failure inhibiting means is suitable for inhibiting the second failure judgment if the first

failure judgment means judges that the first sensor means has failed.

4. *Novelty*

Having regard to the analysis of the prior art document made in sections 3.1 to 3.3 above, the subject-matter of Claim 1 is novel.

5. *Inventive step*

- 5.1 Feature (b), see above section 3.1, concerns the failure judgment of the second sensor, such judgment being done by combining the signals of both first and second sensors. Feature (c), see above section 3.1, is strictly related to feature (b) and to the operation of the first failure judgment means, insofar as the failure detection inhibiting means inhibits the failure judgment of a second sensor if the first sensor fails.

In other words, the presence of a failure detection inhibiting means according to feature (c) has, in the present case, a technical sense only if the apparatus comprises at least two failure judgment means for two different sensors and the failure judgment of one of the sensors is performed by combining the output signals of both sensors.

Between features (b') and (c'), according to above section 3.3, there is an analogous relationship as between features (b) and (c) insofar as the failure detection inhibiting means inhibits the failure judgment of a second sensor only if the first sensor is out of order.

If the second failure judgment means were not inhibited during failure of the first sensor, it would be possible

that the second failure judgment means, which also takes into account the first sensor output signal, delivers a failure judgment, although the second sensor is working perfectly, due to the fact that the first sensor is not working correctly.

To prevent such a misjudgment, the operation of the second failure judgment means is inhibited once the first sensor output signal is proven to be outside a range of manual operating values, i.e. once the first sensor is faulty.

- 5.1.1 Starting from document D1 or from document D2 or from document D3, the problem to be solved can be seen to provide a sensor failure judgment apparatus for an engine, operative in all the operating conditions of the engine, which enables a correct error judgment of a plurality of sensors.

The Board is satisfied that this problem is solved by the combination of features recited in Claim 1.

- 5.2 The available prior art does not contain any indication or suggestion with respect to the combination of either features (b) and (c) or of features (b') and (c').

More particularly: None of the prior art documents discloses either explicitly or implicitly the idea of preventing the operation of a failure judgment means, once it is sure that another sensor means itself, whose output signal is taken into account during that operation, is not functioning properly, i.e. has failed. Therefore, no indication can be found in the prior art documents concerning the necessity of inhibiting the failure judgment of a second sensor if the first sensor fails.

The combination of two or indeed of all the above mentioned documents would not lead to the subject-matter of Claim 1. It could only lead to an apparatus having at least two failure judgment means for two different sensors, each monitoring the output signal of a sensor, without any relationship between them.

5.3 The Appellant - in order to challenge the inventive step of the subject-matter of Claim 1 - presents three different chains of argumentation based respectively on documents D1, D2 and D3 as representing the closest prior art.

5.3.1 According to the first chain of argumentation of the Appellant, the subject matter of Claim 1 is obvious with respect to the prior art known from document D1, since this document discloses an apparatus not only according to the preamble of Claim 1 but also comprising all the features performing the functions defined in the characterising portion. According to the Appellant, comparator 28 has to be considered as the first failure judgment means, whereas the AND-gate 32 has to be considered not only as the second failure judgment means but also as the failure detection inhibiting means.

It goes without saying that the comparator 28 involved issues only a binary value of 1 or 0, and cannot be compared with the claimed first failure judgment means which, as such, i.e. without the help of other features, can generate a standard value signal if the first output signal is outside a range. With respect to the AND-gate 32, it must be stated that neither the first output signal (engine coolant temperature) nor the second output signal (additional temperature) is monitored by the AND-gate.

This argumentation is based on an interpretation of document D1 which cannot be followed by the Board.

Indeed, the comparator (28) only performs a comparison between the signal of the first temperature sensor (18) and a reference temperature value. Even if the binary signal at the output of that comparator (28) were to be considered as a failure signal (which would only be the case if comparator 30 is also giving an appropriate output binary signal), the comparator itself does not generate a standard value signal. Document D1 unequivocally discloses an apparatus provided with a single failure judgment means.

5.3.2 The second chain of argumentation is based on document D2 as a starting point.

In particular the Appellant refers to the description of document D2 (page 2, lines 23 to 26; page 4, second paragraph). The Appellant - interpreting the first and second sentences in the second paragraph of page 4 - submits that, during warming up of the engine, the signal of engine load (p) is given (in German: "freigegeben") only when a determined pressure is arrived at and argues that such sentences imply a first failure judgment means for generating a first failure signal and a standard value signal. A second failure judgment means monitoring the output signal of the engine load (first output signal), as well as the signal of an other sensor (16 or 13), is, in the Appellant's view, clearly shown in Figure 1. Moreover, the Appellant - interpreting the third sentence in the second paragraph of page 4 - submits that the feature concerning the failure detection inhibiting means could be derived from document D2.

The Board cannot accept this argument because it is based on an *ex post facto* analysis of document D2:

This document discloses an apparatus having a failure judgment means for only one sensor, namely for the load sensor (14). Since none of the other sensors (16 and 13) is associated with a further failure judgment means, there is no need to inhibit the operation of a failure judgment means which does not exist.

The fact that the system (i.e. the failure judgment means) according to Figure 1 is not used under certain conditions has nothing to do with a wrongly operating sensor means but with the fact that certain output values of the concerned, correctly operating, sensor means are not wanted.

5.3.3 The third chain of argumentation of the Appellant is based on document D3.

The Appellant compares the first failure judgment means of Claim 1 with the O<sub>2</sub> sensor activation detecting circuit shown in Figure 2B with the reference sign (61), and the second failure judgment means with the second failure detecting arrangement shown in Figure 2A with the reference sign (B) and submits that this second failure judgment means also performs the function of the failure detection inhibiting means according to Claim 1.

The Board cannot accept this interpretation. The O<sub>2</sub> sensor activation detecting circuit (61) cannot be compared with a failure judgment means because the check of the activation of the O<sub>2</sub> sensor is normally made only on start-up of the engine and is not comparable with the detection of a failure which can occur in all operating conditions of the engine when the sensor is operative to

produce an output signal utilised for the control of the engine.

It should furthermore be emphasised that, in arrangement B, box 79 only monitors the engine coolant temperature signal ( $T_w$ ) which is compared with a predetermined value to generate a binary value of 1 or 0. The OR-gate 83 only receives binary values, whereas flip-flop 82 only receives a binary signal S1 (0 or 1) from box 61 whether or not circuit 61 or second failure detecting arrangement B is generating a standard value signal. It goes without saying that the Board cannot agree with the comparison made by the Appellant.

- 5.4 Therefore the Board considers the subject-matter of Claim 1 as involving an inventive step over each of the prior art documents D1 to D3 taken singly or in combination.
6. The patent can therefore be maintained as granted.

### Order

**For these reasons, it is decided:**

The appeal is dismissed.

The Registrar:



N. Maslin

The Chairman:

  
C. Andries