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D E C I S I O N
of 1 December 1999

Case Number: T 0916/98 - 3.4.2

Application Number: 91300705.0

Publication Number: 0441523

IPC: G01F 1/68, G01F 5/00

Language of the proceedings: EN

Title of invention:
Air flow rate measuring device for an internal combustion engine

Patentee:
Hitachi, Ltd., et al

Opponent:
Robert Bosch GmbH

Headword:
-

Relevant legal provisions:
EPC Art. 54, 56, 84

Keyword:
"Inventive step (main request, auxiliary requests 1 and 2: no)"
"Claims - support by description (auxiliary request 3: no)"
"Novelty and inventive step (auxiliary request 4: yes)"

Decisions cited:
-

Catchword:

-

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Case Number: T 0916/98 - 3.4.2

D E C I S I O N
of the Technical Board of Appeal 3.4.2
of 1 December 1999

Appellant: (Proprietor of the patent)
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Respondent: (Opponent)
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Representative:
-

Decision under appeal:
Decision of the Opposition Division of the European Patent Office posted 14 July 1998 revoking European patent No. 0 441 523 pursuant to Article 102(1) EPC.

Composition of the Board:

Chairman: E. Turrini
Members: R. Zottmann
V. Di Cerbo

Summary of Facts and Submissions

I. The appellant (patentee) lodged an appeal against the decision of the Opposition Division revoking European patent No. 0 441 523 with the application No. 91 300 705.0.

The opposition was based on the grounds of opposition laid down in Article 100(a) EPC that the subject-matter of the patent was not novel and did not involve an inventive step.

The reason for said decision was that the subject-matter of the amended independent claims 1 according to four requests did not involve an inventive step.

II. The following prior art documents were cited during the appeal proceedings:

D1: EP-A-0 295 647

D2: EP-A-0 313 089

D3: SAE Technical Paper Series; R. Sauer, Robert Bosch GmbH Stuttgart: "Hot-Film Air Mass Meter - A Low-Cost Approach to Intake Air Measurement; International Congress and Exposition Detroit, Michigan; February 29 to March 4, 1988, pages 105 to 109

D4: DE-A-2 710 473

D5: DE-A-3 007 851

D6: US-A-4 766 214

D7: English translation of JP-A-60-56 244 (pages 1 to 5) filed by the respondent and Figures 1 and 2 of JP-A-60-56 244

D11: EP-A-0 173 946

D12: US-A-4 677 850

D13: DE-A-3 326 047

D14: DE-U-8 910 740

D15: EP-B-0 175 077

III. Oral proceedings were held at the end of which the decision was announced.

IV. The appellant requested that the decision under appeal be set aside and that the patent be maintained on the basis of the main request or, in the alternative, on the basis of the auxiliary requests 1 to 6 filed at the oral proceedings.

The respondent (opponent) requested that the appeal be dismissed.

V. Claim 1 of the main request reads as follows:

1. An air flow rate measuring device for an internal combustion engine including a housing (1) adapted to be inserted through a body (11) defining an air intake main passage (4) of said engine, said

housing (1) having an auxiliary air passage (3) for a portion of the intake air, wherein the auxiliary air passage (3) includes at least one curved portion extending between an inlet port and a downstream outlet port and said housing (1) supports a thermal sensor (6) for detecting the air flow rate in said auxiliary passage (3), characterized in that said housing (1) includes a wall means (18) for location in said main passage to be cooled by intake air and a circuit module (5) mounted on said wall means (18) for driving said thermal sensor (6) and to process signals therefrom, wherein an enclosure for installing said circuit module (5) and said auxiliary air passage (3) are formed within said housing (1)."

Claim 1 of auxiliary request 1 reads as follows:

"1. An air flow rate measuring device for an internal combustion engine including a housing (1) adapted to be inserted through a body (11) defining an air intake main passage (4) of said engine, said housing (1) having an auxiliary air passage (3) for a portion of the intake air, wherein the auxiliary air passage (3) includes at least one curved portion extending between an inlet port and a downstream outlet port and said housing (1) supports a thermal sensor (6) for detecting the air flow rate in said auxiliary passage (3), characterized in that
said housing (1) includes a metallic wall means (18) for location in said main passage to be cooled by intake air and a circuit module (5) mounted on said metallic wall means (18) for

driving said thermal sensor (6) and to process signals therefrom, wherein
an enclosure for installing said circuit module (5) and said auxiliary air passage (3) are formed within said housing (1), said auxiliary air passage (4) and said enclosure are formed in a plastics or synthetic resin molding."

Claim 1 of auxiliary request 2 reads as follows:

"1. An air flow rate measuring device for an internal combustion engine including a housing (1) adapted to be inserted through a body (11) defining an air intake main passage (4) of said engine, said housing (1) having an auxiliary air passage (3) for a portion of the intake air, wherein the auxiliary air passage (3) includes at least one curved portion extending between an inlet port and a downstream outlet port and said housing (1) supports a thermal sensor (6) for detecting the air flow rate in said auxiliary passage (3), characterized in that
said housing (l) includes a metallic wall means (18) for location in said main passage to be cooled by intake air and a circuit module (5) mounted on said metallic wall means (18) for driving said thermal sensor (6) and to process signals therefrom, wherein
an enclosure for installing said circuit module (5) and said auxiliary air passage (3) are formed within said housing (1), said auxiliary air passage (4) and said enclosure are formed in a plastics or synthetic resin molding and said circuit module (5) is located in said enclosure

which is delimited inside said housing (1) by a separation wall between said enclosure and said auxiliary passage (3)."

Claim 1 of auxiliary request 3 reads as follows:

"1. An air flow rate measuring device for an internal combustion engine including a housing (1) adapted to be inserted through a body (11) defining an air intake main passage (4) of said engine, said housing (1) having an auxiliary air passage (3) for a portion of the intake air, wherein the auxiliary air passage (3) includes at least one curved portion extending between an inlet port and a downstream outlet port and said housing (1) supports a thermal sensor (6) for detecting the air flow rate in said auxiliary passage (3), characterized in that
said housing (1) includes a metallic wall means (18) for location in said main passage to be cooled by intake air and a circuit module (5) mounted on said metallic wall means (18) for driving said thermal sensor (6) and to process signals therefrom, wherein
an enclosure for installing said circuit module (5) and said auxiliary air passage (3) are formed within said housing (1), said auxiliary air passage (4) and said enclosure are formed in a plastics or synthetic resin molding and said circuit module (5) is located in said enclosure which is formed between an entrance and said curved portion of said auxiliary air passage (3)."

Claim 1 of auxiliary request 4 reads as follows:

"1. An air flow rate measuring device for an internal combustion engine including a housing (1) adapted to be inserted through a body (11) defining an air intake main passage (4) of said engine, said housing (1) having an auxiliary air passage (3) for a portion of the intake air, wherein the auxiliary air passage (3) includes at least one curved portion extending between an inlet port and a downstream outlet port and said housing (1) supports a thermal sensor (6) for detecting the air flow rate in said auxiliary passage (3), characterized in that
said housing (1) includes a metallic wall means (18) for location in said main passage to be cooled by intake air and a circuit module (5) mounted on said metallic wall means (18) for driving said thermal sensor (6) and to process signals therefrom, wherein an enclosure for installing said circuit module (5) and said auxiliary air passage (3) are formed within said housing (1), said auxiliary air passage (4) and said enclosure are formed in a plastics or synthetic resin molding,
the housing (l) includes two halves (1, 31), one half (1) being adjacent the metallic wall means and forming a partial enclosure about the circuit module (5) and one half of the auxiliary air passage (3), the second half (31) forming the remaining enclosure about the circuit module (5) and the second half of the auxiliary air passage (3) and said remaining enclosure having a cover (100) bonded to the housing (1) after gel injection over the circuit module (5)."

The remaining claims of each of said requests are dependent on claim 1 of the respective claim set.

VI. The arguments of the appellant are summarized as follows:

The meaning of the expression "curved portion" can easily be deduced from the drawings and the description. Said curved portion is a section of the auxiliary air passage which deviates the air stream as a whole by a certain angle and includes also the straight portion immediately following downstream.

Figure 4 of D3 shows that only the power transistor is mounted on the cooling body but not the circuit module.

There are two groups of air flow rate measuring devices. The group where the auxiliary air passage is within the air intake main passage (represented by three documents, e.g. D3 and Figures 2 and 3 of D13), has a straight-line auxiliary air passage. In the group (represented by three documents, e.g. Figures 4 and 5 of D13) where the auxiliary air passage has a curved portion, said passage is realized by a bypass outside the air intake main passage; only D2 is an exception. A combination of these two groups is not obvious since the technology has developed into two quite different directions.

The skilled person is refrained from using the solution according to D2 because the passage on page 109 right-hand column in the middle of D3 suggests bypass installations outside the air intake main passage.

Even if the skilled person combined the teachings of D2 and D3, he would arrange the housing of D3 within an L-shaped housing known from D2 in such a manner that the auxiliary air passage of the housing of D3 comprising the thermal sensor is surrounded by the outer L-shaped bypass.

The gel injection disclosed in claim 1 of auxiliary request 4 reduces the costs, makes possible an easy bonding and protects the circuit.

VII. The arguments of the respondent are summarized as follows:

The expression "curved portion" is unclear. Said portion does not include said straight portion downstream the curved portion. The curved portion comprises also a section of the passage which has at least one curved wall. It is not necessary that the axis is curved. Furthermore, the meaning of the expressions "enclosure" and "wall means" used in the independent claims are unclear.

As can easily be seen from the drawings, the enclosure is not formed between the entrance and the curved portion. Thus claim 1 of the auxiliary request 3 is unclear.

Claims 1 of the main request and auxiliary requests 1 to 3 are not novel - e.g. with respect to D2 and D3 - or at least not inventive with respect to the prior art disclosed in the cited documents. For example, a combination of the teachings of D2 and D3 would lead to a device with all features of claim 1 of auxiliary

request 2.

Admittedly, the last feature of claim 1 of the auxiliary request 4 concerning the gel injection over the circuit module cannot be taken from the cited documents of the prior art. However, said measure is unimportant for the invention and trivial for the skilled person. A cover for an enclosure containing the circuit is shown in Figure 4 of D3.

Reasons for the Decision

1. *Interpretation of features of the claims*

1.1 The feature that the auxiliary air passage formed within the housing includes at least one curved portion extending between an inlet port and a downstream outlet port (hereinafter called feature E) is contained in the independent claim of all requests. The position, extension and form of said curved portion was in dispute during the appeal proceedings.

The appellant took the view that said curved portion is a section of the auxiliary air passage which deviates the air stream by a certain angle (by 90° in Figures 2, 5, 9, 10 and 15) and that the axis of the auxiliary air passage is also curved in the range of said curved portion. Said curved portion includes also the straight portion immediately following downstream (in Figures 2, 5, 9, 10 and 15 for example said straight portion and its axis are extending perpendicular to the axis of the air intake main passage 4).

The respondent was of the opinion that said curved portion does not include said straight portion immediately following downstream the curved portion. The curved portion comprises also such a section of the passage which has at least one curved wall and thus has the effect that only a part of the air stream is deviated from its straight-line path. It is not necessary that the axis is curved. As an example, he mentioned the bevel-edged end portions of the air passage as shown in Figure 4 of D3 and in Figure 9 of D12 where the axis of the passage remains straight.

In the Board's opinion, at least from the drawings follows that said expression is to be interpreted as a section of the auxiliary air passage which deviates the air stream by a certain angle such that the axis of the passage is also curved there. Such a curved portion as defined in the independent claims does thus not comprise such portions of the air passage as the bevel-edged end portions of the air passage as shown for example in Figure 4 of D3 and in Figure 9 of D12. It follows unambiguously from the expression "curved portion" as such that it does not include a straight portion.

1.2 The enclosure of the device according to claim 1 of each request ("an enclosure for installing said circuit module (5) and ... formed within said housing ... ") is a surround, a chamber or the like which need not be closed, but should be suitable to accommodate the circuit module and is a part of the housing.

1.3 The housing comprises parts of the measuring device inside and outside the air intake main passage, in

particular the parts forming the auxiliary air passage and the enclosure, the wall means, the flange(s) for fixing the device to the body of the air intake main passage and the connector.

For conciseness of reasons, the requests of the appellant are ordered as follows:

2. *Auxiliary request 2*

2.1 During the proceedings it was in dispute which of the documents D2 or D3 represents the nearest prior art with respect to the patent in suit.

D3 discloses a hot-film air flow rate measuring device for a combustion engine having a housing (Figure 4: a horizontally hatched upper housing, a vertically hatched lower housing, a diagonally hatched cooling body, a horizontally hatched connector) adapted to be inserted through a tube defining an air intake main passage of the engine (see Figures 4 and 9 with corresponding description on pages 107 and 109). The housing has an auxiliary air passage for a portion of the intake air. Said passage is formed by the inner end section of the housing. Figures 4 and 9 show that the auxiliary air passage is formed in the housing and has a rectangular cross-section and possibly bevel-edged ends, but apparently a straight-line axis, and thus does not include a curved portion in the sense of

claim 1 of the attacked patent (see section 1.1 above). The housing supports a thermal resistor (a hot film resistor) in the auxiliary air passage for detecting the air flow rate in said passage. The sections of the lower housing and the upper housing between said inner end section and the inner tube wall form an enclosure for the circuit module consisting of a power transistor and hybrid plate and suitable for driving the thermal resistor (R_S) and to process signals therefrom (see Figure 2 and corresponding description). The enclosure is delimited inside the housing by a (horizontally hatched) separation wall between the enclosure and the auxiliary air passage. The left-hand part of the circuit (the power transistor) is mounted on a cooling body with ribs exposed to the main air stream through said tube in use of the device and thus cooled by intake air. The cooling body is fixed to and in contact with the lower housing.

Materials for the housing and the cooling body are not mentioned in D3. However, since the connector has to be made of an isolating material - usually a plastics molding - and is hatched in the same manner as the upper housing and apparently integral with the upper housing, the skilled person would assume that the upper housing is made of the same material as the connector. Since the lower housing is connected to the upper housing by snap-on-hooks, it is probably made of the same material as the upper housing and the connector. Because of the considerably higher heat conductivity of metals with respect to commonly used non-metallic materials such as plastics or ceramic material, the skilled person would prefer metal as material for said cooling body.

Hence, when taking into account that the skilled person would prefer the above-mentioned materials for the housing and the cooling body, the subject-matter of claim 1 differs from the device of D3 only in that the auxiliary air passage includes at least one curved portion extending between an inlet port and a downstream outlet port.

Document D2 describes an air flow rate measuring device which is adapted for an internal combustion engine. Said device comprises a housing (30, 253) adapted to be inserted through a body (20, 250) defining an air intake main passage (21) of said engine. An auxiliary air passage (31, 252) for a portion of the intake air is formed within said housing. The housing includes a circuit module (2) for driving the thermal sensor and to process signals therefrom. The auxiliary air passage includes at least one curved portion extending between an inlet port and a downstream outlet port (31d, 252d). Moreover, the housing supports a thermal sensor (2a) for detecting the air flow rate in said auxiliary air passage. Reference is made e.g. to the abstract, to column 5, line 50 to column 6, line 26 and to Figures 1, 2, 15, 17 and 31.

Therefore, claim 1 differs from the device known from D2 in that the housing includes a metallic wall means for location in the air intake main passage to be cooled by intake air, the circuit module is mounted on the wall means, an enclosure for installing and locating the circuit module is formed within the housing, the enclosure is delimited inside the housing by a separation wall between the enclosure and the auxiliary air passage and the enclosure are formed in a

plastics or synthetic resin molding.

Hence, D3 represents the nearest prior art with respect to the subject-matter of claim 1.

2.2 Said difference between the subject-matter of claim 1 and D3 has the effect that the thermal sensor is better protected against damage caused by backfire or blowback originating from the engine into the auxiliary air passage.

Therefore the problem underlying the invention according to claim 1 is to improve the device known from D3 in such a manner that the sensor is better protected against backfire or the like.

2.3 Faced with the above-mentioned problem, the skilled person would have regard to the teaching of prior art D2 belonging to the same technical field. Moreover since the problems arising from backfire are addressed in D3 (see page 109, right-hand column first paragraph) and since D2 stresses that provision of an auxiliary air passage with an L-shaped portion (and thus including a curved portion) results in a protection of the thermal sensor (see D2, column 4, lines 2 to 13), the skilled person would provide as a matter of course the air flow rate measuring device according to D3 with the auxiliary air passage as shown in D2, thus obtaining a measuring device with all the essential features of claim 1.

2.4 The objection of the appellant that only the power transistor is mounted on the cooling body but not the circuit is not convincing since the power transistor of

D3 is an integral part of the circuit (see e.g. Figure 2). Moreover, claim 1 does not indicate that all parts of the circuit module are in close contact with the wall means. In addition, if better cooling of these parts is necessary or advantageous, the skilled person would shape the cooling body in such a manner that also other parts of the circuit are in direct contact with said body. Such a design modification could be realized easily (see above all Figure 4 where a cavity between the cooling body and the hybrid plate is shown).

The appellant alleges that the prior art devices can in substance be classified in two groups representing two incompatible types of air flow measuring devices (see section VI above) and that thus the skilled person would not combine these two types. In the Board's view, prejudice cannot be established by such a low number of documents. Moreover, the device according to document D2 represents a combination of said two types and thus the above allegation of the appellant is refuted.

If the housing of D3 were accommodated in an L-shaped bypass within the air intake main passage, as according to D2, this would lead to a clumsy device and the skilled person would expect a considerably change in the flow characteristics leading to incalculable vortices and thus higher measuring errors. Therefore, the skilled person would take into account such a construction.

The appellant alleged that the skilled person is refrained from using the solution according to D2 because D3 suggests bypass installations outside the air intake main passage (he referred to page 109,

right-hand column in the middle). First, said passage does not mention **outside** bypass installations and thus a bypass construction for said passage as used in D2 is not excluded (see in D2 e.g. column 3, line 53 to column 4, line 18 where the auxiliary air passage **within** the air intake main passage is designated by the term "bypass"). Second, bypass installations outside the main passage require more space and require a complicated (re-)construction of the air intake main passage.

2.5 Thus, the subject-matter of claim 1 does not involve an inventive step in the sense of Article 56 EPC. As a consequence, the auxiliary request 2 is not acceptable.

3. *Main request and auxiliary request 1*

Claim 1 of the main request and claim 1 of the auxiliary request 1 differ from claim 1 of the auxiliary request 2 only in that they do not contain the following features: the circuit module (5) is located in the enclosure and said enclosure is delimited inside the housing (1) by a separation wall between the enclosure and the auxiliary air passage (3); beyond that, claim 1 of the main request does not comprise the following features of the auxiliary request 2: the wall means is metallic and the auxiliary air passage and the enclosure are formed in a plastics or synthetic resin molding.

Therefore and in view of the finding of the preceding section 2 that the subject-matter of claim 1 of auxiliary request 2 is not inventive, also the subject-matters of claim 1 of the main request and of claim 1

of the auxiliary request 1 lack inventive step. As a consequence, the main request and auxiliary request 1 are not acceptable.

4. *Auxiliary request 3*

Taking into account the interpretation of the curved portion (feature E) according to section 1.1 above, the last feature of claim 1 means that the enclosure accommodating the circuit board (5) is extending between the entrance and the curved portion, the latter being the section of the auxiliary air passage (3) which deviates the air stream by a certain angle such that the axis of the passage is also curved there. According to Figures 2, 5, 9 and 10, only the sensors (6, 7) and a straight portion of the auxiliary air passage are arranged between said curved portion in the above-defined sense and the entrance but not said enclosure. Said enclosure is arranged between the straight portion of the auxiliary air passage (3) accommodating the sensors (6, 7) and lying between the curved portion and the entrance of the auxiliary air passage on the one hand and the connector (2) of the housing or the opening of the body (11) through which the housing is to be inserted on the other hand.

Hence, claim 1 is not supported by the description as required by Article 84 EPC and is, therefore, not allowable. As a consequence, the auxiliary request 3 is not acceptable.

5. *Auxiliary request 4*

5.1 Amendments

The Board is satisfied that the amended claims comply with Article 123(2) and (3). Claim 1 contains all features of claim 1 as granted and has been restricted by introducing features from dependent claims 2, 7 and 11 as granted and page 7, lines 11 to 16, page 10, lines 3 to 7, page 12, lines 17 to 36 and page 13, lines 15 to 18 of the description as originally filed.

5.2 Clarity

Admittedly, with the notions "curved portion", "wall means", "enclosure" the corresponding members of the device according to claim 1 are defined in a rather general manner. However, it has to be considered that the clarity of a claim is not diminished by the mere breadth of a notion, if the meaning of such notion - either per se or in the light of the description - is unambiguous for a skilled person. Said notions do have a concrete technical meaning above all when taking into account the drawings and the corresponding description and are thus considered as being sufficiently clear within the context of claim 1; as to the first and third notion, reference is made to section 1 above.

5.3 Novelty

None of the cited prior art documents discloses the feature of claim 1 that the remaining enclosure has a cover bonded to the housing after gel injection over the circuit module. This finding has not even been in dispute. Therefore, claim 1 and the remaining claims which are dependent on claim 1 are novel in the sense of Article 54 EPC.

5.4 Inventive step

Document D3 discloses the nearest prior art also with respect to the subject-matter of claim 1 of the fourth auxiliary request.

Claim 1 differs from said prior art at least in that the remaining enclosure has a cover bonded to the housing after gel injection over the circuit module. Apparently, such a gel in combination with the bonding of the cover permits protection of the circuit and keeping out of moisture (see EP-B-0 441 523 column 7, lines 32 to 38), easy application, better cooling and a simpler accessibility to the circuit in need of repair. The (partial) problem resulting from said differences is to achieve the above-mentioned effects.

The opinion of the respondent that such protection means for the circuit module are obvious is not convincing for the following reasons: firstly, none of the cited prior art documents discloses nor even hints at such means and, secondly, said means bring in combination with other features of claim 1 clear advantages, as before mentioned. Thus the subject-matter of claim 1, in view of the Board, involves an inventive step in the sense of Article 56 EPC.

The dependent claims concern particular embodiments of the subject-matter of claim 1 and are, therefore, likewise inventive.

5.5 In the result, the Board takes the view that the claims as amended according to auxiliary request 4 meet the requirements of the EPC. This applies also to the

drawings as granted.

5.6 However, the description has to be brought into conformity with these claims and the most relevant prior art should be completely identified and briefly described in the description (requirements of Rule 27(1) EPC).

6. *Auxiliary requests 5 and 6*

In view of the findings of section 5 above, it is not necessary to consider the auxiliary requests 5 and 6.

Order

For these reasons it is decided that:

1. The decision under appeal is set aside.

2. The case is remitted to the first instance with the order to maintain the patent on the basis of auxiliary request 4 (claims 1 to 15), with the description to be adapted and the drawings as granted.

The Registrar: The Chairman:

P. Martorana E. Turrini