

Publication in the Official Journal ~~Act~~/ No

File Number: T 555/88 - 3.2.4

Application No.: 82 100 732.5

Publication No.: 0 057 898

Title of invention: Method of controlling a rotational speed to control a throttle valve

Classification: F02D 31/00, F02M 3/06, F02D 41/08

D E C I S I O N
of 18 October 1991

Proprietor of the patent: Hitachi, Ltd.

Opponent: Robert Bosch GmbH

Headword:

EPC Article 114(2), 56

Keyword: "Relevant newly filed documents admitted"
"Inventive step - yes"

Headnote



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Boards of Appeal

Chambres de recours

Case Number : T 555/88 - 3.2.4

D E C I S I O N
of the Technical Board of Appeal 3.2.4
of 18 October 1991

Appellant :
(Opponent)

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Respondent :
(Proprietor of the patent)

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Decision under appeal :

Decision of Opposition Division of the European
Patent Office dispatched on 6 September 1988
rejecting the opposition filed against European
patent No. 0 057 898 pursuant to Article 102(2)
EPC.

Composition of the Board :

Chairman : P. Delbecque
Members : M.G. Hatherly
L.C. Mancini

Summary of Facts and Submissions

- I. European patent application No. 82 100 732.5, filed on 2 February 1982 and published with the publication No. 0 057 898, was granted on 10 September 1986.
- II. The patent was opposed by the Appellant (Opponent) who requested the revocation of the patent in its entirety on the grounds of lack of inventive step (Article 56 EPC).

He cited the following documents within the opposition period:

D1 : FR-A-2 274 792
D2 : DE-A-2 609 842
D3 : DE-A-2 523 283.

After the opposition period he cited a further six documents which the Opposition Division did not take into account, considering them clearly unimportant for the decision (Article 114(2) EPC).

- III. In its decision dispatched on 6 September 1988, the Opposition Division rejected the opposition.
- IV. On 3 November 1988 an appeal against this decision was received, the appeal fee was paid on the same day. The Statement of Grounds of Appeal was received on 30 December 1988.
- V. In addition to referring to document D3, the Appellant cited the following documents for the first time in the appeal proceedings:

D10 : DE-A-3 019 608
D11 : EP-A-17 933
D12 : US-A-4 245 599.

VI. Both parties made a subsidiary request for oral proceedings which were accordingly held on 18 October 1991.

VII. Claim 1 (as granted) reads as follows:

"A method of controlling a rotational speed to control a throttle valve of an internal combustion engine comprising the steps of:

detecting an actual speed (N) of the internal combustion engine;

detecting at least one operating temperature (Tw) of the engine;

detecting whether or not a throttle action of the throttle valve (13) returns under a control of an actuator (7) for adjusting a reset position of the throttle valve (13);

producing a reference speed signal (NT) in response to at least the operating temperature (Tw) of the engine;

comparing the actual speed (N) of the engine with the reference speed signal (NT);

controlling the reset position of the throttle valve (13) of the engine in accordance with a difference (N-NT) between the actual speed (N) of the engine and the reference speed signal (NT) so as to rotate the engine at the reference rotational speed when the throttle action of the throttle valve (13) returns under the control of the actuator 7; characterized by

reducing the reset position of the throttle valve (13) step by step in response to a predetermined amount of increase of the engine temperature when the throttle action of the throttle valve (13) is independent of the actuator (7) for adjusting a reset opening of the throttle valve (13), thereby preventing the engine rotational speed

from increasing above the rotational speed when the engine returns from an accelerated to an idling condition."

VIII. The Appellant's written and oral arguments are essentially that the subject-matter of the disputed Claim 1 is obvious when starting either from document D3 or from document D10.

He argues that the skilled person learns from document D3 of a system for temperature-dependent control of the idling reset position of a throttle valve. The control is switched off when the accelerator is pressed but the temperature-dependent signal for the control continues to be changed according to temperature. From the introduction to document D3 the skilled person knows of temperature-dependent controls of the idling reset position which are active both during and outside idling. His knowledge of combinations of closed loop control and open loop control would make it easy for him to combine the preceding features and arrive at the present subject-matter.

He regards document D10 as even more relevant since it discusses the same problem as that set out in the present patent. The control according to document D10 of a valve in a channel bypassing the throttle valve is shown by document D3 to be equivalent to the present control of the reset position of the throttle valve. In document D10 stability actually means idling, moreover step by step reduction of the opening of the bypass channel valve is what would be expected of a computer-controlled method.

IX. The Respondent's written and oral arguments can be summarised as follows:

He does not accept that the temperature-dependent control of the idling position of the throttle valve according to

document D3 can also be applied outside idling. This document teaches switching off the control of the reset position on leaving the idling condition in order to prevent the reset position being erroneously reduced to its minimum.

He regards document D10 as less relevant than document D3. He agrees that the running stability condition defined in document D10 corresponds over a certain range to the idling condition according to the patent in suit. While he argued on pages 1 and 2 of his letter of 20 October 1991 that it would not be obvious for the skilled man reading document D10 to detect idling rather than stability, he admitted during the oral proceedings that the difference therebetween was not of great importance. While he agreed on page 3 of the above-mentioned letter that the opening of the bypass channel valve of document D10 would be reduced step by step, in the oral proceedings he maintained that interpolation between stored values would produce a continuous reduction of the opening. The open loop control of the bypass channel valve according to document D10 uses tabular values; the method according to the patent in suit is more exact since open loop control starts acting on that throttle valve reset position which has been achieved during closed loop control.

- X. The Appellant's requests are that the decision under appeal be set aside and that the patent be revoked.

- XI. The Respondent's main request is that the appeal be dismissed and that the patent be maintained on the basis of the granted wording. His subsidiary request is for maintenance of the patent on the basis of Claims 1 and 2 as submitted during the oral proceedings.

Reasons for the Decision

1. The appeal is admissible.

2. Amendments - Main Request

The originally filed Claims 1 to 3 were modified using the originally filed description and drawings to arrive at the granted Claims 1 and 2. No formal objection under Article 123(2) EPC has been made by the Appellant and the Board sees no such objection. The main request concerns Claims 1 and 2 as granted so that there is no objection under Article 123(3) EPC.

3. Novelty - Main Request

No prior art document discloses all the features of the granted Claim 1. For example, document D3 does not disclose the features of the characterising portion. The method according to document D10 does not control the reset position of the throttle valve, it controls a valve in a channel bypassing the throttle valve. The novelty of the subject-matter of Claim 1 in its granted form is not at dispute (Article 54 EPC).

4. Interpretation of Claim 1 - Main Request

While Claim 1 in its granted form contains some obscurities, its meaning is clear to the person skilled in the art after reading the whole patent specification. The method controls a rotational speed of an internal combustion engine controlled by a throttle valve. The word "returns" in column 7, line 53 should be read as "returns to be" or simply "is", the detection being whether the throttle action 15 is being influenced by the actuator 7 or by the accelerator. The opening words of the

characterising portion, namely "reducing the reset position of the throttle valve" are discussed in sections 6.6.4 and 6.6.5 below.

5. Inventive step starting from document D3

5.1 Document D3 includes in its family the document D1 which, as explained in column 1, lines 24 to 31 of the disputed patent, discloses an idling control device controlling the reset position of the throttle valve of the engine in accordance with the difference between the actual speed of the engine and a reference speed dependent on the engine temperature so as to achieve the reference engine speed.

5.2 As further explained in column 1, lines 32 to 39 of the disputed patent, in the prior art method the problem arises that when the engine is returned to the idling condition after having been accelerated during warm-up, its speed will abnormally increase. This is because the throttle valve reset position did not change during acceleration but on return to the idling condition the engine is now warmer and friction is thus less so the speed increases.

5.3 The present invention solves this problem by controlling, when not idling, the throttle valve reset position in accordance with the engine temperature, in the particular way set out in the characterising portion of Claim 1.

5.4 In the system disclosed in document D3, see Figure 2 and pages 8 to 10, the position of throttle flap 30 is either determined by cam 42 during idling or by accelerator pedal 34. Generator 22 gives a reference fast idle speed signal having a predeterminable value based on the engine temperature (measured by sensor 20) and the speed determined necessary to sustain the operation of the

engine at this temperature. This reference speed signal is compared at 24 with the engine speed signal from sensor 18. Depending on the result of the comparison, motor 46 drives cam 42 (i.e. the throttle valve actuator) to open or close throttle flap 30 (i.e. to change its reset position) to increase or decrease the idle airflow in order to reduce the difference between the reference speed signal and the actual speed signal to zero. Thus during starting and warm-up, the engine fast idles at a speed determined by the engine temperature and independent of the load.

5.5 Document D3 continues in paragraph 2 on page 11 that it may be desirable, when the accelerator pedal 34 is pressed, to deactivate the closed loop electronic auxiliary air delivery system CLEAD by a switch 56 to hold the cam 42 in its original position. Otherwise, when the accelerator pedal is pressed, the throttle flap 30 opens, thus increasing the air flow and speeding up the engine, the comparator 24 then senses the actual engine speed is faster than the reference fast idle speed, and the motor 46 rotates cam 42 to the minimum or warm engine position.

5.6 The steps set out in the characterising part of Claim 1 of the impugned patent (resulting in the control of the throttle reset position in accordance with the engine temperature during non-idling) thus differ from the steps proposed in document D3 during acceleration of deactivating the motor 46 or allowing said motor to rotate cam 42 to the minimum or warm engine position. In the latter case, although the temperature is measured by sensor 20 and used at 22 to determine the target speed, the temperature has a negligible effect because the engine is being accelerated with an actual speed above the target speed thus causing the motor 46 to turn cam 42 to the

minimum reset position corresponding to a fully warmed-up engine.

- 5.7 Thus the steps disclosed by document D3 - whether or not the engine designer has decided that the CLEAD system be deactivated when the accelerator is pressed - do not overcome the problem of the engine speeding up abnormally when it returns from acceleration to idling.
- 5.8 The Appellant argues that document D3 mentions on page 10 a stepping motor making obvious the stepwise control of the idling position of the throttle valve during non-idling. However this stepping motor would be motor 46 on Figure 2 which is preferably switched off by switch 56 when the engine is not idling.
- 5.9 The introduction of document D3 discusses devices which move cams in dependence on temperature to control the idling air flow, see page 2, lines 4 to 9. However there is no hint in the document leading the skilled person to depart from the teaching of document D3 of deactivating the CLEAD system when the accelerator pedal is pressed, and the Board sees no reason why the skilled person should incorporate ideas from the prior art mentioned in document D3 when this prior art has disadvantages which the system disclosed in document D3 is supposed to overcome. The problem of the engine speeding up abnormally when it returns from acceleration to idling is not discussed in document D3 and it is not apparent to the Board that the teachings of this prior art discussion would lead the skilled person to the same solution to the problem as that set out in the characterising part of Claim 1.

6. Inventive step starting from document D10

6.1 Document D10 discloses a method of controlling a throttle valve 30 (see Figure 1) to control a rotational speed of an internal combustion engine. It deals with the same problem as that set out in the disputed patent namely preventing the engine rotational speed from increasing when the engine returns from an accelerated to an idling condition (see page 6, line 31 - page 7, line 13).

6.2 Document D10 teaches the steps of:

- i. detecting an actual speed NRPM of the internal combustion engine (see page 14, paragraph a);
- ii. detecting at least one operating temperature T of the engine (see page 14, paragraph b);
- iii. detecting whether or not the engine is running stably (see page 6, lines 1 to 6 and page 20, lines 27 to 31);
- iv. producing a reference speed signal NSET in response to the engine operating temperature T (see page 5, lines 25 to 27);
- v. comparing the actual engine speed NRPM with the reference speed signal NSET (see page 5, lines 22 to 27);
- vi. controlling an engine idling regulating valve 50 in accordance with the difference NRPM-NSET between the actual speed NRPM of the engine and the reference speed signal NSET so as to rotate the engine at the reference rotational speed when the engine is running stably (see page 20, lines 1 to 31); and

vii. changing the control signal for the air bypass valve during open loop control depending on the engine or coolant temperature (see page 8, lines 20 to 22 and page 18, lines 1 to 20).

6.3 The closed loop control of engine speed according to document D10 takes place when the engine is running stably and according to the disputed Claim 1 when the engine is idling. Stability and idling are comparable engine conditions and document D10 also discloses the detection of idling using either resistance 124 on Figure 1, see page 15, paragraph c, or a throttle flap switch, see page 15, lines 14 to 19. The Board is of the opinion and the parties agreed during the oral proceedings that the difference between detecting stability and detecting idling was not of great importance.

6.4 The engine speed is controlled, during idling in the disputed Claim 1 by controlling the reset position of the throttle valve in the main air inlet duct and in the prior art method during stability by controlling the idling regulating valve 50 in bypass channel 44.

6.4.1 This feature of document D10 is similar to that shown in Figure 3 of document D3 (see page 12, line 22 to page 13, line 11) where a valve in channel 62 determines the amount of air bypassing the throttle flap 30 in the primary air supply duct 58 to determine the idling speed.

6.4.2 The same document D3 also shows an alternative arrangement in Figure 2 (see page 9, line 11 to page 10, line 6). During idling, cam 42 determines the position of the throttle flap 30 in the primary air supply duct 28 and thus the idling speed. Thus an actuator directly influences the throttle flap.

- 6.4.3 The Board cannot see that the skilled person would be carrying out any inventive activity in modifying the method according to D10 (which controls the valve in the bypass channel) to use the method corresponding to Figure 2 of D3 (which controls the position of the throttle flap). The advantage thus achieved during acceleration, mentioned by the Proprietor in section 5.3.(2-2) on page 8 of his letter of 20 September 1991, of air passing only through the clearance between the intake manifold and the throttle flap (since no bypass channel is present) would be apparent to the skilled person.
- 6.5 According to document D10 (see page 17, line 13 to page 18, line 31), if the engine is running unstably then the microcomputer takes over the open loop control of the engine speed using the table on page 18 of reference or set engine speed NSET against coolant temperature T_w , the table values being stored in read only memory ROM 104.
- 6.5.1 Lines 18-20 of page 18 state that the engine speed changes in steps of 12.5 rpm and that interpolation is used between the tabular temperatures. Since the engine speed is said to change in 12.5 rpm steps and since the reference engine speeds NSET on the table differ by more than 12.5 rpm, the Board is of the opinion that interpolation is used between the tabular temperatures to arrive at the 12.5 rpm steps. Temperature interpolation is not carried out to the extent to fill in all the gaps and achieve a continuous change. Each reference speed corresponds to a narrow temperature range.
- 6.5.2 Accordingly the Board considers that a predetermined amount of increase of the engine coolant temperature produces a step by step reduction of the reference engine speed NSET achieved by altering with the valve body 58 the

amount of air passing through the channel 44 bypassing the throttle flap 30. This is analogous to the presently claimed method according to which the throttle valve reset position is reduced step by step upon a predetermined amount of increase of the engine temperature.

6.6 It is clear that the method according to document D10 of controlling a valve in a channel bypassing a throttle valve must differ from the method according to the present Claim 1 controlling the throttle valve itself. The method according to document D10 however differs more from the method of the present Claim 1 than would be necessary to take account of the basic bypass valve/throttle valve difference.

6.6.1 To change the engine speed according to document D10 when the throttle flap is closed, it is necessary to alter with the valve body 58 the amount of air passing through the channel bypassing the throttle flap 30, this being achieved by altering the variable pulse width control signal applied to electromagnet 92 (see page 13, lines 1 to 6 and page 18, lines 24 to 27). Upon change-over from stable running closed loop control to unstable running open loop control (see page 19, lines 19 to 27), a particular control signal for the electromagnet 92 is chosen (depending on engine temperature) from data stored in a read only memory. This particular control signal should be such that the engine runs at the reference speed.

6.6.2 However according to document D10 the control signals are predetermined for the engine and thus would take no account of its age i.e. whether it is run in or not; accordingly the control signals may not actually be suitable to produce the reference speeds. Thus the control signal extracted from stored values and used immediately

after change-over from closed loop control to open loop control may be incorrect and differ from the control signal used for closed loop control immediately before the change-over. In such a case there is a step change in the position of valve body 58 at change-over. Subsequent open loop control signals extracted from stored values may also be incorrect, giving rise to a step change of valve body position on change-over from open loop control to closed loop control.

- 6.6.3 Document D10 also discloses providing a smooth change-over from open loop control to closed loop control by a harmonious change of the valve control signal, see page 8, line 23 to page 9, line 1. During open loop control the valve control signal may be changed not merely according to rising temperature but also to take account of the closed loop control signal, see page 19, lines 13 to 18.
- 6.6.4 In the method according to the impugned patent the throttle valve reset position is determined during closed loop control by the actuator 7 depending on the difference between actual and reference speeds in order to achieve the reference speed. During open loop control the throttle valve reset position is reduced step by step in response to a predetermined amount of increase of the engine temperature. This reduction of throttle valve reset position starts from the throttle valve reset position at the moment of change-over. There can thus be no step change to a prestored value prior to commencing controlling the throttle valve reset position in accordance with rising temperature.
- 6.6.5 The Board considers that the skilled person in the art reading the patent specification would understand Claim 1 in the way discussed in the preceding paragraph 6.6.4, the throttle valve reset position referred to in the opening

words of the characterising portion being the same throttle valve reset position already referred to towards the end of the pre-characterising portion of the claim. Expressed in more detail, the reset position referred to column 8, line 4 in the wording "reducing the reset position of the throttle valve (13) step by step in response to a predetermined amount of increase of the engine temperature" is the reset position of the throttle valve at the moment of change-over from closed loop control, which reset position has already been referred to in column 7, line 61 in the wording "controlling the reset position of the throttle valve (13) of the engine". This is how, according to the Board, the claim is to be interpreted.

- 6.7 In the opinion of the Board the particular method set out in the impugned Claim 1 cannot be derived in an obvious way starting from document D10 which although dealing with the same problem solves the problem in a different way.
7. Thus the subject-matter of Claim 1 in its granted form is not seen by the Board as being obvious either starting from document D10 or starting from document D3. Moreover the Board cannot see any obvious combination of prior art documents that would lead in an obvious way to the subject-matter of the claim.
8. Documents D10, D11 and D12 were cited by the Appellant for the first time in the appeal proceedings. Document D10 is clearly relevant and so is admitted into the proceedings. The subject-matter of independent Claim 1 is inventive so document D11, used in an inventive step argument only against dependent Claim 2, is clearly unimportant. Document D12 discloses no more of the subject-matter of the disputed Claim 1 than is already known from document D3 and thus included in the pre-characterising portion of

the claim. In accordance with Article 114(2) EPC, documents D11 and D12 thus were not taken into account.

9. For the reasons given above, the subject-matter of Claim 1 involves an inventive step within the meaning of Article 56 EPC and is patentable within the meaning of Article 52 EPC. Claim 2 is dependent upon Claim 1 and is therefore also patentable. The patent can thus be maintained in its granted form.

Accordingly there is no need to examine the Respondent's auxiliary request.

Order

For these reasons, it is decided that:

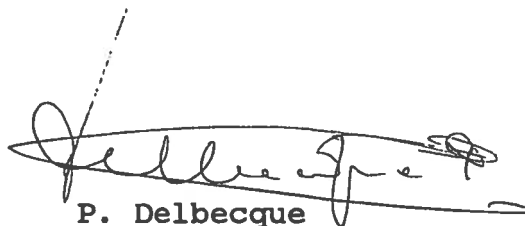
The appeal is dismissed.

The Registrar:



N. Maslin

The Chairman:



P. Delbecque

