BESCHWERDEKAMMERN DES EUROPÄISCHEN PATENTAMTS

BOARDS OF APPEAL OF THE EUROPEAN PATENT OFFICE

CHAMBRES DE RECOURS DE L'OFFICE EUROPEEN DES BREVETS

Internal distribution code:
(A) [ ] Publication in OJ
(B) [ ] To Chairmen and Members
(C) [X] To Chairmen

D E C I S I O N
of 24 January 1994

Case Number: T 0527/92 - 3.5.1

Application Number: 85307532.3

Publication Number: 0179625

IPC: B60H 1/00

Language of the proceedings: EN

Title of invention:
Air conditioner for automobiles

Patentee:
Nippondenso Co., Ltd.

Opponent:
Robert Bosch GmbH
Siemens AG

Headword:
Behr GmbH & Co

Relevant legal norms:
EPC Art. 56, 111

Keyword:
"Inventive step (main request, no)";
"Remittal to the first instance (auxiliary request)"

Decisions cited:
-

Catchword:
-

Europäisches Patentamt | European Patent Office | Office européen des brevets

Beschwerdekammern | Boards of Appeal | Chambres de recours

Case Number: T 0527/92 - 3.5.1

D E C I S I O N
of the Technical Board of Appeal 3.5.1
of 24 January 1994

Appellant: (Opponent 01)
Robert Bosch GmbH
Zentralabteilung Patente
Postfach 30 02 20
D-70442 Stuttgart (DE)

Representative:
-

Respondent: (Proprietor of the patent)
Nippondenso Co., Ltd
1-1, Showa-cho
Kariya-shi
Aichi-ken (JP)

Representative:
Klingseisen, Franz, Dipl.-Ing.
Patentanwälte
Dr F. Zumstein
Dipl.-Ing. F. Klingseisen
Bräuhausstrasse 4
D-80331 München (DE)

Other party: (Opponent 02)
Siemens AG
Postfach 22 16 34
D-80506 München (DE)

Other party: (Opponent 03)
Behr GmbH & Co
Mauserstrasse 3
D-70469 Stuttgart (DE)

Decision under appeal: **Decision of the Opposition Division of the European Patent Office dated 30 March 1992 rejecting the opposition filed against European patent No. 0 179 625 pursuant to Article 102(2) EPC.**

Composition of the Board:

Chairman: P. K. J. van den Berg
Members: C. G. F. Biggio
F. Benussi
P. Alting van Geusau
G. Davies

Summary of Facts and Submissions

I. European patent No. 0 179 625 was granted with effect from 7 March 1990, on the basis of European patent application No. 85 307 532.3, filed on 18 October 1985.

II. The patent was opposed by three Opponents (O1 to O3).

The grounds for opposition were, in all cases, that the subject-matter of the granted Claim 1 was not new and/or did not involve an inventive step (Article 100(a) EPC).

For their argumentation the opponents relied on, among other documents,

D2: EP-B1-0 007 775,
D4: Isermann, "Digitale Regelsysteme", Springer-Verlag, Berlin/Heidelberg/New York, 1977, pages 111 to 148, and
D10: Jacquot, "Modern digital control systems", Marcel Dekker,Inc., New York, 1981, pages 122 to 124.

III. By its decision dated 30 March 1992, the Opposition Division rejected the oppositions.

The Opposition Division held that it would not have been obvious to turn to "modern" (or "optimal") control theory for the improvement of air conditioning systems for automobiles.

IV. On 5 June 1992, the Appellant (Opponent O1) lodged an appeal against this decision and paid the prescribed appeal fee the same day.

On 6 August 1992 a statement setting out the Grounds of Appeal was filed.

Following the reply by the Respondent (Patent Proprietor), the Appellant submitted further prior art documents, namely:

D11: Pritchard, "Optimization of a Solar Heating System with Integral Compensation", Modeling and Simulation, Vol. 10, Part 3, Proceedings of the 10th Annual Pittsburgh Conference, 1977, pages 1295 to 1299; and

D12: Fan et al., "Applications of Modern Optimal Control Theory to Environmental Control of Confined Spaces and Life Support Systems", Build. Sci., Vol. 5, pages 149 to 152, Pergamon Press, 1970.

V. In a communication pursuant to Article 11(2)) of the Rules of Procedure of the Boards of Appeal, dated 6 August 1993, the Board expressed the preliminary view that the subject-matter of Claim 1 lacked an inventive step.

In said communication, the Board referred to a further textbook on general control theory, namely:

D13: Ackermann, "Abtastregelung", Vols I and II, Springer-Verlag, 1983, in particular
- Chapter 3.4.3: "Integralregler", pages 105 to 108;
- Chapters 5.2: "Der Beobachter der Anordnung" and 5.3: "Der reduzierte Beobachter", pages 208 to 219; and
- Chapter 9.5: "Quadratisch optimale Regelung", pages 165 to 172;

VI. On 22 December 1993, the Respondent filed new claims 1 to 3.

VII. Oral Proceedings, which were attended by the Appellant, the Respondent and Opponent O2, were held on 24 January 1994.

The Respondent requested maintenance of the patent on the basis of the amended Claims 1 to 3 filed on 21 December 1993 and Claims 4 to 10 as granted (main request) or on the basis of amended Claims 1 to 9 filed at the Oral Proceedings (auxiliary request).

Claim 1, according to the main request, reads: "An air conditioner for automobiles comprising: blow off air control means (M2) for controlling at least temperature and flow rate of blow off air discharged into a vehicle compartment (M1); internal air temperature detecting means (M3) for detecting the temperature within said vehicle compartment; and air conditioning control means (M4) for feedback controlling said blow off air control means so that said detected internal air temperature equals a setting target temperature, characterized in that said air conditioning control means (M4) is formed as an integral-added optimal regulator, said optimal regulator comprising: a perturbation component computing means (P3) for computing a perturbation component of a parameter of an air conditioning system including said vehicle compartment, the computed perturbation component being measured from a reference parameter value which occurs under a state where steady air conditioning is being performed; a state observer (P4) for estimating state variables on the basis of the perturbation component computed by the perturbation component computing means (P3), said estimated state variables indicating a dynamic internal state of the air conditioning system including said vehicle compartment; and feedback amount determining means (P5) for determining a feedback control amount of said control

means (M4) on the basis of said estimated variables and an optimal feedback gain (F) which is predetermined according to dynamic models of said air conditioning system".

Claim 1, according to the auxiliary request, reads: "An air conditioner for automobiles comprising: blow off air control means (M2) for controlling at least temperature and flow rate of blow off air discharged into a vehicle compartment (Ml); internal air temperature detecting means (M3) for detecting the temperature within said vehicle compartment; and air conditioning control means (M4) for feedback controlling said blow off air control means so that said detected internal air temperature equals a setting target temperature, characterized in that said air conditioning control means (M4) is formed as an integral-added optimal regulator, said optimal regulator comprising: a perturbation component computing portion (P3) for computing a perturbation component of a parameter of an air conditioning system including said vehicle compartment, the computed perturbation component being derived from a measured valued (TR) and from a reference parameter value (TRa) which occurs under a state where steady air conditioning is being performed; a state observer (P4) for estimating state variables on the basis of the perturbation component (ÙTR) computed by the perturbation component computing portion (P3) and perturbation components (ÙVB, ÙVC, ÙVD) calculated by a feedback amount determining portion (P5), said estimated state variables indicating a dynamic internal state of the air conditioning system including said vehicle compartment; wherein said feedback amount determining means (P5) determines a feedback control amount of said control means (M4) on the basis of said estimated variables and an optimal feedback gain (F) which is predetermined according to dynamic models of said air

conditioning system; and wherein variables (VC, VB, VD) of blow off air controlled by said blow off air control means (M2) includes at least the amount of air flow from a blower motor (3) which sends said blow off air, cooling capability for cooling air sent by said blower motor (3), and a controlled variable of an actuator (24) which causes the temperature to blow off air by reheating said sent air, and wherein for each variable (VC, VB, VD) a corresponding state variable (ÙVB, ÙVC, ÙVD) is estimated by said state observer (P4)".

VIII. The Appellant requested that the decision under appeal be set aside and the patent be revoked.

In support of his request he argued essentially as follows.

All the features mentioned in the characterising clause of Claim 1 - i.e. the integral-added regulation, the computation of a perturbation component around the steady-state value, the state observer, and the feedback amount determining means - are inherent features of the "optimal" control and therefore this claim does not define more than the use of optimal control in an automobile air conditioner.

There was no reason why the skilled man would not have applied optimal control principles to air conditioning in an automobile. D12 expressly mentions that modern "optimal" control theory is highly suited for air conditioning systems.

As to sudden parameter variations which can occur in air conditioning for motor cars, the solar heating system in D11 would also have to cope with similar, drastic

changes, e.g. when the sun comes out from behind a cloud.

There were also no features in Claim 1 that could be considered to improve the interaction of the optimal control and the air conditioner in order to achieve any unexpected effects that might be considered as an indication of an inventive step.

IX. The Respondent's submissions, in support of the patentability of the subject-matter of Claim 1 of the main request, may be summarised as follows.

Although it was not denied that the "optimal" control theory has been known for a number of years, it was not obvious to apply said rather complex theory to air conditioning of automobiles.

The temperature of a car compartment depends on factors which may change very abruptly, such as when the car leaves a tunnel and is suddenly exposed to sunshine. Such strong variations were incompatible with a control model essentially based on a linearization of differential equations around a point of equilibrium.

Previous applications of the theory to solar heating and life support systems (D11, respectively D12) would not lead the skilled man to the present use, because of the particular complexity of automobile air conditioning, involving interactions between the control efforts. Moreover, these known systems made no use of an observer.

Reasons for the Decision

1. The appeal complies with Articles 106 to 108 and Rule 64 EPC and is therefore admissible.

Main Request

2. Admissibility of the Amendments In respect of Claim 1 as granted, the scope of Claim 1 according to the main request has been limited by the addition of features concerning the "perturbation component computing portion" and the "state observer for estimating state variables on the basis of the perturbation component computed by the perturbation component computing means".

Support for the amendments is to be found in the passages of the originally filed application which correspond to page 6 of the description as granted (see: lines 47 to 59; respectively claim 3).

Consequently, the requirements of Article 123(2 and 3) EPC are complied with.

3. *Procedural considerations*

Claim 1, as amended according to the main request, has not yet been considered by the Opposition Division.

The Board, therefore, has considered, whether the amendments were of such a nature that immediate remittal to the first instance was appropriate, also having regard to the fact that relevant prior art (D11 and D12) has been submitted by the Appellant in the appeal proceedings.

Considering that, although filed after the nine-month period stipulated in Article 99 (1) EPC, both D11 and D12 were cited in response to the inventive step

arguments relied upon by the Opposition Division and by the Respondent in his reply to the Grounds of Appeal, and that the prior art disclosed in these further documents is particularly relevant in respect of the application of optimal control theory to air conditioning of confined spaces, this further prior art should be taken into account for deciding upon inventive step of the subject-matter of the patent.

The function of the first means added to Claim 1 is given in the description as relating a system parameter (actually the compartment temperature, i.e. the system output) to a predetermined operating point around which a linear approximation is assumed valid. The Board notes that the "optimal" control theory, according to which the invention works, is limited to linear systems (see D10, page 123); thus linearization would, in any case, be required to control a non-linear system (see also D11, page 1297). Furthermore, the further features added to Claim 1, as granted, e.g. the incorporation of a state observer are known as such. Such observers are always fed with, among other signals, the system output (see e.g. D4, Figure 8.6.1).

Claim 1 according to the main request is, therefore, in substance very similar to Claim 1 as granted and decided upon by the Opposition Division in that it sets out a combination of known air conditioning systems features and known control theory tools.

It could be expected therefore that the arguments as to lack of an inventive step, which applied to Claim 1 as granted, would also apply to Claim 1 according to the main request.

In view of this, Claim 1 of the main request was not remittedto the Opposition Division for further prosecution, but was examined by the Board.

4. *Inventive step*

4.1. The subject-matter of Claim 1 according to the main request is an air conditioner for automobiles.

The preamble sets out the actual air conditioner features, such as blow off air control means and temperature detecting means. These are known in combination from D2, a fact which the Respondent has not denied.

4.2. Such a conventional air conditioner based on feedback control has poor transient response so that it is difficult to provide a comfortable environment to the vehicle occupants, in particular, when environmental conditions (solar radiation) vary abruptly, page 2, lines 43 to 50 of the patent description.

The air conditioner according to Claim 1 resolves such problems "and contemplates to provide a system which controls the temperature within a vehicle compartment deriving fully the capability of the used air conditioner unit" (see page 2, lines 57 to 59 of the patent description). The invention is also resulting in low fuel costs, page 20, lines 41 to 49 and page 11, lines 45 to 47 of the patent description.

4.3 The problems are solved by the characterising features of Claim 1. These characterising features define the control conditions of the air conditioner; they would typically be implemented as a computer program. Feedback control is performed according to the so-called "modern"

or "optimal" control theory which is discussed in several standard books, such as D4 and D13.

Referring to D13, an integral-added optimal rgulator is shown in Figure 3.9; observers are dealt with in chapter 5; and methods for determining the feedback gain as a function of the state variables are given in Chapter 9. In any case, linearization is, as already mentioned, a necessary feature and can be regarded as implicit in D13.

The combination of the characterising features of Claim 1 is thus inherent to the use of an integral-added optimal regulator.

As regards the question whether or not the air conditioner in accordance with Claim 1 involves an inventive step, the main issue to be considered is, therefore, whether or not the skilled person would have thought of applying "optimal" control to air conditioning in an automobile.

4.4. This was also the issue before the Opposition Division, which considered such an application to be non-obvious.

The reasons given were that conventional control techniques seemed to offer a sufficiently satisfactory approach with relatively simple means, while, in contrast thereto, the new theory involved complex computations, without any expectation that the result would be more satisfactory.

4.5. The Board is unable to follow this reasoning.

In assessing whether it is obvious to apply a relatively new - but nevertheless scientifically established -

theory to a given technical field, the advantages the skilled man would have expected to gain by this approach should be balanced against the foreseeable disadvantages.

If it is considered that the skilled person would have regarded the theory as manifestly unsuitable for the application, an inventive step may be involved, when an inventor shows that it can nevertheless be used with success.

4.6. In the present case, the Opposition Division did not indicate any advantages to be expected when applying the theory; only drawbacks were pointed out. However, when trying to find a solution to the above stated problems, it would, in the Board's view, be easy for a skilled person to find reasons why he would want to use the "optimal" control theory, it suffices to look into any textbook on the subject. In Chapter 8.1 of D4, for example, it is stated that "optimal" control offers the possibility of finding those specific values of the control efforts (u) which bring the system into the desired state, while minimising a predetermined cost function, i.e. a "performance index", (see also: the Appellant's Grounds for Opposition dated 19 November 1990, page 2; and D11, page 1297, top).

The Board is of the opinion that this characteristic alone, which manifestly suggests a possible reduction in fuel consumption would have led the skilled person to apply the "optimal" control theory to air conditioning in automobiles.

4.7. The drawbacks mentioned in the appealed decision are, in the Board's judgement, not decisive.

Even complex real-time computations could, at the priority date of the contested patent, be easily performed by microcomputers. The allegation that the skilled person would have assumed that the "optimal" control would require too much computing capacity has not been substantiated. Nor has it been shown that the skilled man would have believed the outcome to be unsure, and even if he had, this alone is not unusual in the process of developing new techniques and cannot, in itself, be seen as a bar against the use of such new control techniques.

4.8. One possible reason why "optimal" control has not been used extensively might have been that the necessary modelling, or "system identification", is expensive, as the Opposition Division pointed out.

High development costs are, however, not a technical drawback, or prejudice, and must be treated with caution: expensive techniques are not compulsorily non-obvious.

In cases where a desirable technical effect is known to be obtainable in a particular way, economical considerations are, for the assessment of inventive step, at most of secondary importance.

4.9. The Respondent has submitted that air conditioning in a car is particularly complex in that the various control efforts interact with each other and in that external disturbances (e.g. sunshine) are severe.

As to the first argument, the Board does not see why the complexity of the system under consideration would have discouraged the skilled person from using "optimal" control; on the contrary it is exactly the most complex

system which requires the most refined technique. Moreover, it is normal to use approximations when necessary.

As to the second argument, it has not been shown that "optimal" control is particularly in sensitive to disturbances. Perfection was in any case not required by the skilled person; a good performance under normal conditions may well be a sufficient result.

4.10. The Board thus takes the view that at the least, the skilled person would, **have tried** to apply the "optimal" control theory to the kind of air conditioner known from D2.

As already pointed out, the characterising clause of Claim 1 according to the main request consists of features which are well-known, as such, from the "optimal" control theory, and are not explicitly related to particular parameters of an air conditioner for automobiles. Thus no inventive step can be recognised in the use of said "optimal" control theory to the particular application considered here.

This is true also for the feature involving the "state observer". The Board recognises that the "observer" is different from the other characterising features of Claim 1, in that it is not a compulsory component of an "optimal" regulator.

Instead, it is conventionally used to estimate state variables which cannot be measured (D4, page s 111, 123 and 139).

In Claim 1, the state variables are not defined. They are thus arbitrary, as confirmed by the description

(page 11, lines 62 to 65), where it is stated that other variables -different from ÙTB, ÙTC and ÙTD- may be used as the state variable X(k).

Arbitrary variables may or may not be possible to measure; those which are not measurable would have to be computed in an observer which, therfore, should be incorporated into the system.

4.11. In view of the foregoing, the Board is of the opinion that the subject-matter of Claim 1, according to the main request, does not involve an inventive step.

Auxiliary Request 5.1. Claim 1, as filed during the oral proceedings before the Board, has been limited in different ways, in particular by including the features of Claim 2 of the main request and adding features concerning the control efforts (VB, VC, VD) and the state variables (ÙTB, ÙTC, ÙTD).

The Board has considered this claim and concluded that the addition of these further features does not, at least **prima facie**, follow immediately from the considerations set out above in respect of Claim 1 of the main request.

The subject-matter of this claim has not been the subject of the proceedings before the first instance.

The Board considers it appropriate, therefore, that the case be remitted to the first instance for further prosecution.

5.2. The Board would like to emphasize that the new claims will have to be examined with respect to all relevant

requirements of the EPC, including those of Articles 123 and 84.

Order

For these reasons it is decided that:

For these reasons, it is decided that:

1. The decision under appeal is set aside.

2. The main request is refused.

3. The case is remitted to the first instance for further prosecution on the basis of Claims 1 to 9 according to the auxiliary request.

The Registrar: The Chairman:

M. Kiehl P. K. J. van den Berg