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D E C I S I O N
of 1 July 1997

Case Number: T 0843/95 - 3.2.1

Application Number: 88908200.4

Publication Number: 0434678

IPC: B60R 21/32

Language of the proceedings: EN

Title of invention:

Air-bag system for protection of the occupants of motor vehicles

Patentee:

Robert Bosch GmbH

Opponent:

- (01) Kansei Corporation
(02) Siemens AG
(03) Eric Blumenthal

Headword:

-

Relevant legal provisions:

EPC Art. 56

Keyword:

"Inventive step (yes)"

Decisions cited:

-

Catchword:

-



Case Number: T 0843/95 - 3.2.1

D E C I S I O N
of the Technical Board of Appeal 3.2.1
of 1 July 1997

Appellant:
(Opponent 02)

Siemens AG
Postfach 22 16 34
D-80506 München (DE)

Representative:

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Respondent:
(Proprietor of the patent)

Robert Bosch GmbH
Postfach 30 02 20
70442 Stuttgart (DE)

Representative:

-

Other party:
(Opponent 01)

Kansei Corporation
2-1910, Nisshin-cho
Omiya, Saitama 331 (JP)

Representative:

Müller, Frithjof E., Dipl.-Ing.
Patentanwälte
Müller & Hofmann
Innere Wiener Strasse 17
81667 München (DE)

Other party:
(Opponent 03)

Eric Blumenthal
7912 Narcissus Ct.
Springfield
VA. 22152 (US)

Representative:

Meister, Wolfhard, Dipl.-Ing.
Patentanwälte
Grünecker, Kinkeldey,
Stockmair & Schwanhäusser
Maximilianstrasse 58
80538 München (DE)

Decision under appeal:

Interlocutory decision of the Opposition Division
of the European Patent Office posted 31 July 1995
concerning maintenance of European patent
No. 0 434 678 in amended form.

Composition of the Board:

Chairman: F. A. Gumbel
Members: P. Alting van Geusau
G. Davies

Summary of Facts and Submissions

- I. The mention of grant of European patent No. 0 434 678 in respect of the international application No. PCT/EP88/00837 filed on 14 September 1988, was published on 2 December 1992.
- II. Notices of opposition were filed by the appellant (opponent 02) and by the other parties (opponents 01 and 03) on the grounds of Article 100(a) EPC. In support of objections as to lack of novelty and inventive step the opponents referred *inter alia* to the following documents:
- D1: US-A-4 220 871
- D2: FR-A-2 267 221
- D4: WO-A-88/01 241 (cited in the description of the patent)
- D6: WO-A-87/07 388
- D7: US-A-4 438 424
- D8: US-A-4 020 453
- D9: H. Weber, "Electronic Breakerless Inductive Storage Ignition", from Automotive Electronics, Society of Automotive Engineers Inc., New York, February 1974, pages 245 to 254
- D10: US-A-4 933 570 (no prior art, see also EP-A-0 284 728 (D3)).

III. By a decision announced during oral proceedings held on 26 June 1995 and issued in writing on 31 July 1995 the Opposition Division maintained the patent in amended form.

The Opposition Division was of the opinion that, starting from the closest prior art, as represented by D4, the underlying problem to be solved by the patent could be seen in an improvement to handle shunts or short circuits in the air-bag igniters so that all the air-bags could be ignited with the reduced supply of energy after a loss of battery power. The solution claimed in the amended claim 1 was not obvious to the skilled person because, to the extent that the prior art documents addressed the problem of a limited power supply during a crash, the solution was different and the general disclosures of electronic current limiting means referred to by the opponents did not belong to the same technical field, in particular they did not deal with problems encountered with reduced energy supply in crash protection systems.

Amended claim 1 reads as follows:

"1. System for the protection of the occupants of a motor vehicle, particularly an air bag protection system, having a firing circuit (1) which is located between a battery supply voltage and the vehicle earth and which includes a plurality of bag igniters (3), each of which is connected in series with a respective triggerable power switch (T_1 , T_2 , T_3), and at least one retardation sensitive mechanical arming switch (6), there being associated with the firing circuits a single energy storage capacitor (E) associated commonly with all of said firing circuits (1a, 1b, 1c) for supplying initiation energy to those circuits over a upper common power stage (7) in the event of a loss of the battery supply voltage, characterised in that there

is provided a means (9) of limiting the current flowing through the individual triggerable power switches (T_1 , T_2 , T_3), and hence through the igniters (3), from the energy storage capacitor (E), and wherein the current limiting means comprises a resistor (R_1 , R_2 , R_3) in series with each power switch (T_1 , T_2 , T_3) means for detecting the voltage drop across said resistors, comparing same with a reference voltage and in the event that the voltage drop exceeds said reference voltage controlling the power switches (T_1 , T_2 , T_3) to reduce the current therethrough."

- IV. On 29 September 1995 a notice of appeal was lodged against that decision together with payment of the appeal fee.

In the statement of grounds of appeal, filed on 30 November 1995, the appellant additionally referred to a number of additional prior art documents.

- V. In response to a communication by the Board, in which the provisional opinion was expressed that most of the late-cited documents did not appear to be more relevant than the documents already on file and that therefore the Board envisaged to disregard these documents, the appellant introduced

D15: *U. Tietze, Ch. Schenk*, "Halbleiter-Schaltungstechnik", Springer-Verlag, Berlin, 1976, pages 370, 371,

D16: *H. J. Bederke, H. Müller* "Der Transistor in Spannungs- und Stromkonstanthaltern" published in the book: "Transistoren und ihre Anwendung in der Industrie", Allgemeine Elektrizitäts-Gesellschaft, 1960, pages 53 to 57,

as evidence of the general knowledge of the skilled electronics engineer, considered to be competent for the subject-matter claimed in the patent.

- VI. Oral proceedings were held on 1 July 1997 in the presence of the appellant and the respondent. The other parties, which had been duly summoned, were not present and the oral proceedings were held without them (Rule 71(2) EPC).
- VII. In support of its request for revocation of the patent, the appellant essentially relied upon the following submissions:

D1 or D2, rather than D4, should be seen to represent the closest prior art since these documents already addressed the problem of energy shortage for ignition of a number of air-bags encountered when a short circuit occurred in one of the air-bag igniters. The solution proposed in D1 and D2 was related to limiting the current through the short circuited part by the introduction of either a resistor (D1) or a fuse (D2) in series with the igniter circuit.

The single difference when compared to the subject-matter of claim 1 of the patent in suit was that, in D1 and D2 a passive control for current limitations was disclosed, whereas in the patent an active current limiter, based on an electronic current limiting circuit, was used. However, the competent skilled person was well aware of the different methods of current control and in this respect it was even explicitly stated in D15 that a fuse could be replaced by an electronic current limiting circuit. Since D15 and also D16, another reference book in which passive and active current limitation were presented as mere alternatives, represented the general knowledge of the skilled person, no inventive activity was necessary to

develop the passive current limitations known from D1 or D2 to incorporate an electronic current limiter, in particular when having regard to the easier availability of more complex electronic control parts in the 1980's.

Also when starting from the prior art disclosed in D4 the skilled person was immediately led by D2 or D1 to incorporate a current limiter and, applying his general knowledge about electronic current limiting as disclosed in D15 and D16, to apply electronic limiting means as a well-known alternative for the known fuse or resistor.

The alleged advantages claimed by the respondent were either obvious consequences of the replacement of a resistor or fuse by an electronic current limiter or not existent in the system in its form as presently claimed.

D2 disclosed on page 6, from line 23 onwards, that the characteristics of a fuse could be tuned to particular requirements, for example as to the duration and intensity of a current before the fuse would be burned through and it would need no inventive activity to provide the electronic current limiter with a similar characteristic. As regards an alleged improved individual control of the different air-bag igniters, this was also possible with the known resistors or fuses and D15 hinted to a similar potential for a controlled current limiter.

Anyhow when starting from D4 the objective problem to be solved by the subject-matter of claim 1 was related to the avoidance of overload of the power switches and exactly such a problem was addressed in D15 and solved by the introduction of an active current control of the amplifier power stage. Since a power switch was in

principle also a power amplifier, the skilled person would be led directly to the solution claimed in claim 1.

VIII. The respondent contested the appellant's view and in support of its request for dismissal of the appeal relied upon the following submissions:

The closest prior art was represented by D4 rather than by D1 or D2 because the circuits disclosed in the latter documents did not include the combination of both a triggerable power switch and a mechanical arming switch in an air-bag ignition circuit.

The underlying problem of the patent was primarily related to the individual control of the current through the air-bag igniters so as to be able to ensure ignition of the individual air-bags by individual control of the ignition current while at the same time optimising the use of the limited available electric power in the event of shunts or short circuits in the air-bag igniters. Although D1 and D2 also addressed such a problem area the solution proposed was different in that no active current control through the igniters was possible. In this respect the appellant could not be followed when stating that a fuse was already capable of some sort of active control.

D15 was not related to either the problems concerned with igniters for air-bags or the current control of a triggerable power switch. Although this prior art document could indeed be considered to represent the general knowledge of the skilled person, the actual example referred to by the appellant related to a push-pull amplifier which was remote from a triggerable power switch of the form as defined in current claim 1.

The skilled person was therefore not likely to consider this prior art when searching for a solution to the present problem, specifically related to an air-bag ignition system.

Although in claim 1 the word "limiting" of the current was used, this term should be interpreted in a wide sense to include a current control in accordance with prevailing circumstances, thus including a limitation to zero amps or to specific constant values suitably adapted to the individual air-bag igniters. Such possibilities were neither disclosed nor hinted at in any of the cited documents.

Therefore, in the absence of any disclosure of or realistic hint at the solution claimed, the skilled person could not arrive at the system claimed in the current claim 1 without the exercise of an inventive activity.

Reasons for the Decision

1. The appeal is allowable.
2. *Amendments*
 - 2.1 Current claim 1 is a combination of the subject-matter of granted claims 1 and 3, which are identical with the originally-filed claims 1 and 3.

The dependent claims 2, 3 and 4 are repetitions of the granted claims 2, 4 and 5, which are identical with the originally-filed claims 2, 4 and 5.

Therefore, the present set of claims does not give rise to objections under the EPC, in particular in respect of the requirements of Article 123(2) and (3) EPC.

2.2 The description was amended to take account of the prior art disclosed in D1 to D10 and does not give rise to objections under the EPC either.

3. *Novelty*

Novelty of the subject-matter of claim 1 follows from the fact that none of the cited documents discloses a system for the protection of the occupants of a motor vehicle having a firing circuit which includes a plurality of air-bag igniters in which current limiting means for limiting the electric current flowing through individual triggerable power switches, and supplied from a single energy storage capacitor, are provided.

Novelty was in fact not in dispute during the appeal proceedings.

4. *Inventive step*

4.1 In the Board's opinion the closest prior art is represented by D4. This document discloses an air-bag protection system for a motor vehicle comprising the combination of features defined in the pre-characterising part of claim 1 under consideration.

In particular this known system comprises a firing circuit for a number of individual air-bag igniters each of which is connected in series with a respective triggerable power switch and at least one retardation sensitive mechanical arming switch. Energy is supplied by a single energy storage capacitor.

4.2 The appellant considered that D1 or D2 would come closer to the subject-matter of claim 1 because these documents already addressed the problem of current limitation so as to ensure that all the igniters were supplied with sufficient electric current even when one of the igniters was shortened at its conductors.

Although indeed D1 and D2 are linked with the problems relating to enhanced reliability of the ignition of a plurality of air-bags with a single energy source, the circuits disclosed in these prior art documents lack individual triggerable power switches for each individual air-bag in addition to the, at least one, mechanical arming switch. These systems thus relate to another category of ignition circuits and, although relevant, are not considered suitable as a starting point for the assessment of inventive step of the subject-matter of claim 1.

4.3 In a situation where there is a loss of battery power, and shunts or short circuits are formed in one or more of the igniters, the limited energy supplied by the single condenser may be consumed before all the individual air-bags can be reliably ignited. Consequently the system disclosed in D4 cannot ensure in all circumstances correct ignition of all the air-bags installed in the motor vehicle.

It is therefore a principal object of the patent in suit to improve reliability and safety, especially in case of loss of battery power (see column 1, lines 18 to 21 of the patent in suit).

4.4 The appellant was of the opinion that the underlying problem of the subject-matter of claim 1 simply related to limiting the current flow so as to avoid overload of

the triggerable power switches, which object was also mentioned in the patent description in column 1, lines 22 to 26.

Anyhow, the subject-matter of claim 1 did not solve the problem of power drain essentially because current flow was not stopped, as was the case in D2 when the fuse was blown, but merely limited. There was thus still the risk of unwanted power consumption in the event of a short circuit in one or more of the igniters.

However in this respect the Board takes the view that, similarly, to the system disclosed in D1, by limiting the maximum current in the individual ignition lines of the system the risk of a total power drain by a short circuit is avoided and more power remains in the condenser for ensuring ignition of the remaining air-bags.

The subject-matter of claim 1 therefore indeed provides a solution to the problem stated even in the case that the current flow is not stopped completely.

Rather than being an aim of the present patent the reduced risk of overloading of the triggerable power switches is a specific additional advantage of the claimed solution, (see page 4, lines 19 to 23 of the originally filed description) based on the possibility opened by the claimed electronic current control to limit the current to a value independent of the power source voltage and create thereby the possibility to charge the capacitor with a higher voltage than usual and thereby increase the amount of available energy. Such measure enables the use of a relatively small capacitor without having to accept an otherwise insufficient energy capacity.

4.5 The problems encountered with a short circuit developing in the air-bag igniters are known from D1 (see column 1, lines 18 to 21) and D2 (see page 2, lines 10 to 24 and page 9 lines 31 to 36). In these prior art documents, it is suggested either to limit the maximum current by means of a resistor placed in series with the igniter (D1) so as to ensure ignition of further igniters or to use a fuse in series with the igniter so that when a short circuit occurs the fuse melts (D2) to stop any drain of electric energy.

On the basis of this prior art, the skilled person would primarily be led to incorporate either a resistor or a fuse in the system disclosed in D4. The resulting conversion of the system disclosed in D4 would thus lead to a passive current control but not to the active current control of the triggerable power switches claimed in claim 1 of the amended patent.

4.6 The appellant submitted that the skilled person was well aware of the passive current control on the one hand and active current control on the other and that he would select either one in accordance with the prevailing circumstances. Moreover, D15 explicitly mentioned on page 370, point 12.3 the possibility to replace a fuse, the limitations of which such as its slowness were well known to the skilled person, by electronic current limiting means for the protection of a power amplifier.

Since the triggerable power switches were in principle power amplifiers and their protection played a role of importance it would be immediately apparent to the skilled person to apply this general knowledge also to D4 and thus to arrive in an obvious manner at the claimed solution.

Although the Board accepts that the electronic current limiter disclosed in D15 represents general knowledge of the skilled person, this known electronic current limitation is closely linked to the problem of short-circuit overload of a solid state power amplifier and protection against burn-out of its final-stage power transistors.

In the Board's opinion, there is no apparent link between such an overload protection measure and the underlying problem of the patent, which merely concerns avoidance of power loss so as to be able to ensure ignition of a number of air-bags. Furthermore, even considering that a switching transistor principally may be seen to represent a "power amplifier", the actual power amplifier addressed in D15 is a push-pull amplifier which is quite remote from a triggerable power switch let alone its function in an ignition system for an air-bag.

Therefore, in spite of his general knowledge as regards short circuit protection of solid state amplifiers, the skilled person was not led to apply the respective principles to the system disclosed in D4 because neither is there an incentive to do so for solving the specific technical problem underlying the invention nor is it apparent - without hindsight - what structural adaptations of the system disclosed in D4 would be necessary to provide an electronic current limiter and arrive at the specific circuit defined in the current claim 1 of the patent in suit.

No hints are derivable either at the possibility provided by the active current control for using a higher ignition circuit supply voltage without the risk of overload of the triggerable power switch.

- 4.7 Similar considerations apply to the content of D16 not any longer relied upon by the appellant in the oral proceedings. Also this document discloses the principle of short circuit protection by means of an electronic current limitation circuit as an alternative for a fuse. No disclosure or hint is derivable from this prior art to apply such circuit in an air-bag ignition system with the view to avoid power drain and ensure multiple air-bag ignition.

There is no need to consider in detail the further documents cited but no longer relied upon by the appellant because none of these documents comes closer than the documents discussed above.

- 4.8 For the above reasons the Board concludes that the subject-matter of claim 1 according to the respondent's request cannot be derived in an obvious manner from the cited prior art, even when considered in the light of the skilled person's general knowledge of electronic circuits, and accordingly involves an inventive step (Article 56 EPC). Consequently this claim, together with its dependent claims 2 to 4, relating to particular embodiments of the invention in accordance with Rule 29(3) EPC, are acceptable.

Taking into account the amendments made by the respondent, the present patent documents meet the requirements of the EPC and the patent as amended is to be maintained in this form (Article 102(3) EPC).

Order

For these reasons it is decided that:

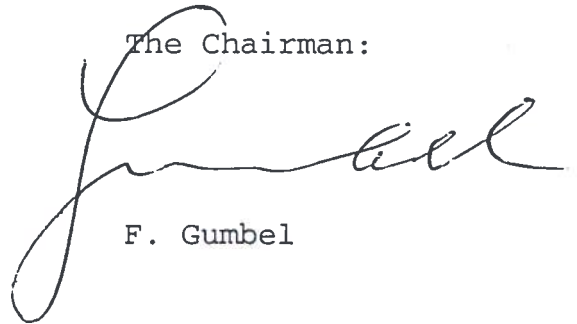
The appeal is dismissed.

The Registrar:



S. Fabiani

The Chairman:



F. Gumbel