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D E C I S I O N
of 4 April 1995

Case Number: T 0624/93 - 3.2.1

Application Number: 84115179.8

Publication Number: 0147720

IPC: B60T 8/88

Language of the proceedings: EN

Title of invention:
Fail-safe system in anti-skid brake control system for automotive vehicles

Patentee:
NISSAN MOTOR CO., LTD.

Opponent:
Robert Bosch GmbH

Headword:
-

Relevant legal provisions:
EPC Art. 123(2), (3), 56

Keyword:
"Amendments - added subject-matter (no)"
"Broadening of a claim (no)"
"Inventive step (yes)"

Decisions cited:
-

Catchword:
-

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Case Number: T 0624/93 - 3.2.1

D E C I S I O N
of the Technical Board of Appeal 3.2.1
of 4 April 1995

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 announced on 23 March 1993, with written reasons posted on 10 May 1993, revoking European patent No. 0 147 720 pursuant to Article 102(1) EPC.**

Composition of the Board:

Chairman: F. A. Gumbel
Members: P. Alting van Geusau
J. C. M. de Preter

Summary of Facts and Submissions

I. European patent No. 0 147 720 was granted with effect from 6 March 1991 on the basis of European patent application No. 84 115 179.8, filed on 11 December 1984.

II. The Respondent (Opponent) filed an opposition against the European patent on the grounds that the subject-matter of the patent lacked an inventive step having regard to the prior art disclosed in the documents:

D2: DE-A-3 102 108
D8: DE-A-1 755 741
D9: DE-C-2 257 213.

III. By decision announced at oral proceedings held on 23 March 1993, with written reasons posted on 10 May 1993, the Opposition Division revoked the patent.

The Opposition Division was of the opinion that the combination of features disclosed in D2 and D9 would lead in an obvious manner to the subject-matter of the granted Claim 1.

VI. The Appellant (Proprietor) filed a Notice of Appeal against this decision on 7 July 1993 and paid the appeal fee on the same day. The Statement of Grounds of Appeal was filed on 20 September 1993.

V. In a communication for preparation of oral proceedings, as was requested by both parties, the Board pointed at some inconsistencies of the granted Claim 1 vis-a-vis the disclosure of the description of the patent and expressed its doubt whether the subject-matter of this Claim 1 involved an inventive step having regard to the disclosures of D2 and D9.

A new Claim 1 in accordance with an auxiliary request filed together with the Statement of Grounds of Appeal was not considered acceptable for reasons of Article 123 (2) EPC.

VI. Oral proceedings were held on 4 April 1995 in the presence of both parties. At the oral proceedings the Appellant filed amended patent documents:

- Claims 1 to 6
- description pages 2 to 21 and
- Figures 27a, 27B, and 28.

The new Claim 1 was based on Claim 1 of the earlier auxiliary request.

The Appellant requested that the decision under appeal be set aside and that the patent be maintained on the basis of the documents filed at the oral proceedings together with Figures 1 to 26 and 29 as granted.

Claim 1 of the request for maintenance of the patent in amended form reads as follows:

"1. A fail-safe system for an anti-skid brake control system comprising:

a hydraulic brake circuit;
pressure control valve means disposed in said brake circuit for increasing hydraulic brake pressure at a wheel cylinder (30a, 34a, 38a) in its first position, for decreasing hydraulic pressure in said wheel cylinder in its second position and for holding hydraulic brake pressure in said wheel cylinder in its third position;
an actuator (16, 18, 20) associated with said pressure control valve means for operating said pressure control valve among said first, second and third positions

according to a control signal, said actuator being connected to an electric power source (300) to receive power supply therefrom;
a sensor (10a, 10b, 10c) for detecting wheel speed and producing a second signal indicative of the wheel speed;
a detector (311, 316, 318, 320 326, 338, 348, 354, 388, 396, 406) for detecting faulty operation of the components of said anti-skid brake control system and producing a fault-indicative signal when faulty operation of at least one of said components is detected, said detector (301, ...406) being responsive to said fault-indicative signal to terminate power supply to said actuator (16, 18, 29) and to hold said pressure control valve means in said first position; and
a controller (12, 202, 204, 206) receiving said sensor signal and processing the sensor signal, deriving values of wheel acceleration and slippage, and deriving said control signal in accordance with said values;
characterised in that
said detector (311,...406) includes means receiving said control signal and signals indicative of the response of the components of the anti-skid control system to the current control signal, comparing said control signal and said response-indicative signals and producing said fault-indicative signal when said responsive-indicative signals do not fully correspond to the response of properly functioning anti-skid control system components to the current control signal, said pressure control valve means being a three-position valve (16a, 18a, 20a), said actuator (16, 18, 20) placing said pressure control valve (16a, 18a, 20a) at said first position while no power is supplied from said power source (300), at said second position while a predetermined first level of power is supplied and at said third position while a predetermined second level of power is supplied, and that said controller (202, 204, 2069 receives said fault-indicative signal and carries out a background job

(Fig. 28) for outputting the control signal by which said actuator (16, 18, 20) places said pressure control valve (16a, 18a, 20a) at said first position when said fault-indicative signal is present."

VII. In support of his request for maintenance of the patent in amended form the Appellant relied essentially on the following arguments:

The new Claim 1 is based on the granted Claim 1 and now contains further features to clarify the nature of double fail-safe operation of the anti-skid brake system which is the object of the present patent. As can be derived from the electric circuit disclosed in Figures 27A, 27B and the flowchart of Figure 28, the fault-indicative signal coming from OR gate 344 is not only used to switch-off the power supply to the anti-skid system but at the same time activates the controller such that the output terminals are set to zero and consequently the pressure control valve is actuated to move to the application mode. The latter function is described on page 20, lines 36 to page 21, line 11 of the description of the patent. In so far the new Claim 1 complies with the requirements of Article 123(2) and (3) EPC.

The closest prior art document is D2. In this prior art fail-safe system, power supply to the actuators of the control valves is terminated when the output voltage of the power supply decreases beyond a predetermined minimum value and also the individual channels to each of the actuators are interrupted when a fault-indicative signal for such a channel is generated, in both cases only after lapse of a delay time during which the anti-skid brake operation is continued. In accordance with the present Claim 1 of the patent in suit the detector detects whether all system components respond properly

to the current control signal and in case this is not so double fail-safe operation is achieved in that the power is switched off and at the same time the pressure control valves are brought in the first position for free communication of the brake pedal hydraulic master cylinder with the hydraulic brake cylinder.

In the prior art disclosed in D9, no normal manual brake operation is established when the monitoring circuit determines that the intermediate or third position of the control valve is not reached or maintained but rather a warning lamp is illuminated or the brake pressure is relieved. Therefore, when considering the prior art as disclosed in D2 and D9 or the remaining documents no lead is given to the subject-matter of Claim 1 and as thus it was not obvious for a person skilled in the art to arrive at this subject-matter even when combining the teachings of both documents.

VIII. The Respondent requested that the appeal be dismissed and argued essentially as follows:

The subject-matter of the amended Claim 1 does not appear to meet the requirements of Article 123(3) EPC in that in accordance with the granted Claim 1 the controller terminates power supply to the actuators and in new Claim 1 this is done by the detector.

Furthermore the meaning of "background job" is not sufficiently clear and in view of the disclosure in relation to Figure 28, it appears that determination of the fault-indicative signal coming from the detector is not part of a "background-job" in the meaning of a sub-routine carried out by the controllers. Present Claim 1 does not therefore meet the requirements of Article 84 EPC either.

D2 indeed is the closest prior art document. This document discloses in addition to the pre-characterising features also the last features of Claim 1. The detector not only activates the relay 48 for disabling the anti-skid system in case of low circuit supply voltage, it can also activate the controller in a manner so as to prevent anti-skid control of the brake pressure control valve of a wheel in case the wheel speed sensor of that wheel fails.

The other features of the characterising part of Claim 1 are essentially known from D9. The three-position hydraulic pressure control valves disclosed in D9 are used in an anti-skid system in which in accordance with the embodiments disclosed in relation to Figures 6 and 7 a fault-indicative signal is produced when a detected control valve response is not in agreement with properly functioning of the anti-skid control system. Since both D2 and D9 relate to anti-skid systems it would not need an inventive activity to further develop the system known from D2 with the features known from D9 in order to make use of the known advantageous three-position control valves and to monitor in addition to the features already supervised in this known anti-skid system also the anti-skid control response signal and to compare it with the control signal in a manner as known from D9.

Reasons for the Decision

1. The appeal complies with the requirements of Articles 106 to 108 and Rules 1(1) and 64 EPC. It is admissible.

2. *Amendments*

2.1 Present Claim 1 is based on the granted Claim 1, which itself was based on the originally filed Claims 1 and 7, and additional subject-matter disclosed in the originally filed description, pages 16, lines 19 to 21, page 18, lines 1 to 6 and page 18, lines 16 to 20. Present Claim 1 contains further features relating to the double fail-safe function in response to a detected error disclosed in relation to the embodiment shown in Figures 27A, 27B, and 28 of the patent and application documents, respectively. In this respect the present Claim 1 now makes it clear that the fault-indicative signal is not only used to switch-off the circuit power but at the same time activates the controller such that the output terminals are set to zero and consequently the pressure control valve is actuated to come into the "first" position which allows free communication of hydraulic fluid between the master brake cylinder and the wheel brake cylinders. The latter function is described on page 20, lines 36 to page 21, line 11 of the description of the patent and page 59, line 34 to page 61, line 26 of the originally filed description, respectively.

2.2 The Respondent expressed doubt whether the requirement of Article 123(3) EPC was fulfilled, in particular considering that the pre-characterising part of Claim 1 does not any longer contain the feature that the controller terminates power supply to the actuator. He further was of the opinion that the amended Claim 1 did not meet the requirements of Article 84 EPC in respect of the features relating to the "background job".

However, in regard of Article 123(3) EPC it is the entirety of the new Claim that should be considered when comparing its subject-matter to the subject-matter of

the granted Claim 1. In this respect it follows from the last two features in the characterising part that in response to the fault-indicative signal the controller produces an output signal of zero power so that the actuator places the pressure control valve in its first position.

As follows already from the considerations in point 2.1 above, the present Claim 1 is supported by the disclosure of the patent and the application documents in their originally filed form. In respect of the last feature of Claim 1 relating to a specific "background job" to be carried out by the controller, the Board considers that the skilled person would immediately realise that the sub-routine disclosed in relation to Figure 28 does not necessarily have to be one for successive error checking but may be just one for checking the output level of the OR gate 344 only (see page 61, lines 23 to 26 of the originally filed description). Anyhow this subject-matter was already implicitly comprised in the granted Claim 1 when taking account of the last pre-characterising feature according to which the controller terminates the power to the actuator in response to the fault-indicative signal.

In view of the fact that the "background job" to be carried out by the controller is specified in detail in the last feature of Claim 1, the Board sees no difficulty for the skilled person for the understanding of this feature.

2.4 The dependent Claims 2 to 6 are repetitions of the granted Claims 2 to 6 and the originally filed Claims 2 to 6, respectively.

2.5 In view of the above assessments no objections in respect of Article 123(2), (3) and Article 84 EPC arise against the new claims.

2.6 The amendments to the description and drawings concern the corrections of obvious errors and deletion of references to non-identifiable patent documents which do not lead to objections under the EPC.

3. *Novelty*

Novelty of the subject-matter of Claim 1 follows from the fact that none of the cited documents discloses a fail-safe system for an anti-skid brake control system in which the control signals and response-indicative signals are compared and when these signals do not fully correspond to the response of properly functioning anti-skid control system components to the control signal then both the power supply to the actuator is terminated and the actuator is placed in the position so that there is free communication between the hydraulic master cylinder and wheel brake cylinders ("first position").

Novelty was in fact not contested and it is therefore not considered necessary to give a detailed analysis of this matter.

4. *Inventive step*

4.1 The parties and the Board are in agreement that D2 discloses the prior art coming closest to the subject-matter of Claim 1. There is also agreement that this prior art discloses the combination of features of the precharacterising part of Claim 1.

4.2 In the system disclosed in D2 the situation in which one wheel brake control channel is not functioning properly, for example in case of failure of a wheel speed sensor, and the situation in which all brake control channels are affected, for example if the supply voltage is too low, are treated in a different manner (see page 5, "Wirkungsweise"). Apparently in both situations the power supply is eventually switched-off but only in the former case where the fault concerns only one channel the respective channel of the controller is switched-off too.

It cannot be derived from D2 that switching-off of an individual channel is carried out in response to a signal of the safety circuit (detector) 28. The last paragraph on page 5 of D2 on which the Respondent based such interpretation merely discloses that sensor failure is detected by the safety circuit 28 **and** provokes blocking of the valve control based on logical deciding criteria in the controller 10. In the Board's opinion this does not imply that the controller receives a fault-indicative signal from the safety circuit 28 but rather indicates that the controller itself comprises means for detection of such a failure (see also page 4, line 7 to line 13 of D2).

For these reasons the Respondent cannot be followed that part of the last characterising features of Claim 1, i.e. that the controller receives the fault-indicative signal provided by the detector for switching-off of the actuator, is known from D2.

Present Claim 1 thus meets the requirement of Rule 29(1) EPC in that it is satisfactorily related to the closest prior art.

4.3 In the fail-safe system for an anti-skid control system in accordance with D2, it cannot be ensured that when the anti-skid control system and the fail-safe system both malfunction, the vehicle brake system is actuated to the application mode in which braking pressure can be built up in the brake cylinders by manual brake application (see page 2, lines 19 to 22 of the description of the patent).

It is therefore the object of the present patent to provide a fail-safe system for an anti-skid control system which under all circumstances ensures manual control of the brakes in case of malfunction of the anti-skid control system and/or the fail safe system.

4.4 This object is met by the features of Claim 1. The use of a single three-position valve with a corresponding actuator which is activated by the controller provides reliable and simple control of the hydraulic pressure in case of failure of a part of the anti-skid system while such valve also enables the detector to supervise in a simple manner whether valve response corresponds to the response of proper functioning of this anti-skid control system component. Moreover, by controlling the valve to move to the position of free communication ("first position") in case the detector detects a failure, manual control of the brake is ensured even in case the power supply to the anti-skid brake system is not or not sufficiently quickly terminated by the detector.

4.5 The system known from D2 cannot give a lead to the characterising features of Claim 1, essentially because the detector is not arranged to supervise the response of the anti-skid control system components but rather only the input variables and power supply voltage.

4.6 D9, considered to be pertinent by the Respondent, is the only available document that discloses in addition to the use of a three-position pressure control valve in an anti-skid control system of similar construction and function as claimed in Claim 1 of the patent in suit means for supervising the response of the pressure control valve.

However, the detection of failure of the pressure control valve is restricted to supervising the position in which the pressure is held constant, only in so far as that failure is indicated by a lamp but not used as a control signal (circuit shown in Figure 6 of D9) or, in accordance with another example, the failure results in switching of the valve to the position of pressure decrease (circuit shown in Figure 7).

4.7 Although, this prior art discloses a pressure control valve of the type claimed in Claim 1 and also the feature of supervising the control valve middle position, in the Board's opinion, there is no real teaching derivable from this document to solve the above stated problem, e.g ensuring manual control even in case the fail-safe system fails.

In this respect neither D2 nor D9 discloses or can be considered to give an indication to the idea of moving the pressure control valve in its "first position" in response to the fault-indicative signal coming from a detector which signal is at the same time used to activate the pressure control valve controller for moving that valve in the same sense.

More particularly, considering the concept of anti-skid systems disclosed in D2 and D9, the combination of these known systems would, in the Board's opinion, lead to the incorporation of the additional safety measures in

accordance with the systems shown in Figures 6 and 7 of D9 rather than that the skilled person would be led to use the detector known from D2 to supervise all components of the anti-skid control system and, in case of failure of one of those components, use the fault-indicative signal given by the detector not only to terminate power supply to the anti-skid control system but also to activate the controller for bringing the pressure control valve in the "first position".

Therefore, even when applying the teaching disclosed in D9 to the system disclosed in D2, further substantial modifications would be necessary to arrive at the combination of features of Claim 1. Since such modifications are not hinted to in any of the other available prior art documents or could be considered obvious for other reasons, the subject-matter of Claim 1 is considered to be based on an inventive step.

5. Summarising, in the Board's judgment, the proposed solution to the technical problem underlying the patent in suit defined in the independent Claim 1 is inventive and therefore this Claim as well as its dependent Claims 2 to 6, relating to particular embodiments of the invention in accordance with Rule 29(3) EPC, can form the basis for maintenance of the patent (Article 52(1) EPC).

The description and drawings are in agreement with the actual wording and scope of the current Claims. Hence these documents are also suitable for maintenance of the patent in amended form.

Thus taking into account the amendments made by the Appellant, the patent and the invention to which it relates meet the requirements of the EPC and the patent as amended may be maintained in this form (Article 102(3) EPC).

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 with the following documents:

   - Claims 1 to 6, description pages 2 to 21 and Figures 27A, 27B, 28, as presented at the oral proceedings,
   - Figures 1 to 26 and 29 as granted.

The Registrar: The Chairman:

S. Fabiani F. Gumbel