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D E C I S I O N
of 3 March 2003

Case Number: T 0913/00 - 3.2.1

Application Number: 94918969.0

Publication Number: 0705190

IPC: B60T 13/575

Language of the proceedings: EN

Title of invention:
Brake booster

Patentee:
Lucas Industries Limited

Opponent:
Continental Teves AG + Co. oHG

Headword:
-

Relevant legal provisions:
EPC Art. 56, 114(2)

Keyword:
"Inventive step (no)"
"Late submitted material - document admitted (yes)"

Decisions cited:
T 0574/88, T 0606/89, T 0834/91, T 0897/92, T 0298/93, T 0380/93, T 0795/93, T 1040/93

Catchword:
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Case Number: T 0913/00 - 3.2.1

D E C I S I O N
of the Technical Board of Appeal 3.2.1
of 3 March 2003

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

Decision under appeal:
Interlocutory decision of the Opposition Division of the European Patent Office posted 6 July 2000 concerning maintenance of European patent No. 0 705 190 in amended form.

Composition of the Board:

Chairman: F. J. Pröls
Members: J. Osborne
M. K. S. Aúz Castro

Summary of Facts and Submissions

I. The appeal of the opponent (appellant) is directed against the decision of the Opposition Division that, account being taken of the amendments made by the patent proprietor during the opposition proceedings, the European patent No. 0 705 190 and the invention to which it relates meet the requirements of the EPC. During the opposition procedure *inter alia* the following evidence was cited:

D6: partial translation into German and Figures 1 to 4 of JP-U-61-205858.

II. During an oral proceedings held before the Board 12 April 2002 the appellant filed a full translation into English of JP-U-61-205858 (hereafter D6T) and the respondent amended Claim 1 according to its main request by introducing a feature from the description. The procedure was continued in writing and the appellant was set a time limit of four months to respond to the amendment. With a letter received 13 August 2002 the appellant filed *inter alia* the following evidence:

D10: abstract in English of JP-A-58-221757.

III. The Board summoned the parties to further oral proceedings to be held 3 March 2003 and set a time limit of one month before that date for filing further submissions. With a letter received 3 February 2003 the appellant filed *inter alia*:

D12: "Teves präsentiert kostengünstiges ABS", Internationale Motor-Korrespondenz, 17 March 1987.

With a letter received 17 February 2003 the appellant filed a full translation into English, together with Figures 1 to 4, of JP-A-58-221757 (hereafter D10T).

IV. During the oral proceedings held 3 March 2003 the appellant (opponent) requested that the decision under appeal be set aside and that the patent be revoked.

The respondent (patent proprietor) requested that the appeal be dismissed with the proviso that the patent be maintained on the basis of Claims 1 to 17 filed on 3 February 2003, description pages 2, 2a, 2b and 5 filed on the same date, description pages 3 and 4 of the patent specification and Figures 1 to 16 as granted.

V. Claim 1 according to the respondent's request reads as follows:

"Use of a brake booster comprising a fluid-actuated servo piston to which the supply of working fluid is controlled by the valve mechanism (8A, 14A) actuated under the influence of a driver-operated force input member (16), the input member (16) acting via a force transmission assembly on an output member (10) arranged, in use, to provide power assisted input to a master cylinder, the force transmission assembly including a reaction element (19) and providing surfaces through which force is transmitted between the input (16) and output (10) members, characterised by yieldable means (24, 31, 37, 50, 64, 74, 81) arranged to yield under a predetermined transmitted force when the input force is increased beyond that required for normal braking to permit movement of at least one part

of the force transmission assembly in order to cause a change in the ratio of the operative surface areas (A2:A1) in a manner such as to increase the boost ratio (A3:A1) in a braking system incorporating an anti-skid facility."

VI. The appellant argued essentially that the subject-matter of Claim 1, which had been rendered unclear by the introduction during the appeal procedure of a reference to "normal braking", differs from the disclosure of D10/D10T only by the features that the yieldable means yield in order to cause a change in the ratio of the operative surface areas of the reaction element and that the brake booster is used in a braking system incorporating an anti-skid facility. There exists no functional relationship between the two differentiating features which are obvious in the light of the disclosure of D6 and on the basis of general technical knowledge respectively.

VII. The respondent countered essentially as follows:

The closest prior art as determined according to case law of the EPO Boards of Appeal (e.g. T 574/88, T 606/89, T 834/91, T 897/92, T 380/93, T 1040/93 and T 795/93 none published in OJ EPO) is that which involves the fewest structural changes to arrive at the subject-matter in question. In respect of Claim 1 in the present case this requirement is satisfied by the prior art disclosed in D6. However, D6 teaches changing the ratio of the operative areas of the surfaces of the reaction member at low pedal loads within the range of normal braking in order to improve the feel through the pedal by approximating a quadratic relationship between the output and input forces of the booster. The

subject-matter of Claim 1 differs from the disclosure of D6 in the feature that the ratio of the operative surface areas is changed when the input force increases beyond that required for normal braking and in the use of the booster in a braking system incorporating an anti-skid facility i.e. incorporating ABS. The two differentiating features exhibit a functional relationship because the increase in the boost ratio at a pedal force beyond that required for normal braking enables the braking in high grip conditions to take place at the peak of the μ/slip curve whilst ABS ensures that it remains close to the peak, thereby ensuring optimum retardation.

According to case law of the Boards of Appeal the disclosure of a complete prior art document has greater evidential value than its abstract. Whereas D10 discloses a brake booster in which the boost ratio increases in dependence on the input force, D10T discloses that the boost ratio increases in dependence on the speed of movement of the booster input shaft. Moreover, although braking systems including ABS were known at the reference date of the contested patent, D12 indicates that ABS was conceived for use in low grip conditions and neither D6 nor D10/D10T discloses a system incorporating ABS. The idea of increasing the boost ratio when the input force increases beyond that required for normal braking to permit a driver to achieve optimum levels of retardation during emergency braking in high grip conditions and to use ABS to maintain that condition does not result from a combination of D6 and D10/D10T.

The respondent further requested that late filed evidence should be disregarded.

Reasons for the Decision

1. *Late filed evidence*

During the first oral proceedings held before the Board the respondent amended Claim 1 of its then main request by *inter alia* introducing from the description the feature relating to an increase in the input force beyond that required for normal braking. The Board admitted the amended claim into the procedure and allowed the appellant time to conduct a further search in respect of the newly introduced feature. The respondent filed D10 within the time limit set and, particularly since it was filed in response to the amendment made to the claim, it is not late filed within the meaning of Article 114(2) EPC. Although D10T was filed after expiry of all time limits the respondent argued during the oral proceedings that the disclosure of the translation D10T supported its case better than did the disclosure of D10 alone. The respondent also used the disclosure of D12 to support its submissions. Under these circumstances the respondent is not disadvantaged by the appellant's late filing of D10T and D12 and so the Board sees no reason to disregard them.

2. *Inventive step*

2.1 It is well established that in order to objectively assess inventive step it is necessary first to determine the closest prior art. According to case law the closest prior art is a technically realistic starting point from which the claimed subject-matter could most easily have been made by the skilled person.

According to T 574/88, T 606/89, T 834/91, T 897/92, T 380/93, T 1040/93 and T 795/93 (*supra*) referred to by the appellant it is a requirement that the minimum number of structural and functional modifications should be necessary to arrive at the claimed subject-matter. In respect of functional modifications the disclosure should be of subject-matter conceived for the same purpose as the claimed invention and according to T 298/93 (also not published in OJ EPO) ideally that purpose or objective should be something already mentioned in the prior art document as a goal worth achieving.

2.2 The contested patent relates to a vacuum brake booster in which the boost ratio, i.e. the ratio between the respective forces transmitted by the output and input shafts of the booster, increases within the booster's operating range. Some prior art boosters have a boost ratio which remains unchanged throughout their operating range and this is satisfactory for normal braking which in good conditions does not fully utilise the grip available. It is explained in the specification that it has been found that a fixed boost ratio has the disadvantage that when higher levels of deceleration are required, such as during emergency braking, some drivers fail to exert enough force on the pedal and so are unable to fully utilise the maximum grip available in dry conditions. According to present Claim 1 the boost ratio is changed when the input force increases beyond that required for normal braking in order that a driver can more easily utilise the maximum grip available under dry conditions when performing e.g. emergency braking.

2.3 The booster according to D6 exhibits greater

constructional similarity with the subject-matter of present Claim 1 than does that of D10/D10T in as far as, whilst in both boosters the boost ratio is changed within the booster's operating range, this is achieved according to D6 by means of a change of operative surface areas, as in present Claim 1, whereas the booster of D10/D10T employs a system which alters the effective lengths of levers. However, D6T discloses that the boost ratio is changed for the purpose of controlling feel in the brake pedal and in the preferred embodiment the boost ratio changes at a relatively low deceleration level of around 0.2 g corresponding to an input load of about 20 kg which, taking into account the mechanical advantage conventionally achieved by means of the brake pedal mounting arm, corresponds to a pedal load considerably lower than 20 kg. In contrast, according to D10 the boost ratios for "normal braking" and "braking hard" differ and according to D10T the boost ratio changes in order to reduce the load to be applied to the brake pedal to achieve "high deceleration" (D10T page 7, lines 3 to 5; page 9, penultimate sentence). It follows that the goal sought according to D10/D10T corresponds to that for present Claim 1 although the mechanism by which that goal is achieved differs. In the Board's view a skilled person wishing to provide a booster which fulfills a certain purpose would choose one which already fulfills that purpose in preference to modifying another which does not. The Board therefore considers D10/D10T to represent the closest prior art for assessing inventive step.

2.4 D10T acknowledges its closest prior art with reference to Figure 1 as being a vacuum booster having conventional valves 6, 7, 8 for selectively

interrupting a connection between the chambers A, B on either side of the diaphragm assembly 9 and admitting air into the chamber B to provide servo-assistance during braking. When force is applied to the input shaft 15 the valves operate and the diaphragm assembly 9 applies force via the fulcrum point C to levers 19 and so to a reaction plate 20 and the output shaft 18. The inner ends E of levers 19 contact the end face of the valve plunger 7 which thereby provides feedback to the driver through the input shaft 15. The feedback is representative of the force in output shaft 18 and is applied to the levers 19 at a point D where the reaction plate contacts each lever between its fulcrum point C and the lever end E. It is explained in D10T that the constant boost ratio of this prior art arrangement arises from the fixed lengths between the points C, D, E and has the disadvantage that "in the range of high deceleration such as when a sudden braking is applied, the stepping force on the brake pedal must be very large" (page 7, lines 3 to 5). In the invention of D10/D10T an additional, larger reaction plate 22 is provided which in the non-operative condition is spaced from the reaction plate 20 by a conical spring 23. In operation the spring 23 ensures that load transmission between the output shaft 18 and levers 19 initially is by the smaller reaction plate which contacts the levers at a point G (D10T Figure 2). When the spring 23 is subjected to a load sufficient to compress it and allow the two reaction plates to move together load is transmitted between the output shaft 18 and levers 19 by the larger reaction plate 22 which contacts the levers at a point K which is closer than point G to the fulcrum point J, resulting in an increased boost ratio (D10T Figure 3).

2.4.1 Whilst the parties are in agreement as regards the disclosure of the above-mentioned constructional features of D10/D10T they disagree in respect of the conditions under which the boost ratio increases. In particular, the respondent argues that the disclosure of D10 and D10T differ in this respect and asserts that in such a situation the decisive disclosure is that of the full document as represented here by D10T. However, as can be seen from the following, the teaching of D10T to the skilled person in this respect is consistent with disclosure of D10 and the matter of the relative evidential values of a document and its abstract therefore need not be considered in this case. According to the respondent the spring 23 would be compressed upon movement of the input shaft 15 by depression of the brake pedal at a speed sufficiently high that the input shaft would move forwards to abut the output shaft before the valve could operate and so before the diaphragm assembly moves and it refers to particular sections of text of D10T to support this view. The appellant, on the other hand, argues that compression of the spring would be in response to the application of a sufficiently high load to the input shaft and finds support for its view in other sections of text. It is undisputed that D10 is clear in distinguishing between "normal" and "hard" braking. However, D10T is somewhat less clear in as far as it uses not only such terms as "stepping force ... very large", "low deceleration" and "high deceleration" but also, for instance, "quick" stepping force and "sudden stepping" on the pedal. It is not stated in D10T which force serves to compress the spring 23. A comparison of Figures 2, 3 is inconclusive in as far as Figure 3 shows the reaction plate 20 nested within the reaction plate 22 with the spring 23 fully compressed but

apparently with no other component applying a force to retain it in the position shown. However, decisive in this respect is the understanding by the skilled person in the light of the whole document and in this respect the detailed explanation of the operation of the booster is of particular importance. When explaining the compression of the spring during operation of the booster to achieve a high deceleration it is stated that "the reaction plate 20 is pushed forward by the power piston 9 ... . For this reason ... the tray spring 23 is deformed ...", "power piston" being the expression used in D10T to denote the diaphragm assembly (page 9, beginning in the second full sentence). Since the diaphragm assembly only moves after the valve has operated it follows that the spring 23 is not compressed before the valve operates. Indeed, the skilled person would immediately understand that in a braking system having a brake booster the degree of assistance which it provides is such that the achievement of high deceleration, such as in emergency braking, would necessarily rely on the booster providing assistance to the driver. It is therefore the Board's view that D10T when taken as a whole is consistent with D10 in providing an unambiguous teaching to the skilled person that the spring is compressed in response to the application of sufficient force through the input shaft.

2.4.2 In the light of the above the Board considers that the subject-matter of present Claim 1 differs from that of D10/D10T by the following features:

- use of the booster in a braking system incorporating an anti-skid facility; and

- the increase in boost ratio results from a change in the ratio of the operative surface areas of the reaction element.

The mechanism by which the boost ratio is changed, in this case the change of operative surface areas of the reaction element, has no influence on the operation of the booster as regards its use in a braking system incorporating an anti-skid facility i.e. including ABS. The differentiating features therefore are juxtaposed and are to be treated separately for assessment of inventive step.

2.5 The parties are in agreement that it was known before the reference date of the contested patent to use a brake booster having a fixed boost ratio in a braking system including ABS which serves to control the pressure generated in the braking system by the action of the booster. The purpose of ABS is to aid in maintaining control of the vehicle under conditions when tyres may lose grip with the surface. Tyres commonly reach the limit of their adhesion during braking on a low grip surface and, as correctly stated by the respondent with reference to D12, it is under these conditions that ABS typically would function. Because of the low grip level ABS would operate without the need for the vehicle driver to apply a force in excess of that for normal braking, i.e. a condition under which the boost ratio of the booster according to D10 would remain at its lower level. It follows that when used in a situation in which ABS would usually be expected to function the booster of D10/D10T would not differ in its operation from a conventional one. Although the increase in boost ratio of the booster according to D10/D10T increases the likelihood of ABS

functioning under higher grip conditions, the only effect resulting from the increased ratio is that it is easier for the driver to achieve the necessary level of braking force and ABS would still function in its normal way. The use of the booster of D10/D10T in a braking system incorporating an anti-skid facility therefore was obvious in the light of the general technical knowledge of the skilled person.

2.6 The mechanism comprising the levers 19, reaction plates 20, 22 and spring 23 in the booster according to D10/D10T operates to produce a single increase in the boost ratio at a predetermined level of force applied to the input shaft. D6 also discloses a booster which operates to produce a single increase in the boost ratio at a predetermined level of force applied to the input shaft and in which a rubber reaction element 32 is interposed between the output shaft 31 and the valve plunger 33. The reaction element initially acts against the combined areas of the end face of the plunger and the end face of a spring-loaded sleeve 38 surrounding the end of the plunger. When the pressure in the reaction element exceeds a certain value the sleeve is displaced and the reaction element acts against only the area of the end of the plunger, thereby increasing the boost ratio. Although the aim of the invention according to D6 is to improve feel in the brake pedal, this is achieved merely by increasing the boost ratio. In the Board's opinion the skilled person would be aware that the mechanism of D6 is in respect of increasing the boost ratio a technical equivalent of the lever system used in D10/D10T and that, by merely changing the values of the relevant parameters to achieve the increase when the input force is beyond that for normal braking, it could be used in that

booster in place of the lever system.

2.7 The Board therefore concludes that the subject-matter of present Claim 1 is obvious in the light of a combination of the disclosures of D10/D10T and D6 and so does not involve an inventive step (Article 56 EPC).

Order

For these reasons it is decided that:

1. The decision under appeal is set aside.

2. The patent is revoked.

The Registrar: The Chairman:

S. Fabiani F. Pröls