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D E C I S I O N
of 23 February 2004

Case Number: T 1002/02 - 3.2.1

Application Number: 96102381.9

Publication Number: 0728654

IPC: B62D 5/083

Language of the proceedings: EN

Title of invention:

Steering control valve with different size flow gaps for noise suppression

Applicant:

TRW Automotive U.S. LLC

Opponent:

-

Headword:

-

Relevant legal provisions:

EPC Art. 54

Keyword:

Novelty (yes)

Decisions cited:

T 0204/83, T 0190/99

Catchword:

-



Case Number: T 1002/02 - 3.2.1

D E C I S I O N
of the Technical Board of Appeal 3.2.1
of 23 February 2004

Appellant: TRW Automotive U.S. LLC
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Decision under appeal: Decision of the Examining Division of the
European Patent Office posted 29 April 2002
refusing European application No. 96102381.9
pursuant to Article 97(1) EPC.

Composition of the Board:

Chairman: S. Crane
Members: J. Osborne
A. Pignatelli

Summary of Facts and Submissions

- I. The appeal is directed against the decision posted 29 April 2002 in which the Examining Division refused European patent application 96 102 381.9
- II. The Examining Division was of the opinion that the subject-matter of claim 1 according to both the main and auxiliary requests lacked novelty with respect to a document it designated as
D1: JP-Y-1 043974 which is the publication of an examined application for a utility model.

During the procedure and in response to the Examining Division's citation of D1 the applicant had supplied D1': a translation into English of JP-U-58 121767 which is the publication of the unexamined application forming the basis for D1.

The following prior art was also cited in the search report:

D2: EP-A-0 585 107

D3: EP-A-0 592 095

D4: EP-A- 0 472 101

D5: EP-A-0 337 723

D6: WO-A-86 05753

- D7: Patent Abstracts of Japan, vol. 18, no. 483
(M 1670), 30 September 1994 & JP-A-06 156292,
abstract
- D8: Patent Abstracts of Japan, vol. 6, no. 69 (M-125),
30 April 1982, & JP-A-57 007763, abstract
- D9: Patent Abstracts of Japan, vol. 9, no. 94, (M-374),
24 April 1985, & JP-A-59 220458, abstract
- D10: US-A-5 263 512.

III. Upon appeal the applicant requested to set aside the decision to refuse the application and to proceed with the grant of the patent on the basis of claims 1 to 6 filed with a letter of 13 July 2001 (main request) or alternatively on the basis of claims 1 to 17 filed with a letter of 22 February 2000 (auxiliary request).

IV. Claim 1 according to the main request reads as follows wherein features added to the wording as originally filed are indicated in italics and wording which has been deleted is included in []:

"A valve for controlling flow of hydraulic fluid, said valve comprising: first and second valve members (82, 80) *each* having a plurality of lands and grooves; said valve members (82, 80) being relatively movable from a neutral position *in which each of the lands of said first valve member does not substantially overlap with any of the lands of said second valve member* to a displaced position in which surface segments (216, 218, 226, 228) of respective pairs of lands overlap to form flow gaps (232, 234) for restricting flow of fluid between respective pairs of [grooves] *the lands; said*

first valve member (82) having a plurality of inlet passages (94) which are adapted to be communicated with a fluid supply (52) and first and second supply passages (100, 112) on the opposite sides of each of said inlet passages, said first and second supply passages being adapted to be communicated with first and second chamber portions (24, 22), respectively, of an apparatus (12) which is to be driven by the fluid, said first and second chamber portions selectively constituting a portion to which fluid is supplied and a portion from which fluid is discharged; said second valve member (80) having a plurality of return passages (126); [at least one] each of the flow gaps (232) formed between said inlet passages and said first and second supply passages by the surface segments of the lands which overlap with each other due to relative rotation of said first and second valve members being convergent by having a cross-sectional flow area which decreases along a direction of fluid flow; [at least one] each of the flow gaps (234) formed between said first and second supply passages and said return passages by the surface segments of the lands which overlap with each other due to relative rotation of said first and second valve members being divergent by having a cross-sectional flow area which increases along a direction of fluid flow; and said flow gaps having minimum cross-sectional flow areas defined by said surface segments, characterized in that said flow gaps being sized such that said minimum cross-sectional flow area of said convergent flow gaps (232) is larger than said minimum cross-sectional flow area of said divergent flow gaps (234) for suppressing valve noise so that a fluid volume flow rate for said convergent

flow gaps is greater than a fluid volume flow rate for said divergent flow gaps".

Claims 2 to 6 according to the main request define features additional to the subject-matter of claim 1.

Claim 1 according to the auxiliary request is essentially identical to that as originally filed whilst dependent claims 2 to 17 define further features of the valve.

The appellant's arguments can be summarised as follows:

According to the application the cross-sectional flow area at the divergent flow gap is made smaller than that at the convergent flow gap by providing a smaller chamfer angle together with a different depth for the chamfer cut. The reduction in flow area in the divergent gap results in a decrease in the Reynolds number and an associated reduction in the likelihood of cavitation occurring. The term "minimum cross-sectional flow area" relates to the flow-area at the position of maximum rotation of the valve rotor. By comparison, in D1 a smaller chamfer angle in the divergent flow gap is used to reduce the venturi effect, resulting in a less pronounced local pressure depression and so a reduced likelihood of cavitation.

Reasons for the Decision

Main request

Amendments to claim 1

1. The features added to claim 1 and, where applicable, the associated deletion of features find a basis in the description as originally filed as set out below:

- that "each" of the valve members has a plurality of lands and grooves and that each of the lands does not substantially overlap in the neutral position is derivable by the skilled person from figure 2;
- the content of the block of additional text beginning "said first valve member (82) ..." and "said second valve member (80) having a plurality of return passages (126)" is disclosed in the description page 6, line 23 to page 7, lines 12, page 8, lines 11 to 14 and figure 2;
- the amendment of "flow gaps (232, 234) for restricting flow of fluid between respective pairs of grooves" to read "flow gaps (232, 234) for restricting flow of fluid between respective pairs of the lands", is disclosed in the description page 15, lines 15 to 23 and page 16, lines 4 to 12 together with figure 3 from where it is clear that fluid which passes from one groove to another passes through a flow gap formed between a pair of lands;

- the full definition of each of the convergent and divergent flow gaps is derivable from page 15, line 15 to page 16, line 12;
- the final, added functional feature beginning "so that ..." is disclosed in page 17, lines 17 to 20.

It follows that the amendments to claim 1 do not contravene the requirements of Article 123(2) EPC.

Novelty of the subject-matter of claim 1 with respect to D1

2. Although the Examining Division based its decision on D1 which was published in 1989 and is the publication after examination of an application for a utility model, it appears that it actually supplied to the applicant a copy of JP-U-58 121767 which was published in 1983 and is a publication of the same application before examination and which has identical drawings to D1. The Examining Division did not rely in its decision on any part of the text of either D1 or D1' which is a translation into English of JP-U-58 121767. Since the text of D1' does not contradict any statement made by the Examining Division, the Board will consider the text of D1' as being an integral part of D1.
3. The application relates to a valve for controlling flow of hydraulic fluid. Such a valve is typically used as part of a hydraulically assisted power steering system on a road vehicle in which a fixed displacement pump delivers fluid to a power steering motor having a piston connected to the steering linkage which controls the direction of the steered wheels. The valve comprises a sleeve, hereafter designated as a first

valve member, and a core rotatably mounted within the sleeve, hereafter designated as the second valve member. Each of the first and second valve members has a plurality of lands and grooves that cooperate to regulate fluid pressure within the valve and control flow from the pump to the power steering motor. When the first and second valve members are in a neutral position fluid is communicated generally equally to opposite chambers of the power steering motor. When the first and second valve members are relatively rotated away from the neutral position fluid flow is variably restricted by the cooperation of lands on the respective valve members which define flow gaps of variable size. The restriction of the fluid flow causes the fluid to be delivered at a lower pressure to one of the chambers of the power steering motor than to the other. According to the application noise generation is problematic due to cavitation of the fluid flowing through the flow gaps.

- 3.1 According to the preamble of claim 1 the grooves of the first valve member include inlet passages receiving fluid from the hydraulic pump and first and second supply passages communicating with respective chambers of the motor. The second valve member has a series of passages for returning fluid to a reservoir. Overlap of respective lands when the valve is rotated out of the neutral position results in the flow into a first supply passage being restricted through a first flow gap which converges in the flow direction. Fluid flowing from a second supply passage towards a return passage in the second member is also restricted but passes through a second flow gap which diverges in the direction of flow. Since each flow gap is divergent or

convergent the cross-sectional flow area will be at a minimum at a point along the length of the flow gap.

- 3.2 According to the characterising portion of claim 1, in order to suppress noise the flow gaps are sized such that the minimum cross-sectional area and fluid volume flow rate of the convergent flow gaps are larger than the minimum cross-sectional flow area and fluid volume flow rate for the divergent flow gaps.
4. D1 relates to a valve generally of the type as described under 3.1 above. According to D1 in an earlier prior art valve of this type the angles of divergence and convergence of the flow gaps were determined by the angle of the chamfer provided on the corners of the lands of the second valve member. Cavitation in the divergent flow gap resulted in noise and the solution proposed in D1 was to provide a smaller chamfer angle in the divergent flow gap than in the convergent flow gap.
5. According to the impugned decision the solution proposed by D1 results in the subject-matter of present claim 1 because the sizes of the minimum cross-sectional flow areas in the respective flow gaps are determined by the respective chamfer angles. The Examining Division argues that since the convergent flow gaps comprise larger chamfer angles than the divergent flow gaps there is an implicit disclosure of the characterising feature of present claim 1 that the minimum cross-sectional area and fluid volume flow rate of the convergent flow gaps are larger than the minimum cross-sectional flow area and fluid volume flow rate for the divergent flow gaps. At this point the Board

considers it useful to reiterate the well established case law of the Boards of Appeal that a prior art document destroys the novelty of the subject-matter of a claim only if that subject-matter is clearly and unambiguously derivable from the prior art. It is in the light of this case law that the disclosure of D1 will now be considered in more detail.

- 5.1 The only part of D1 which could serve as any indication of the relative sizes of the minimum flow areas is figures 4 and 5 which are large scale views of the respective flow gaps formed between pairs of lands. There is no indication in D1 that the content of the figures is drawn to scale with the result that, according to case law of the Boards of Appeal, they cannot serve as the basis for measurements (T 204/83 OJ EPO 1985, 310). However, even if the drawings of D1 were to be measured, in the position illustrated in figures 4 and 5 the minimum flow areas are essentially equal. It follows that the condition defined in the characterising portion of present claim 1 is not disclosed in the figures themselves.
- 5.2 The Examining Division's argument appears to be based on the assumption that the respective minimum cross-sectional flow areas in the flow gaps at the position of maximum relative rotation of the valve members of D1, as shown in figures 4 and 5, are essentially equal. The Examining Division has interpreted the subject-matter of the claim as referring to any single position of the valve and the condition defined in the characterising portion of present claim 1 would then be satisfied by D1 whenever that valve is placed in an intermediate rotational position. The question therefore arises

whether the subject-matter of claim 1 is to be interpreted as relating to any single position of the valve members, as stated by the Examining Division, as relating to the position of maximum relative rotation, as stated by the applicant, or whether it is to be understood as a requirement relating to all positions. According to the present application the features of the characterising portion of claim 1 serve to reduce noise generation. However, it is silent as to whether both the problem and the claimed solution relate to any particular relative rotational positions of the valve or to all such positions. When interpreting a claim it should be read in such a way as to make technical sense (see T 190/99 not published in OJ EPO, Reasons 2.4; also the Guidelines C-III, 4.2). In the absence of any clear indication to the contrary the only sensible technical interpretation of the claim is that the defined relationship of flow areas and flow rates be present at all relative rotational positions of the valve.

- 5.3 In order for D1 to destroy novelty of the present claim when interpreted in this way the skilled person would have to inevitably choose to set the flow gap in the condition of D1 figure 4 to be smaller than that in figure 5. The Board is unable to identify any reason why that necessarily would be the case. The teaching of D1 restricts itself to the relative angles of divergence and convergence and is silent as regards the dimensions of the flow gaps either in the position of maximum relative rotation or in any other position.
- 5.4 The Board concludes from the foregoing that D1 does not destroy the novelty of the subject-matter of claim 1.

Novelty of the subject-matter of claim 1 with respect to the remainder of the cited prior art

6. D2 relates to a valve according to the preamble of present claim 1 but in which there is no disclosure as regards the relative sizes of the respective flow gaps. Moreover, the included angles of the convergent flow gaps are smaller than those of the divergent flow gaps. D3 relates to a similar valve but in which the flow gaps formed between the first and second supply passages and the return passages are convergent. Neither D4 nor D5 contains any teaching as regards the relative minimum sizes of the respective flow gaps. According to D6 a valve has convergent flow gaps between the inlet passages and the first and second supply passages. However, the flow gaps between the first and second supply passages and the return passages are not divergent. In the valve according to D7 the flow gaps between both the inlet passage and the first and second supply passages and also between the supply passages and the return passages are divergent. Although in the valve of D8 the flow gaps between the inlet passage and the first and second supply passages are larger than those between the supply passages and the return passages, the flow gaps are formed between parallel surface segments and so are neither convergent nor divergent. Also in the valve according to D9 the respective surface segments of the lands are parallel so that there are no divergent or convergent flow gaps. D10 discloses a valve in which all flow gaps are identical.

6.1 It follows that the subject-matter of claim 1 is novel also with respect to the remainder of the cited prior art. Since the subject-matter of claims 2 to 6 contains all features of claim 1 this conclusion applies equally to those claims.

7. Since the subject-matter of claim 1 according to the main request is novel with respect to all cited prior art it is not necessary to consider novelty of the subject-matter of claim 1 according to the auxiliary request. However, the question of inventive step of the subject-matter of claim 1 according to the main request has not been addressed by the first instance. The Board therefore considers it appropriate to make use of its discretion in accordance with Article 111(1) EPC to remit the case to the first instance for further prosecution.

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 for further prosecution.

The Registrar:

The Chairman:

S. Fabiani

S. Crane