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**D E C I S I O N**  
**of 29 February 2000**

**Case Number:** T 0835/98 - 3.2.1

**Application Number:** 88307639.0

**Publication Number:** 0306180

**IPC:** F16H 7/16

**Language of the proceedings:** EN

**Title of invention:**

Belt tensioner with releasable belt load damping

**Patentee:**

LITENS AUTOMOTIVE INC, et al

**Opponent:**

SKF GmbH

**Headword:**

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**Relevant legal provisions:**

EPC Art. 56

**Keyword:**

"Inventive step (yes)"

**Decisions cited:**

-

**Catchword:**

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Boards of Appeal

Chambres de recours

Case Number: T 0835/98 - 3.2.1

**D E C I S I O N**  
**of the Technical Board of Appeal 3.2.1**  
**of 29 February 2000**

**Appellant I:** SKF GmbH  
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**Representative:** Glanz, Werner  
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**Decision under appeal:** Interlocutory decision of the Opposition Division  
of the European Patent Office posted 25 June 1998  
concerning maintenance of European patent  
No. 0 306 180 in amended form.

**Composition of the Board:**

**Chairman:** F. Gumbel  
**Members:** S. Crane  
J. Van Moer

## Summary of Facts and Submissions

- I. European patent No. 0 306 180 was granted on 25 October 1995 on the basis of European patent application No. 88 307 639.0.
- II. The patent was opposed on the grounds that its subject-matter lacked novelty and/or inventive step (Article 100(a) EPC). Of the state of the art relied upon in the opposition proceedings only that represented by DE-A-3 225 411 (document D1) or its US equivalent US-A-4 473 362 (document D1') has played any role on appeal.
- III. With its interlocutory decision posted on 25 June 1998 the Opposition Division held that the patent could be maintained in amended form.
- IV. Both parties appealed against this decision.

The notice of appeal of the opponents was filed on 18 August 1998 and the fee for appeal paid at the same time. Their statement of grounds of appeal was filed on 16 October 1998. In addition to document D1 the opponents referred to a further prior art document viz. DE-A-2 524 744 (D4).

The notice of appeal of the proprietors of the patent was filed on 4 September 1998 and the fee for appeal paid at the same time. Their statement of grounds of appeal was filed on 30 October 1998.

- V. Oral proceedings before the Board were held on 29 February 2000.

The opponents requested that the decision under appeal be set aside and the patent revoked in its entirety.

The main request of the proprietors was for maintenance of the patent in amended form on the basis of the documents according to Schedule N1, submitted on 29 June 1999, with columns 11 to 14 of the description replaced by the corresponding columns submitted at the oral proceedings. In the alternative they requested maintenance of the patent on the basis of auxiliary requests 1 to 9, also submitted on 29 June 1999.

Independent claims 1 and 18 of Schedule N1 read as follows:

"1. An assembly comprising:-

an internal combustion engine (10) including an engine frame (12) subject to vibrational forces resulting from the operation of said internal combustion engine;

a plurality of shafts (14,40,38,36,34,32) mounted for rotational movement about parallel axes fixed with respect to said engine frame;

a plurality of pulleys (16,30,28,26,24,22) fixed to said plurality of shafts;

one of said plurality of shafts constituting an output shaft (14) of said internal combustion engine (10);

an endless flexible belt (20) of a size capable of being loosely trained about said plurality of pulleys; and

a belt tensioner (42);

said belt tensioner (42) comprising:-

a fixed structure (46) mounted on said engine

frame;

a pivoted structure (68);

a belt tensioning pulley (88) mounted on said pivoted structure for rotational movement about a rotational axis (90);

said pivoted structure (68) being mounted on said fixed structure (46) for pivotal movement about a fixed pivotal axis (80) parallel with said rotational axis (90) between a first position and a second position;

spring means (100) for resiliently biasing said pivoted structure (68) in a direction toward said second position with a spring torque which varies as the position of said pivoted structure (68) approaches said second position, so that said belt tensioning pulley (88) is biased into an intermediate operating static equilibrium position in tensioning engagement with said belt (20) wherein the spring torque is equal and opposite to a belt load torque which varies with the variation in the spring torque as the intermediate operating position approaches said second position due to belt elongation, by maintaining the belt load force generally constant and varying the lever arm distance to said pivotal axis (80) through which the belt load force acts; and

means (60) for damping the pivotal movements of said pivoted structure (68) as a result of dynamic belt load forces varying from the generally constant belt load force when the belt is moving, said damping means (60) including sliding friction surface means (64,66) providing interengaging surfaces arcuate about said fixed pivotal axis (80) and such as to slide relative to one another and define the pivotal movements of said pivoted structure (68) with respect to said fixed structure (46);

said sliding friction surface means (64,66) being arranged to establish a damping torque resistance sufficient to restrict the pivotal movements of said pivoted structure (68), by virtue of the pressure of interengagement of said sliding friction surface means (64,66) and the position of interengagement of said sliding friction surface means (64,66) relative to said pivotal axis (80), to an extent such that in the absence of vibrational forces movements in response to dynamic changes in the belt load force within a range of changes are prevented, said range of belt load force changes extending from the generally constant belt load force to a positive extent wherein the belt load force increases and to a negative extent wherein the belt load force decreases;

characterised in that said interengaging surfaces of said sliding friction surface means (64, 66) are disposed in annularly surrounding relation to said rotational axis (90);

said damping means (60) being operable in response to vibrational forces to instantaneously release the damping torque resistance of the damping means to a level permitting instantaneous pivotal movements in response to dynamic changes in the belt load force, which would otherwise be prevented by said sliding friction surface means (64,66) as being within said range of changes; and the damping means being arranged to establish a damping torque resistance by the belt load force and a reactionary force created thereby in the fixed structure compressing said interengaging surfaces together such that the dominant damping torque resistance of the damping means is proportional to the magnitude of the belt load force."

"18. In a belt tensioner (42) which comprises: a fixed structure (46) mounted on an engine frame (12) of an internal combustion engine (10); a pivoted structure (68); a belt tensioning pulley (88) mounted on said pivoted structure for rotational movement about a rotational axis (90); said pivoted structure (68) being mounted on said fixed structure (46) for pivotal movement about a fixed pivotal axis (80) parallel with said rotational axis (90) between a first position and a second position; spring means (100) for resiliently biasing said pivoted structure (68) in a direction toward said second position with a spring torque which varies as the position of said pivoted structure (68) approaches said second position, so that said belt tensioning pulley (88) is biased into an intermediate operating static equilibrium position when in tensioning engagement with a loosely-trained endless flexible belt (20) of the internal combustion engine (10), wherein the spring torque is equal and opposite to a belt load torque which varies with the variation in the spring torque as the intermediate operating position approaches said second position due to belt elongation, by maintaining the belt load force generally constant and varying the lever arm distance to said pivotal axis (80) through which the belt load force acts; and means (60) for damping the pivotal movements of said pivoted structure (68) as a result of dynamic belt load forces varying from the generally constant belt load force when the belt is moving, said damping means (60) including sliding friction surface means (64,66) providing interengaging surfaces arcuate about said fixed pivotal axis (80) and such as to slide relative to one another and define the pivotal movements of said pivoted structure (68) with respect

to said fixed structure (46);

said sliding friction surface means (64,66) being arranged to establish a damping torque resistance sufficient to restrict the pivotal movements of said pivoted structure (68), by virtue of the pressure of interengagement of said sliding friction surface means (64,66) and the position of interengagement of said sliding friction surface means (64,66) relative to said pivotal axis (80), to an extent such that in the absence of vibrational forces movements in response to dynamic changes in the belt load force within a range of changes are prevented, said range of belt load force changes extending from the generally constant belt load force to a positive extent wherein the belt load force increases, and to a negative extent wherein the belt load force decreases;

the use of vibrational forces for the purpose of instantaneously releasing the damping torque resistance established by the sliding friction surface means (64,66), to a level permitting instantaneous pivotal movements of the pivoted structure (68) in response to dynamic changes in the belt load force, which would otherwise be prevented by the sliding friction surface means (64,66) as being within said range of changes of belt load force;

said interengaging surfaces of said sliding friction surface means (64,66) being disposed in annularly surrounding relation to said rotational axis (90); and

the damping means being arranged to establish a damping torque resistance by the belt load force and a reactionary force created thereby in the fixed structure compressing said interengaging surfaces together, such that the dominant damping torque



resistance of the damping means is proportional to the magnitude of the belt load force."

Claims 2 to 17 and 19 to 23 are dependent on claims 1 and 18 respectively.

VI. The arguments of the opponents in support of their request for revocation of the patent can be summarised as follows:

On a fair reading of document D1 this disclosed not only all the features of the preamble of claim 1 according to the main request, but also, at least implicitly, the second and third features stated in its characterising clause. In particular, it was a generally known engineering technique to reduce the static friction between two surfaces by applying vibrations thereto; it was thus clear to the person skilled in the art that in the belt tensioner disclosed in document D1 the damping torque resistance of the damping means would automatically be released by the vibrations naturally occurring in the engine environment, in fact, a statement to this effect could be found on page 28 (hand-written pagination), at lines 25 to 30. Furthermore, the requirement of document D1 that the damping torque resistance be proportional to the spring torque amounted to the same thing as required by present claim 1, namely that the damping torque resistance be proportional to the belt load force, since the spring torque was dependent on the belt load force.

As a consequence of these considerations the only true distinction between the belt tensioner claimed and that

disclosed in document D1 was the requirement that the sliding friction surface means be disposed in annularly surrounding relation to the rotational axis about which the pulley rotated. Such a configuration was however known from the belt tensioner disclosed in document D4. It was obvious for the person skilled in the art that this space-saving configuration was generally applicable and it needed no inventive step to recognise that the belt tensioner of document D1 could advantageously be made more compact if reconfigured in the manner taught by document D4.

The same arguments applied *mutatis mutandis* to the subject-matter of claim 18.

VII. In reply the proprietors argued substantially as follows:

The belt tensioner of the patent and that disclosed in document D1' differed from each other in a number of significant aspects, both with regard to structure and mode of operation. The basic concept underlying the proposal of document D1' is to make the level of the damping torque resistance proportional to the spring torque so that effective long term operation of the belt tensioner is guaranteed as its belt tensioning pulley is moved to take up lengthening of the belt in service; without this proportionality there would be the danger of excessive damping torque resistance causing pulley hang-up. In contrast thereto the present invention provided that the dominant damping torque resistance was proportional to the belt load force and was set at a relatively high level by virtue of the fact that the sliding friction surface means of the

damping means operated with a greater effective lever arm than did the tensioning pulley. In normal circumstances pivotal movement of the pivoted structure carrying the tensioning pulley was therefore prevented, thus reducing wear; the pivoted structure would however be instantaneously freed for movement where this was necessary to give damping during resonance and to avoid hang-up with a slack belt by virtue of vibrational forces, in particular those naturally occurring in an internal combustion engine, reducing the damping torque resistance.

There was nothing in document D4 which could lead the person skilled in the art to modify the belt tensioner of document D1 in the direction taken by the invention. In particular, document D4 did not disclose damping means which produced a damping torque resistance which was proportional to the belt load force.

### **Reasons for the Decision**

1. The respective appeals of the opponents and the proprietors of the patent both comply with the requirements of Articles 106 to 108 and Rules 1(1) and 64 EPC. They are therefore admissible.
  
2. *Formal admissibility of the amended documents*  
(*main request*)

Claim 1 according to the main request has been derived from granted claim 1 by the transfer of some features from the characterising clause to the preamble and by

the addition of features specifying more precisely the nature and disposition of the sliding friction surface means, taken from granted claim 3, and the manner in which the dominant damping torque resistance is generated, taken from the description. With the content of granted claim 1 corresponding in essence to that of claim 1 as originally filed and that of granted 3 being derived from claims 13 and 14 as originally filed, it is apparent that present claim 1 according to the main request complies with the requirements of both Articles 123(2) and (3) EPC. This has not been put in question by the opponents.

Amendments corresponding to those made in claim 1 have been made to present claim 18 in comparison with granted claim 19 and similar considerations concerning the requirements of Articles 123(2) and (3) EPC apply. Although the Board has some reservations about the necessity for such a claim, which it understands as being directed in effect to a method of tensioning a belt using a belt tensioner as defined in claim 1, wherein vibrational forces play a particular role, opposition appeal proceedings would not be the appropriate forum for addressing this aspect of the claims with regard to the requirement of Article 84 EPC that they be concise. The same applies to the dependent claims, some of which might be considered redundant or unduly repetitive.

3. *Technological background*

Self-adjusting belt tensioners for the belt drive systems of internal combustion engines are well known. Typically, such a belt tensioner comprises a pivoted

structure which carries a belt tensioning pulley and which is biased by a torsion spring in a direction tending to take up slack in the belt. Although the spring torque will decrease as the pivoted structure is moved in this direction as the belt lengthens during service, the belt load force and hence belt tension are held substantially constant by arranging the pulley in such a way that the lever arm through which the belt load force acts decreases in the same direction. Periodic dynamic belt load force variations as a consequence of the normal operation of the engine could lead to disastrous resonant vibratory movement of the pulley if no appropriate measures were taken. To avoid this means for damping movement of the pivoted structure are therefore provided.

One such proposal is to be found in document D1' on which the preamble of present claim 1 is based and which was already discussed extensively in the introductory description of the original application. (Since there has been no suggestion that there is any significant difference in the technical content of the documents D1 and D1', further reference will only be made to the latter.)

The basic design principle on which the belt tensioner of document D1' is based is explained in column 3, lines 43 to 66: The aim is to provide sufficient damping to avoid resonance over the whole working range without the risk of pulley hang-up due to excessive damping torque resistance; the proposed solution is to make the damping torque resistance proportional to the spring torque.

In practice, a cylindrical mounting portion of the pivoted structure of the belt tensioner according to document D1' is pivotally mounted on a fixed shaft via a damping body of elastomeric material or nylon, depending on the frequency and amplitude of the vibrations which are expected to be encountered. The pivoted structure takes the form of an arm extending from the mounted portion on the free end of which arm there is mounted the belt tensioning pulley. The mounting portion of the pivoted structure is surrounded by the turns of a coil spring which acts to apply the required torque to the pivoted structure. The arrangement of this spring is that it will undergo lateral movement under the influence of a lateral force which is proportional to the spring torque and accordingly apply a corresponding force to the interengaging sliding surfaces of the mounting portion of the pivoted structure, the damping body and the fixed shaft, thus generating a damping torque resistance which is proportional to the spring torque.

4. *The claimed invention; inventive step (main request)*

According to the proprietors of the patent, cf. column 2, lines 19 to 43, of the patent specification, the proposal of document D1' entailed limiting the damping torque to a level which allowed a significant amount of pulley movement during normal operation, which resulted in excessive wear and a shortened service life. In contrast thereto their patent aims to provide a belt tensioner wherein the damping torque resistance is normally maintained at such a high level that for the bulk of its service there is no pulley movement and hence no wear of the associated sliding

friction surfaces; where however pulley movement is required, the damping torque resistance is automatically released to allow this movement to occur.

In structural terms the underlying idea of the claimed invention is achieved by a combination of two measures. Firstly, the radius of the arcuate sliding friction surfaces which define the pivotal movements of the pivoted structure is increased to the extent that these surfaces are disposed in annularly surrounding relation to the rotational axis of the belt tensioning pulley. In other words, the effective lever arm for the frictional force generated between these surfaces is made greater than the distance between the rotational axes of the pivoted structure and the belt pulley and hence the lever arm for the belt load force tending to pivot the pivoted structure. Secondly, the dominant damping torque resistance is made proportional to the magnitude of the belt load force.

Now, the opponents argue that the second of those requirements is already implicitly present in the construction of document D1'. The Board cannot agree. Certainly, as conceded by the proprietors of the patent, there will indeed be an element of the overall damping torque resistance offered by the damping means of document D1' which will be proportional to the belt load force. This follows from the fact that the belt load force is transmitted from the mounting portion of the pivoted structure to the fixed shaft via the damping body, the outer and inner surfaces of which are fictionally engaged with the mounting portion and the fixed shaft respectively. It is therefore apparent that there will be a frictional force generated between

these surfaces by virtue of the belt load force and which is proportional thereto. It is also evident, although nothing is said about this in document D1' itself, that this frictional force will make a contribution to the overall damping torque resistance. It is however equally clear, given the prime aim of document D1' of having a damping torque resistance which is proportional to the spring torque and the special technical means adopted to achieve this end, that that part of the overall damping torque resistance which is proportional to the belt load force cannot be the dominant one, as in the claimed invention. Additionally or alternatively the opponents have also argued that the spring torque is dependent on the belt load force so that the proportionality aimed at in document D1' amounts to the same thing as that envisaged in the present patent. However, as already mentioned in general terms above (and defined in the preamble of present claim 1) the basic set up is designed to maintain the belt load force substantially constant as the spring torque decreases, so that a linear dependence between the two, as suggested by the opponents, is clearly not given.

Furthermore, there is nothing in document D4 which could suggest to the person skilled in the art that it could be advantageous to provide a damping torque resistance to movement of the pivoted structure of a belt tensioner which was proportional to the belt load force. Where the belt tensioner of document D4 does have more resemblance with that of the present patent than does the belt tensioner of document D1' is in its overall compact configuration wherein the rim of the belt pulley surrounds the pivoted structure. The



provision of frictional damping means between the pivoted structure and the fixed structure is mentioned in general terms in document D4, but not shown in the drawings. One possibility mentioned is the provision of a friction ring and a cup spring between the two structures. It is however apparent that neither in this proposal, nor in any of the other possibilities mentioned, would the belt load force act through the sliding friction surfaces in such a way as to generate a damping torque resistance which was in any way dependent on the belt load force. In this context the opponents have also argued that a damping torque would in any case be generated between the bearing surfaces of the pivoted and fixed structures, since there would certainly be some friction here, and this torque would be inevitably proportional to the belt load force. But even if that is the case then it is clearly apparent that any contribution made by the bearing surfaces to the overall damping torque resistance will be relatively insignificant in comparison with the contribution of the means specifically provided for this purpose.

Returning to the first of the structural measures mentioned above, the disposition of the sliding friction surfaces in annularly surrounding relation to the rotational axis of the belt tensioning pulley, the opponents again rely on document D4 as showing that this was something already known in the art. Here the Board can agree, at least in general terms. However, nothing can be drawn from document D4 which could indicate that this arrangement could be of advantage in providing a relatively high level of damping torque resistance.

Summing up the Board therefore comes to the conclusion that the person skilled in the art would have had no incentive, on the basis of what is taught by document D4 or any other general considerations, to replace what is after all the central idea of document D1' of having the damping torque resistance proportional to the spring force by an arrangement wherein it is proportional to the belt load force and to increase the relative level of this damping torque resistance by having the sliding friction surfaces of the damping means surround the rotational axis of the belt pulley. Thus on the basis of these structural features alone the Board is satisfied that the subject-matter of claim 1 cannot be derived in an obvious manner from the state of the art and accordingly involves an inventive step (Article 56 EPC). In these circumstances the Board sees no need to investigate fully the extent to which the functional statement in the characterising clause of claim 1 concerning the way the damping means is released by vibrational forces is capable in itself of providing a clear distinction over the prior art according to document D1'. In this context the opponents have referred in particular to the passage in column 11, lines 18 to 23, of document D1' where it is stated that the vibrational environment of the engine tends to cause the damping body to assume a torsionally unstressed condition. The proprietors of the patent on the other hand point to the following sentence at column 11, lines 23 to 26 as meaning that there is no instantaneous release of the damping means in the sense of their invention but merely a gradual release of stress in the damping body. Both arguments are not without force; for the reasons stated above, however, the conflict does not need to be resolved.

Insofar as the subject-matter of independent claim 18 is predicated upon the existence of a belt tensioner with the structural features set out in claim 1 and discussed above, it is evident that this subject-matter also must be considered as involving an inventive step.

## **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 in amended form on the basis of the following documents:

**Claims:** 1 to 23 according to Schedule N1 filed on 29 June 1999;

**Description:** columns 1 to 10 and 15 according to Schedule N1 filed on 29 June 1999 and columns 11 to 14 submitted at the oral proceedings;

**Drawings:** as granted.

The Registrar:

The Chairman:

S. Fabiani

F. Gumbel