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**DECISION**  
of 4 November 2003

**Case Number:** T 0940/01 - 3.2.1

**Application Number:** 99202470.3

**Publication Number:** 1089013

**IPC:** F16G 5/16

**Language of the proceedings:** EN

**Title of invention:**

Drive belt and transmission wherein such is used

**Applicant:**

Van Doorne's Transmissie B.V.

**Opponent:**

-

**Headword:**

-

**Relevant legal provisions:**

EPC Art. 56

**Keyword:**

"Inventive Step (yes, after amendment)"

**Decisions cited:**

-

**Catchword:**

-



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Boards of Appeal

Chambres de recours

Case Number: T 0940/01 - 3.2.1

**D E C I S I O N**  
of the Technical Board of Appeal 3.2.1  
of 4 November 2003

**Appellant:** Van Doorne's Transmissie B.V.  
Dr. Hub van Doorneweg 120  
NL-5026 RA Tilburg (NL)

**Representative:** -

**Decision under appeal:** Decision of the Examining Division of the  
European Patent Office posted 2 March 2001  
refusing European application No. 99202470.3  
pursuant to Article 97(1) EPC.

**Composition of the Board:**

**Chairman:** S. Crane  
**Members:** J. Osborne  
G. E. Weiss

## Summary of Facts and Submissions

I. The appeal is directed against the decision of the Examining Division posted 2 March 2001 refusing European patent application 99 202 470.3.

II. The following prior art was cited in the search report:

D1 S. Ashley, "Is CVT the car transmission of the future?", Mechanical Engineering, November 1994, 64-68

D2 EP-A-0 522 612

D3 EP-A-0 798 492.

The Examining Division was of the opinion that the subject-matter of claim 1 then on file lacked inventive step in the light of the disclosure of D1.

III. During oral proceedings held 4 November 2003 the appellant (applicant) requested that the impugned decision be set aside and that a patent be granted on the basis of the following documents:

- claims 1 to 3 and description submitted at the oral proceedings;
- drawings as originally filed.

IV. Claim 1 according to the appellant's request reads:

"Drive belt (7) for a continuously variable transmission (1) for motor vehicles comprising a number of radially stacked endless bands forming a laminated ring (16) slidably supported by a number of cross

elements (15), the bands being provided in two laminated rings (16) that are mutually axially spaced, the elements (15) each having two principle faces (17) oriented substantially transverse to the longitudinal direction of the drive belt (7), the principal faces (17) of the cross elements (15) have a substantially trapezoidal section and the cross elements (15) having a width B and a specific weight  $\rho$ , characterised in that the said number of radially stacked endless bands in a laminated ring (16) is 14 or 15 and the parameters of the width B and the specific weight  $\rho$  satisfy the equation:  $B^2 \cdot \rho = 9 \text{ kg/m.}''$

Claims 2, 3 relate to features additional to those contained in claim 1.

v. The appellant essentially argued as follows:

The subject-matter of claim 1 has been restricted to a belt for typical passenger car applications by defining the number of bands as 14 or 15. As evidenced by D1 it was known before the present application to provide drive belts for continuously variable transmissions for passenger cars, which were either 24mm or 30mm wide and had either 9 or 12 bands. The skilled person faced with the disclosure of D1 would expect that the torque capacity of the transmission could be increased in correspondence with increases both in the number of bands in the belt and in the width of the elements. The equation contained in claim 1 is the result of an insight into the fact that when the width of a drive belt of a given material is increased beyond a certain value the torque transmitting capacity not only does not increase correspondingly but actually falls. The

skilled person beginning with the disclosure of D1 and wishing to provide for greater torque transmission would increase the width of the belt to a value larger than that corresponding to present claim 1 and so go beyond the optimum value.

## Reasons for the Decision

### *Amendments*

1. The essential amendments of claim 1 in comparison with the claim as originally filed and the basis therefor in the application as originally filed are as follows:
  - a number of radially stacked endless bands forming a laminated ring ... two laminated rings that are mutually axially spaced, see claims 5, 6;
  - the principal faces of the cross elements have a substantially trapezoidal section, see claim 9;
  - the number of radially stacked endless bands in a laminated ring is 14 or 15, see claim 8;
  - $B^2 \cdot \rho = 9 \text{ kg/m}$ , see page 4, lines 25 to 28 where the value of 9 kg/m is given and in which this is stated as providing a drive belt with maximum torque transmitting capacity.

1.1 The subject-matter of claims 2, 3 is disclosed in original claims 9 and 10. The description has been amended essentially only to delete subject-matter for consistency with the claims.

1.2 From the above it follows that the requirements of Article 123(2) EPC are satisfied.

*Inventive step*

2. D1 is the most relevant prior art and is an article relating to the development of continuously variable transmissions (CVTs). It is explained in D1 that modern CVTs comprise belts which consist of an endless train of thin metal elements held together by radially stacked spring steel bands passing through slots in the elements. The elements comprise a trapezoidal shaped portion, the inclined faces of which co-operate with the inner surfaces of pulley sheaves around which the belt passes. The two halves of each sheave are forced together in order to create a frictional force against the inclined faces of the elements and thereby enable the transmission of force into the belt. The principle faces of the elements are arranged transverse to the longitudinal direction of the belt and the belt transmits force from the driving sheave to the driven sheave along a series of elements subjected to a compressive force forming the elements into a rigid column. Under the influence of the force applied from the pulley sheaves to the inclined surfaces of the trapezoidal portions the elements are forced radially outwards and the bands are tensioned and support the elements on the return run of the belt from the driven sheave to the driving sheave.

2.1 D1 gives details of two specific applications of CVTs in passenger cars. In one application the belt comprises 24mm wide elements and two sets of ten bands whilst in the other 30mm wide elements are combined with two sets of twelve bands, providing a torque capacity of 300Nm. A further belt, for a commercial vehicle, has a width of 40mm and a torque capacity of 400Nm. The Board is satisfied that the restriction of the subject-matter of present claim 1 to a belt having at most 15 bands limits it to belts suitable for use in passenger cars.

2.2 The subject-matter of claim 1 differs from any belt disclosed in D1 by comprising 14 or 15 bands and by the belt width and material satisfying the relationship  $B^2 \cdot \rho = 9 \text{ kg/m}$ . For steel the value of  $\rho$  is approximately  $7800 \text{ kg/m}^3$ , resulting in a value for B according to the claimed relationship of approximately 34mm.

2.3 The ability of the bands to withstand the tensile force limits the frictional force which can be created between the sheaves and the belt and so limits the maximum force and therefore torque which can be transmitted. The cross-sectional area of the bands is therefore an important factor in determining the capacity of a particular belt. The maximum thickness of each band is limited by the flexibility necessary to adopt the minimum operating radius around the sheaves. It is possible to increase the cross-sectional area of the bands by increasing their width but this necessitates a corresponding increase in the width of the elements. In the description of the present application it is explained that an increase in the

width of the elements requires a corresponding increase in both their thickness and their height in order to maintain resistance to buckling. The thickness of the elements has no influence on the mass of the belt because it is of fixed length. However, the increase in height of the elements increases the mass of the belt and therefore also the centrifugal force acting on it. As a result, the positive contribution to torque transmission capacity achievable by increasing the width of the bands is offset by an increase in the centrifugal force acting on the belt and according to the application these conflicting effects are of a similar order. As a result there is an optimum belt width above which the linear influence due to increasing band width is outweighed by the quadratic influence resulting from an increase in both the width and the height of the elements. It is this insight into the conflicting influences to which the belt is subjected which underlies the subject-matter of present claim 1.

- 2.4 As the appellant rightly argues the skilled person faced with the disclosure of D1 would expect that each increase in belt width would correspondingly increase the torque transmission capacity. The skilled person striving for a given increase in torque transmission capacity would not perform a series of tests using incrementally increasing belt widths but would widen the belt by an amount commensurate with the desired torque transmission capacity. He therefore would not find the optimum value by routine trial and error testing.



2.5 D2 relates to the relationship of some dimensions of the principal faces of CVT push belt elements but includes no teaching as regards the width of the belt or torque transmission capacity. D3 relates to increasing torque transmission in a CVT by optimizing the angles of the inclined surfaces of the trapezoidal portions. None of the cited prior art contains any suggestion to lead the skilled person away from his conventional expectations as regards the relationship between belt width and torque transmission capacity.

2.6 The subject-matter of claim 1 involves therefore an inventive step (Article 56 EPC). Since claims 2 and 3 contain all features of claim 1 this conclusion applies equally to those claims.

**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 grant the patent on the basis of the following documents:
  - claims 1 to 3 and description submitted at the oral proceedings;
  - drawings as originally filed.

The Registrar:



S. Fabiani

The Chairman:



S. Crane

