

Internal distribution code:

- (A) [] Publication in OJ
(B) [] To Chairmen and Members
(C) [X] To Chairmen
(D) [] No distribution

D E C I S I O N
of 22 April 2004

Case Number: T 0093/02 - 3.2.1

Application Number: 92105326.0

Publication Number: 0506096

IPC: B61C 9/48

Language of the proceedings: EN

Title of invention:

Gear drive device for railway motor car

Patentee:

MITSUBISHI DENKI KABUSHIKI KAISHA

Opponent:

ABB Daimler-Benz Transportation (Technology) GmbH

Headword:

-

Relevant legal provisions:

EPC Art. 54, 56

Keyword:

"Novelty (yes)"
"Inventive step (yes)"

Decisions cited:

-

Catchword:

-



Case Number: T 0093/02 - 3.2.1

D E C I S I O N
of the Technical Board of Appeal 3.2.1
of 22 April 2004

Appellant:
(Opponent) ABB Daimler-Benz
Transportation (Technology) GmbH
Saatwinkler Damm 43
D-13627 Berlin (DE)

Representative: Karlhuber, Mathias
COHAUSZ & FLORACK
Patent- und Rechtsanwälte
Bleichstrasse 14
D-40211 Düsseldorf (DE)

Respondent: MITSUBISHI DENKI KABUSHIKI KAISHA
(Proprietor of the patent) 2-3, Marunouchi 2-chome
Chiyoda-ku
Tokyo-to, 100 (JP)

Representative: Popp, Eugen, Dr.
MEISSNER, BOLTE & PARTNER
Widenmayerstrasse 48
D-80538 München (DE)

Decision under appeal: Decision of the Opposition Division of the
European Patent Office posted 16 November 2001
rejecting the opposition filed against European
patent No. 0506096 pursuant to Article 102(2)
EPC.

Composition of the Board:

Chairman: F. J. Pröls
Members: J. Osborne
A. Pignatelli

Summary of Facts and Submissions

I. The appeal is directed against the decision dated 16 November 2001 to reject the opposition to European patent No. 0 506 096 in which the patent had been opposed on the grounds of lack of novelty and lack of inventive step (Article 100(a) EPC).

II. The following prior art played a role during appeal:

E1: DE-C-566 042

E2: CH-A-334 505

E4: *I. Johansson et al*, "Development of gears for narrow-gauge railway vehicles", ASEA Journal LX(3-4) 1987, 22-25.

III. In oral proceedings held 22 April 2004 the appellant requested that the decision under appeal be set aside and that the patent be revoked. The respondent requested that the appeal be dismissed and that the patent be maintained on the basis of claims 1 to 4 as presented during the oral proceedings.

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

"Gear drive device for a railway motor car comprising: a larger gear (24) fixed on an axle (19) which is rotatably supported on a frame (18) of a bogie (12); a traction motor (21) suspended on said axle (19) and said frame (18);

a smaller gear (23) fixed on a rotary shaft (22) of said traction motor (21) and engaged with said larger gear (24);

tooth traces of either one of said smaller or larger gears (23, 24) having a crowning defined by a radius of curvature (R_{c12});

wherein the tooth traces of the teeth (23e, 24b) of said smaller gear (23) and said larger gear (24) respectively are adapted to engage in parallel arrangement when the center axis (24a) of the larger gear (24) has an inclination (α) due to deflection of the axle (19) under the load due to the weight of said railway motorcar under the condition that the gear device is in no-load;

wherein the tooth trace of either one of said smaller gear (23) and said larger gear (24) is twisted by the amount of said inclination (α) to provide said parallel arrangement."

Claims 2 to 4 define features additional to the subject-matter of claim 1.

V. The appellant's submissions can be summarised as follows:

The subject-matter of claim 1 lacks novelty with respect to the disclosure of E4. As derivable from figure 1, this article discloses a gear drive device generally of the type defined in present claim 1. The section on page 24 headed "Tooth form" refers to figure 7 and relates to the form of the teeth of the smaller and larger gears. E4 explains that deflection of the shafts in general affects the meshing of the gear teeth and figure 7 shows that the trace of a tooth

on the smaller gear has, in addition to crowning, an angular deflection. With a railway vehicle of sufficiently high weight the angular deflection would correspond to the twisting defined in present claim 1.

Alternatively, the subject-matter of present claim 1 lacks an inventive step in the light of the prior art acknowledged in the patent specification when considered together with the disclosure of E2. The patent specification acknowledges with reference to figures 7 to 13 that it was previously known for railway car drive devices of the type to which present claim 1 relates to comprise crowning on the teeth of the gears. In these prior art arrangements the gears suffered misalignment as the result of bending of the axle carrying the weight of the railway car and bending of the motor shaft under driving loads. Whereas the effect of the former is constant that of the latter is variable in both magnitude and direction and the crowning must be able to allow for a large degree of misalignment. In order to optimise the gear contact conditions for both directions of rotation of the motor the skilled person would separate the two effects. E2 acknowledges prior art in which the teeth of the smaller gear are twisted in order to bring the tooth traces of the respective gears into a parallel arrangement. Although this was intended to solve the problem of variable misalignment resulting from the application of motor torque, the skilled person would realise that this would only be optimal for a single degree of misalignment. He would thereby become aware that this solution would be effective to correct the constant misalignment resulting from the weight of the vehicle.

In a further alternative the subject-matter of present claim 1 lacks an inventive step on the basis of reasoning similar to the above in the light of the prior art acknowledged in E1 when considered together with the acknowledgment of prior art in E2.

VI. The respondent rebutted the appellant's arguments essentially as follows:

The angular deviation shown in figure 7 of E4 is that caused by asymmetrical crowning and there is no disclosure that the tooth trace is twisted relative to the gear wheel. The subject-matter of claim 1 therefore is novel.

E1 and E2 disclose similar solutions to similar problems arising from the application of variable motor torque and there is no suggestion to separate the two components of shaft deflection as in present claim 1. Moreover, the prior art acknowledged in E2 does not twist the tooth traces to provide a parallel arrangement but merely provides a tapering tooth. E1 teaches the opposite of the subject-matter of present claim 1 in as far as the gear teeth are not in a parallel arrangement when no drive load is applied. None of the prior art discloses that the radius of the crowning can be increased by the presently claimed features which provide for independent compensation for the constant and variable components of deflection.

Reasons for the Decision

1. The subject-matter of present claim 1 is a railway gear drive device having so-called "nose suspension" of an integral motor/gear unit in which the motor is suspended on the driving axle. A smaller gear mounted on the end of the motor shaft engages with a second, larger gear on the axle. Reaction forces acting on the teeth of the smaller gear during application of torque tend to bend the motor shaft and thereby cause a misalignment of the gear teeth to an extent and in a direction which varies according to the application of the torque. The weight of the railway car is supported on the axle at positions laterally spaced from where the wheels are mounted. The resulting moment of force causes bending of the axle and corresponding misalignment of the teeth of the respective gears in a constant direction. The misalignment between the meshing gears due to the bending of the axle under the influence of the weight of the railway car may be increased or decreased upon the application of torque, depending on the direction of application. Misalignment can result in damage to the teeth, particularly the corners. It is acknowledged in the patent specification that a known solution to this problem was to apply crowning to the traces of the gear teeth. However, the necessity to accommodate a situation in which the respective misalignments are additive requires that the tooth trace be provided with a relatively small radius, thereby resulting in a relatively high contact pressure.

Novelty

2. E4 relates generally to development work performed on gears for narrow-gauge track vehicles, particularly in a "nose-suspension" propulsion unit. It discloses with reference to a figure 7 some details regarding the tooth form necessary to satisfy the demands placed on the gears by the compact arrangement of such a propulsion unit. In the final two paragraphs of page 24 it is stated: "Deflection of the shafts influences tooth mesh. As regards the motor shaft the deflection varies with the motor load and also with the direction of rotation ... the normal tooth form must be corrected to assure a good mesh. Fig. 7 shows an example of such corrections."

2.1 Figure 7 is a perspective view in which it can be seen that the traces on both sides of the tooth incorporate both crowning and an "angular correction". The gear tip is wider at one side of the gear than at the other and the total change in profile between the original form illustrated in dashed lines and the corrected form in full lines is the same on both sides of the tooth whereby the "angular correction" on each side of the tooth is in an opposite direction, i.e. the tooth has the general cross-section of an isosceles trapezium. However, it is not important whether the "angular correction" is the result of asymmetrical crowning, as argued by the respondent, or whether it is additional to the crowning because it is neither clearly explained nor is there any disclosure that it twists the tooth trace to provide a parallel arrangement of the teeth when the gear drive device is in a no-load condition, as required by present claim 1.

2.2 The Board concludes from the foregoing that the subject-matter of claim 1 is novel (Article 54(2) EPC).

Inventive step

3. In a first approach the appellant argues that the subject-matter of present claim 1 is obvious when beginning from the prior art acknowledged with reference to figures 7 to 13 in the specification of the contested patent. The content of this acknowledgement has been summarised under 1 above and the subject-matter of present claim 1 differs from that prior art by the features that:

- the tooth traces of the teeth of the smaller gear and the larger gear are adapted to engage in parallel arrangement when the centre axis of the larger gear has an inclination due to deflection of the axle under the load due to the weight of the railway motor car under the condition that the gear device is in no-load; and
- the tooth trace of either one of the smaller and larger gears is twisted by the amount of the inclination to provide the parallel arrangement.

These features have the effect that the crowning need only accommodate misalignment as the result of the application of torque and that its radius of curvature therefore may be increased by comparison with the prior art arrangement. This solves the problem of reducing the contact stress on the gears.

3.1 The appellant argues that the skilled person would strive to separate the constant and variable components of the misalignment between the gears and, given that the crowning provides a solution for the variable component, would adopt the solution acknowledged as earlier prior art in E2 in respect of the constant component. However, in the Board's opinion this argumentation results from an *ex-post* analysis of the situation. The acknowledgment of the prior art in the present patent specification was presented as an explanation of the contested invention and was not available to the skilled person before the publication of the application for the present patent and none of the prior art documents referred to by the appellant includes a similar analysis referring to constant deflection of the vehicle axle.

3.2 E2 also relates to a railway gear drive device having "nose suspension". The disclosure of E2 initially refers to an earlier prior art arrangement of this type in which misalignment between the driving gears was caused by the reaction force between the gears taking up play in the respective bearings of the motor shaft and drive device supports. According to that earlier prior art proposal the profile of the meshing teeth was changed in such a way that they engaged over their entire width when subjected to load. The parties disagree as to how the profile was changed but this point is not of consequence in the present case because in that earlier prior art arrangement the gears were parallel when transmitting torque whereas the presently claimed arrangement requires that the gears be parallel when in a no-load condition, i.e. when they are not transmitting torque. Moreover, the earlier prior art

arrangement relates to misalignment between the gears caused by the take-up of play in bearings which, unlike misalignment due to bending of the motor shaft, is largely independent of the degree of torque transmitted by the gears but nevertheless occurs when the motor applies torque. By contrast, the feature in present claim 1 which the appellant argues to be obvious in the light of the content of E2 concerns misalignment which is present without the application of motor torque (cf. claim 1: "under the condition that the gear device is in no-load"). It follows that the solution to the problem as disclosed in the discussion of the earlier prior art in E2 was different to that presently claimed.

4. In a second approach the appellant argues when beginning from earlier prior art acknowledged in the first part of the description of E1 that the subject-matter of present claim 1 is rendered obvious by the acknowledgement of earlier prior art in E2 (as discussed in 3.2 above). The earlier prior art acknowledged in E1 relates to the provision of crowning in order to accommodate misalignment between the gears resulting from the application of driving torque. There is no mention of the effects of bending of the vehicle axle due to the vehicle's weight. The skilled person therefore receives no teaching to separate the constant component of the gear misalignment due to the weight of the railway vehicle from the variable component due to the driving torque. Moreover, as already reasoned under 3.2 above, the disclosure of earlier prior art in E2 is such that it would not provide the solution presently claimed.

5. The teaching of each of E1 and E2 is primarily directed not to the acknowledgement of earlier prior art but to the respective inventions according to those documents. However, both documents relate exclusively to the avoidance of misalignment caused by the application of torque and both propose that the gears be arranged in a misaligned condition when under no-load and so teach away from the solution according to present claim 1.

6. The Board concludes from the foregoing that the subject-matter of claim 1 involves an inventive step (Article 56 EPC). Since claims 2 to 4 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 maintain the patent on the basis of the following documents:
 - claims 1 to 4 and description as presented at the oral proceedings;

 - drawings as granted.

The Registrar:

The Chairman:

S. Fabiani

F. Pröls