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Datasheet for the decision of 19 September 2019

Case Number: T 1320/15 - 3.2.06

Application Number: 09000166.0

Publication Number: 2078829

IPC: F01L1/047, F01L1/053, F16H53/02

Language of the proceedings: EN

Title of invention:
Camshaft apparatus

Patent Proprietor:
JTEKT Corporation

Opponent:
ThyssenKrupp Presta TecCenter AG

Headword:

Relevant legal provisions:

Keyword:
Inventive step - main request (no); auxiliary request 4 (yes)
Amendments - added subject-matter - auxiliary request 1 (yes)
Claims - clarity - auxiliary requests 2 and 3 (no)

Decisions cited:

Catchword:

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Boards of Appeal

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Case Number: T 1320/15 - 3.2.06

D E C I S I O N
of Technical Board of Appeal 3.2.06
of 19 September 2019

Appellant: (Patent Proprietor)	JTEKT Corporation 5-8, Minamisemba 3-chome Chuo-ku, Osaka-shi Osaka 542-8502 (JP)
Representative:	Hoefer & Partner Patentanwälte mbB Pilgersheimer Straße 20 81543 München (DE)
Respondent: (Opponent)	ThyssenKrupp Presta TecCenter AG Wirtschaftspark 37 9492 Eschen (LI)
Representative:	Lorenz, Bernd Ingo Thaddeus Andrejewski - Honke Patent- und Rechtsanwälte Partnerschaft mbB An der Reichsbank 8 45127 Essen (DE)
Decision under appeal:	**Decision of the Opposition Division of the European Patent Office posted on 14 April 2015 revoking European patent No. 2078829 pursuant to Article 101(3)(b) EPC.**

Composition of the Board:

Chairman	M. Harrison
Members:	M. Hannam
	E. Kossonakou

Summary of Facts and Submissions

I. An appeal was filed by the appellant (patent proprietor) against the decision of the opposition division revoking European Patent No. 2 078 829, in which it found that the subject-matter of claim 1 according to each of a main request and auxiliary requests 1 to 3 did not involve an inventive step.

II. With its grounds of appeal, the appellant requested that the decision be set aside and the patent be maintained according to a main request or, in the alternative, according to one of auxiliary requests 1 to 4.

III. The respondent (opponent) requested that the appeal be dismissed.

IV. The following documents are relevant to the present decision:

E1 EP-A-1 860 338

V. The Board issued a summons to oral proceedings and a subsequent communication containing its provisional opinion, in which it indicated *inter alia* that the subject-matter of claim 1 appeared not to involve an inventive step. It furthermore indicated that the subject-matter of claim 1 of each of auxiliary requests 1 and 3 failed to meet the requirement of Article 123(2) EPC and that claim 1 of auxiliary request 2 lacked clarity.

VI. Oral proceedings were held before the Board on 19 September 2019. The final requests of the parties

were unchanged from those indicated above.

VII. Claim 1 of the main request reads as follows:

"A camshaft apparatus comprising:
a shaft case (40);
a camshaft (2) surrounded by the shaft case (40) so as not to contact with the shaft case (40);
a pulley (9) attached to the camshaft (2);
a plurality of cams (3A-3D) which are aligned on an outer circumferential surface of the camshaft (2) at predetermined intervals in an axial direction to define inter-cam outer circumferential surface areas on the outer circumferential surface between the adjacent cams (3A-3D);
a single main ball bearing (5) which includes an inner ring (5a) fixed to the outer circumferential surface of the camshaft (2) and having a groove-shaped raceway surface, an outer ring (5b) fixed to an inner circumferential surface of the shaft case (40) and including a groove-shaped raceway surface, and balls (5c) which are disposed so as to fit in groove shaped raceway surfaces of the inner (5a) and outer (5b) rings; and
a plurality of roller bearings (4) which are disposed in at least part of the inter-cam outer circumferential surface areas, wherein each of the roller bearings (4) includes an outer ring (4b) fitted in the inner circumferential surface of the shaft case (40) and having a raceway surface, and rollers (4c) disposed in such a manner as to be in contact with the raceway surface and the corresponding inter-cam outer circumferential surface area,
characterized in that
the main ball bearing (5) is provided on the camshaft (2) in the position lying between the pulley (9) and

the cam (3A) of the plurality of cams (3A-3D) which is situated closest to the pulley (9),
wherein the camshaft (2) is made of a material having a different linear expansion coefficient from that of the shaft case (40), and
an axial relative displacement of the camshaft (2) relative to the shaft case (40) due to a difference in the linear expansion coefficient between the camshaft (2) and the shaft case (40) is absorbed by a relative sliding movement of the rollers (4c) on the inter-cam outer circumferential surface areas."

Claim 1 of auxiliary request 1 reads as for claim 1 of the main request with the following differences:

The word 'and' is deleted from the end of the expression 'wherein the camshaft (2) is made of a material having a different linear expansion coefficient from that of the shaft case (40), and', the following feature then being appended to the claim:

"and wherein the raceway surface of the outer ring (4b) of each of the roller bearings (4) has a diameter smaller than that of the groove-shaped raceway surface of the outer ring (5b) of the main ball bearing (5)."

Claim 1 of auxiliary request 2 reads as for claim 1 of the main request with the following features appended:

"wherein the roller bearings (4) are disposed on the inter-cam outer circumferential surface areas in such a manner as to produce axial displacement absorbing gaps (CL) relatively between the cams (3A - 3D) which define the inter-cam outer circumferential surface area and the outer ring (4b),
wherein the axial displacement absorbing gaps (CL)

which are defined between the cams and the outer ring (4b) are set to such a magnitude that the relative displacement amount at the portion of the camshaft (2) which corresponds to the roller bearing (4) lying farthest away from the main ball bearing (5) can be absorbed sufficiently, and
wherein the main ball bearing (5) is such as to form an axial displacement restraining point relative to the camshaft."

Claim 1 of auxiliary request 3 reads as for claim 1 of auxiliary request 2 with the following differences:

The word 'and' is deleted from the end of the expression 'wherein the axial displacement absorbing gaps (CL) ... can be absorbed sufficiently, and', the following feature then being appended to the claim:

"and wherein the raceway surface of the outer ring (4b) of each of the roller bearings (4) has a diameter smaller than that of the groove-shaped raceway surface of the outer ring (5b) of the main ball bearing (5)."

Claim 1 of auxiliary request 4 reads as for claim 1 of the main request with the following differences:

The word 'and' is deleted from the end of the expression 'wherein the camshaft (2) is made of a material having a different linear expansion coefficient from that of the shaft case (40), and', the following feature then being appended to the claim:

"an auxiliary ball bearing (6) which includes an inner ring (6a) which fixed to the outer circumferential surface of the camshaft (2) and including a groove-shaped raceway, an outer ring (6b) which is provided in

such a manner as to be allowed to axially slide relative to the inner circumferential surface of the shaft case (40) and includes a groove-shaped raceway, and balls (6c) disposed in such a manner as to fit in the groove-shaped raceway surfaces of the inner ring (6a) and the outer ring (6b) of the auxiliary ball bearing (6)."

VIII. The appellant's arguments relevant to the present decision may be summarised as follows:

Main request
The subject-matter of claim 1 involved an inventive step. E1 firstly failed to disclose the plurality of roller bearings disposed between the cams on the camshaft. The camshaft in E1 was fixed in position by the bearings 55 and 56 which were fixed in the cylinder head 52 (see para. [0052]) and were also axially fixed on the camshaft by the spacers 54d. E1 further lacked any disclosure of a thermal expansion of the camshaft and any such thermal expansion could not be accommodated by play in the bearings alone. Consequently E1 failed to disclose an axial displacement of the camshaft relative to the shaft case due to different linear expansion coefficients of the camshaft and shaft case.

The objective technical problem to be solved was thus to extend the service life of the camshaft apparatus, not to reduce friction as the latter already hinted at the solution. Starting from E1, the skilled person would not use roller bearings in the inter-cam positions since para. [0005] of E1 itself indicated that the oil feeding hole associated with roller bearings would create noise and vibrations, thus shortening the service life. Claim 1 also defined a

very specific type of roller bearing lacking an inner ring for which there was no suggestion for the skilled person.

Auxiliary request 1
The subject-matter of claim 1 met the requirement of Article 123(2) EPC. Fig. 1 was a schematic representation of a technical element such that relative sizes shown therein were correct. The technically relevant feature in the figure would be seen by the skilled person as the relative diameters of the two bearing types.

Auxiliary request 2
Claim 1 met the requirements of Article 84 EPC. The feature regarding the relative displacement being 'absorbed sufficiently' was clear in combination with the definition of the relative displacement in the fourth last paragraph of claim 1. The skilled reader would understand being 'absorbed sufficiently' as implying that no contact between the bearings and the cams was possible. The allegedly unclear feature functionally described what would be unduly limiting if claimed otherwise. Paragraph [0011] of the patent also elaborated on the claimed wording, eliminating any potential misunderstanding of the claim.

Auxiliary request 3
No further arguments to those already presented with respect to auxiliary requests 1 and 2 were relevant for the allowability of auxiliary request 3.

Auxiliary request 4
The subject-matter of claim 1 involved an inventive step. The claimed solution of the outer bearing ring axially sliding on the inner surface of the shaft case

to allow the relative axial movement of camshaft relative to shaft case was not known from the cited art. The objective technical problem was to accommodate differential thermal expansion of the camshaft apparatus and no hint was available to the skilled person for the claimed solution to be rendered obvious.

IX. The respondent's arguments may be summarised as follows:

Main request
The subject-matter of claim 1 did not involve an inventive step. Starting from E1, the sole differentiating feature was the inter-cam bearings being roller bearings, this being obvious for the skilled person wishing to reduce the friction in the camshaft apparatus. Consideration of lubrication did not appear in claim 1 and so could not contribute to the objective technical problem. No degree of relative displacement was defined in claim 1, the camshaft of E1 implicitly experiencing such displacement due to the cylinder head being aluminium (see para. [0019] of E1) and the camshaft implicitly not being aluminium.

Auxiliary request 1
The subject-matter of claim 1 failed to meet the requirement of Article 123(2) EPC. Fig. 1 depicted further technically relevant features such as the number of roller bearings and their equidistant separation. It was not even unambiguously derivable that the relative bearing diameters depicted were technically relevant.

Auxiliary request 2
Claim 1 lacked clarity. The expression 'absorbed sufficiently' related to the operating conditions of

the camshaft which were not claimed. It was thus not clear for the skilled person at least what product features resulted in this expression being necessarily realised.

Auxiliary request 4
The subject-matter of claim 1 did not involve an inventive step. The appellant had simply selected one of three ways for the auxiliary bearing to allow relative movement between the camshaft and the case. The selected possibility was even technically the simplest modification in order to reach the claimed subject-matter when starting from E1.

Reasons for the Decision

Main request

1. *Article 56 EPC*

The subject-matter of claim 1 does not involve an inventive step.

1.1 E1, the most promising starting point for an inventive step attack, fails to disclose solely the following feature of claim 1:

'a plurality of roller bearings which are disposed in at least part of the inter-cam outer circumferential surface areas, wherein each of the roller bearings includes an outer ring fitted in the inner circumferential surface of the shaft case and having a raceway surface, and rollers disposed in such a manner as to be in contact with the raceway surface and the corresponding inter-cam outer circumferential surface

area'.

1.1.1 The appellant's contention that E1 also failed to disclose an axial displacement of the camshaft relative to the shaft case due to different linear expansion coefficients of the camshaft and shaft case is not accepted. The skilled person would unambiguously see this feature as being implicitly present in the assembly depicted in Fig. 11 of E1.

1.1.2 There is firstly no doubt that differential expansion will occur between the camshaft 54 and the bracket of the cylinder head 52b, 52d of E1. The camshaft housing (here the cylinder head) is indicated in para. [0019] as being formed of an aluminium block and the skilled person would undoubtably see this as applying to all embodiments of E1, not least since no alternative material for the cylinder head material is disclosed elsewhere in the entire document; the skilled person would also know that, due to strength requirements, a camshaft would not be formed from aluminium or aluminium alloy, rather a construction from steel or other non-aluminium based material would be expected. Differential expansion would thus necessarily occur between the two components of different material.

1.1.3 The appellant's argument that any differential expansion in E1 could not be accommodated simply by play in the bearings is not relevant with respect to the claimed apparatus. Simply an axial relative displacement of the camshaft and the shaft case is defined in claim 1 without any indication of its magnitude. Since every ball bearing has a degree of play included in order to allow the movement of the balls relative to the inner and outer race, the existence of ball bearings at each end of the camshaft

in E1 does not exclude an axial movement, however small, of the camshaft relative to the shaft case. However, beyond such minor freedom of axial movement, the Board holds that the skilled person, reading Fig. 11 and in the knowledge of the different materials used for the camshaft and the shaft case, will understand that some further axial movement must implicitly be accommodated by the bearing arrangement. It would be untenable for a camshaft apparatus which undergoes temperature fluctuations of several hundred degrees in use not to be provided with a bearing assembly allowing significant relative movement between camshaft and shaft case as otherwise either buckling of the camshaft or seizing of the bearings could be expected. Even though an arrangement allowing such relative movement is not depicted in Fig. 11, and the wording 'fixed' is used in relation to the bearing and the cylinder head in para. [0052], the skilled person would implicitly understand that there must be freedom of axial movement between the camshaft and the shaft case going beyond the mere play in the ball bearings 55 and 56.

1.2 Thus, based on the sole differentiating feature in point 1.1 above, the objective technical problem may be seen as how to reduce the friction losses in the cam shaft arrangement of E1.

1.2.1 The appellant posed a technical problem to be solved of 'how to extend the service life of the camshaft apparatus of E1'. This is however not objective. Claim 1 lacks any features to support the view that the claimed apparatus would exhibit a longer life than that of E1, apart from perhaps due to a reduction of friction which would perhaps assist in such. Paragraph [0002] of the patent mentions journal bearings being characterised by high friction to start rotation and to

maintain low speed running and it follows that a reduction in friction through use of roller bearings may well result in a longer service life. However, many other factors influence service life such as, for example, lubrication and material selection which are not included in claim 1. It remains, therefore, that the problem of attaining a longer service life is not objectively solved by the subject-matter of claim 1.

1.2.2 The appellant's further argument in this regard that an oil feed hole associated with roller bearings, as disclosed in para. [0005] of E1, would create noise and vibrations, thus shortening the service life is not overcome by the features in claim 1 and so cannot contribute to the problem to be solved. The presence of an oil feed hole in the shaft, supplying oil to the rollers of the roller bearing and thus subject to the same problems as in E1 is not excluded in claim 1, nor is any other lubrication feature included which can be seen, relative to E1, to positively influence the service life of the claimed camshaft apparatus as a whole, nor the noise and vibrations.

1.3 Starting from E1 and faced with the objective technical problem in point 1.2 above, it would be obvious for the skilled person to replace the inter-cam journal bearings with the claimed roller bearings thus reaching the claimed subject-matter while solving the objective technical problem without exercising an inventive step. Para. [0055] of E1 hints to the use of roller bearings in suggesting that a 'sliding bearing or the like may be provided between the plurality of cams', a roller bearing obviously fulfilling such 'or the like' disclosure. Albeit well-known anyway to a skilled person, col. 1, lines 33 to 35 of E1 explicitly discloses the decrease in frictional resistance

associated with roller bearings over journal bearings such that the skilled person would indeed consider roller bearings generally in order to reduce the rotational friction of the camshaft.

1.3.1 The appellant's argument that claim 1 defined a very specific type of roller bearing, lacking an inner ring does not change the Board's finding. The skilled person is aware of all the different types of roller bearings available, the type without an inner ring being just one of these (this as such not having been contested by the appellant). No technical advantage of a roller bearing lacking an inner ring was suggested by the appellant, its selection thus being a trivial design step decided upon as part of standard design considerations by the skilled person without exercising an inventive step.

1.3.2 The appellant's further argument that the skilled person was taught away from using a roller bearing when wishing to find a replacement for sliding bearings, based on paragraph [0005] of E1, is not persuasive. If the skilled person is prepared to accept the disadvantage of noise and vibration which may be caused in exactly the same way in the contested patent due to oil necessary for lubrication being fed to the rollers (albeit via other means, see item 1.2.2 above), then E1 does not teach against the use of roller bearings. The appellant's submission that its claim was not concerned with lubrication also does not alter the Board's conclusion, but simply reinforces the fact that any type of lubrication can be used, also those types subject to the same problem mentioned in E1.

1.4 The subject-matter of claim 1 thus lacks an inventive step (Article 56 EPC). The main request is consequently

not allowable.

Auxiliary request 1

2. *Article 123(2) EPC*

The subject-matter of claim 1 fails to meet the requirement of Article 123(2) EPC.

2.1 Fig. 1 of the application as filed was given as the sole basis for the addition to claim 1 of the following feature:
"wherein the raceway surface of the outer ring (4b) of each of the roller bearings (4) has a diameter smaller than that of the groove-shaped raceway surface of the outer ring (5b) of the main ball bearing (5)".

2.2 This feature, whilst indeed depicted in Fig. 1, is not disclosed in isolation from numerous other features in the figure. For example, as also indicated by the respondent, Fig. 1 depicts the relative bearing diameters in combination with at least a specific number of roller bearings (here four), each notably equidistantly spaced and each associated with a cam pair of a cylinder. In the size relationship shown, a certain width of bearing is also apparent. The isolation of the feature relating to the bearing diameters for inclusion in claim 1, which feature is only disclosed in combination with numerous further features in Fig. 1, thus lacks a direct and unambiguous disclosure.

2.3 The appellant's argument that Fig. 1 was a schematic representation of a technical element such that relative sizes shown therein were accurate is not relevant, since all the features presented in Fig. 1

are disclosed in combination. There is no basis for solely the feature of relative bearing diameters to be extracted from the figure for inclusion in claim 1 in the absence of any suggestion in the description of the application as filed that such is of particular importance. The appellant's further suggestion that the skilled person would see the relative diameters of the two bearing types as the only technically relevant feature in the figure lacks any justification; this feature might well be important but perhaps only, for example, for equidistantly spaced roller bearings. No guidance as to the specific relevance of the relative bearing diameters depicted in Fig. 1 is to be found in the application as filed such that the feature's inclusion in claim 1 in isolation from the other features disclosed in Fig. 1 in combination therewith lacks a direct and unambiguous basis.

2.4 The subject-matter of claim 1 thus fails to meet the requirement of Article 123(2) EPC. Auxiliary request 1 is consequently not allowable.

Auxiliary request 2

3. *Article 84 EPC*

Claim 1 lacks clarity contrary to the requirement of Article 84 EPC.

3.1 One of the features newly added to claim 1 of this request reads:
"wherein the axial displacement absorbing gaps (CL) which are defined between the cams and the outer ring (4b) are set to such a magnitude that the relative displacement amount at the portion of the camshaft (2) which corresponds to the roller bearing (4) lying

farthest away from the main ball bearing (5) can be absorbed sufficiently".

3.2 The expressions 'such a magnitude' and 'absorbed sufficiently' are unclear. What magnitude of axial displacement absorbing gaps is intended and how does the skilled person know when the relative displacement amount has been 'absorbed sufficiently'? The expressions are not absolute and will depend for example on the operating conditions of the camshaft. No operating conditions (e.g. operating temperatures, length of time of operation etc.) are included in claim 1. Thus while particular axial displacement absorbing gaps may allow the relative displacement to be absorbed sufficiently for one set of operating conditions, these may well fail for a second set of operating conditions. As a consequence, the skilled person would not know what magnitude of axial displacement absorbing gaps to select in order to allow 'sufficient absorbing' of the axial camshaft movement.

3.3 The appellant's arguments in defence of claim 1 being clear are not persuasive. As regards the fourth last paragraph of claim 1 enabling the skilled reader to understand the expression 'absorbed sufficiently' as implying that no contact between the bearings and the cams was possible, this is not accepted. As shown in point 3.2 above, what may hold for one set of operating conditions can very well not apply for a different set of operating conditions; lacking a limitation in claim 1 to specific operating circumstances, claim 1 is unclear. The appellant's reference to paragraph [0011] of the patent does not help this situation: also, what is claimed should be clear without requiring a reference to the description to assist understanding.

3.4 The appellant's further submission that the feature functionally described what would be unduly limiting if claimed otherwise is no defence for an unclear claim. Even if it were accepted that the objected to expressions defined functional features of the claimed apparatus, these expressions must still be inherently clear. This is not the case here, as explained above.

3.5 Claim 1 thus lacks clarity contrary to the requirements of Article 84 EPC. Consequently auxiliary request 2 is not allowable.

Auxiliary request 3

4. *Article 84 EPC*

4.1 Claim 1 includes the feature added to claim 1 of auxiliary request 2 identified in point 3.1 above. Claim 1 of that request lacked clarity. The appellant did not withdraw the request but failed to present any additional argument whatsoever, such that the same conclusion with the same reasoning with respect to lack of clarity must, obviously, be reached.

4.2 Claim 1 of the present request thus also lacks clarity contrary to the requirements of Article 84 EPC. Consequently auxiliary request 3 is also not allowable.

Auxiliary request 4

5. *Article 56 EPC*

The subject-matter of claim 1 involves an inventive step.

5.1 Claim 1 of the main request has been supplemented with the following additional features in claim 1 of the present request:
"an auxiliary ball bearing (6) which includes an inner ring (6a) which fixed to the outer circumferential surface of the camshaft (2) and including a groove-shaped raceway, an outer ring (6b) which is provided in such a manner as to be allowed to axially slide relative to the inner circumferential surface of the shaft case (40) and includes a groove-shaped raceway, and balls (6c) disposed in such a manner as to fit in the groove-shaped raceway surfaces of the inner ring (6a) and the outer ring (6b) of the auxiliary ball bearing (6)."

5.2 Starting from E1 as the sole starting document presented by the respondent, the objective technical problem can be seen as how to provide a suitable bearing arrangement to allow relative axial movement under differential expansion.

5.3 The claimed solution of the outer ring of the auxiliary ball bearing being free to axially slide in the shaft case is not to be found in any cited document. This was also not argued to be the case by the respondent. Whilst it can be accepted that the skilled person would know how to allow such axial movement, there is no apparent hint which would lead them to the claimed solution.

5.4 The respondent had argued in writing that ball bearings with axial movement allowance within the bearing were well known to a skilled person. But in relation to the particular relative sliding movement claimed, which is between different surfaces, the respondent argued during the oral proceedings that just three ways of

achieving the axial movement were available to the skilled person: the inner ring sliding on the camshaft; the bearing race groove itself being axially extended; or the outer ring sliding in the shaft case. Despite this, it is noted that each of these options itself has a number of ways in which they can be realised in practice. For example, taking the case of the inner ring sliding on the camshaft of E1 (see Fig. 11), the inner ring of the auxiliary bearing 56 may be completely unrestrained by removing all spacers 54d or alternatively may incorporate limits to the maximum axial movement possible. It is also not accepted that allowing the outer ring to slide relatively is the simplest modification to make to E1 in order to enable the axial movement; freeing the inner ring to slide on the camshaft is seemingly no more complex a solution. The selection of the specific way of achieving the axial movement claimed is thus not suggested to the skilled person in any way, at least not from the acknowledged or cited prior art, to enable the required modification and thus reach the claimed subject-matter without their exercising an inventive step.

5.5 It is noted that the respondent provided no alternative starting points other than E1 for an inventive step attack, nor did it provide any prior art disclosing sliding of an outer bearing race of a ball bearing against a bearing support surface, let alone for the purposes of allowing differential expansion.

5.6 It thus follows that, based on the cited prior art documents and the arguments presented by the respondent, the subject-matter of claim 1 is not obvious to a skilled person. The subject-matter of claim 1 thus involves an inventive step (Article 56

EPC).

5.7 To the adapted description, the respondent had no objections. The Board also has no objections in this regard.

Order

For these reasons it is decided that:

1. The decision under appeal is set aside.

2. The case is remitted to the opposition division with the order to maintain the patent as amended in the following version:
   - sole claim of auxiliary request 4 filed with letter dated 10 August 2015,
   - description pages 2 to 6 filed during the oral proceedings before the Board on 19 September 2019 and
   - figures 1 to 5 of the patent specification.

The Registrar: The Chairman:

M. H. A. Patin M. Harrison

Decision electronically authenticated