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Title of invention:
CROSSHEAD BEARING FOR A LARGE TWO-STROKE DIESEL ENGINE

Patent Proprietor:
MAN DIESEL & TURBO, FILIAL AF MAN DIESEL & TURBO SE, TYSKLAND

Opponent:
Mitsubishi Heavy Industries, Ltd.

Headword:

Relevant legal provisions:
EPC Art. 100(a), 100(b), 100(c), 54, 56

Keyword:
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Case Number: T 1935/13 - 3.2.08

D E C I S I O N
of Technical Board of Appeal 3.2.08
of 27 April 2017

Appellant: (Patent Proprietor)	MAN DIESEL & TURBO, FILIAL AF MAN DIESEL & TURBO SE, TYSKLAND Teglholmsgade 41 2450 København SV (DK)
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Representative:	Garkisch, Marcus Henkel, Breuer & Partner Patentanwälte Maximiliansplatz 21 80333 München (DE)
Decision under appeal:	**Interlocutory decision of the Opposition Division of the European Patent Office posted on 1 July 2013 concerning maintenance of the European Patent No. 1751440 in amended form.**

Composition of the Board:

Chairwoman P. Acton
Members: M. Alvazzi Delfrate
P. Guntz

Summary of Facts and Submissions

I. By its decision posted on 1 July 2013 the opposition division found that European patent No.1751440, in amended form according to the first auxiliary request then on file, and the invention to which it related met the requirements of the EPC.

II. Both the patent proprietor (appellant 1) and the opponent (appellant 2) lodged an appeal against that decision in the prescribed form and within the prescribed time limit.

III. Oral proceedings before the Board of Appeal were held on 27 April 2017. At the end of the oral proceedings the requests were as follows:

Appellant 1 requested that the decision under appeal be set aside and that the patent be maintained as granted or, in the alternative, that the patent be maintained in amended form according to auxiliary request I as filed during oral proceedings.

Appellant 2 requested that the decision under appeal be set aside and that the patent be revoked.

IV. The main request (patent as granted) comprises two independent claims (1 and 10) which are worded as follows:

"1. A crosshead bearing (1) for a large two-stroke engine, the bearing comprising:

a crosshead journal (4),

a bearing saddle (11) integral with a connecting rod (7),

a lower bearing shell (12) with a single bearing surface received in the bearing saddle (11),

at least two axial lubrication grooves or axial lines of lubrication openings (22) disposed in the bearing surface of the lower bearing shell (12) or

in the surface of the journal (4) facing the lower bearing shell (12),

a bearing cap (6) secured to the bearing saddle (11),

the bearing being rotatable about the crosshead journal (4), the journal being formed with an axial bore (5) for communication with a supply of lubricant under pressure and formed with a least one radial bore (15) which meets the axial bore (5) and extends substantially transversely thereof to the surface of the journal associated with the bearing cap (6), and arranged to communicate, during at least some part of the pivoting movement of the connecting rod (7) in operation, with at least one flow path (16, 18, 19, 20, 20', 21) extending to the axial lubrication grooves (22) in the lower bearing shell (12),

whereby the flow path (16, 18, 19, 20, 20', 21) extends along all of its length from the opening of the radial bore (15) at the surface of the journal associated with the bearing cap to the axial lubrication grooves (22) or lines of lubrication openings substantially adjacent the bearing surface and/or substantially adjacent the rear side of either the upper or lower bearing shell."

"10. A crosshead bearing (1) for a large two-stroke engine, the bearing comprising:

a crosshead journal (4),

a bearing saddle (11) integral with a connecting rod (7),

a lower bearing shell (12) with a single bearing surface received in the bearing saddle (11),

a bearing cap (6) secured to the bearing saddle (11),

the bearing being rotatable about the crosshead journal (4), the journal being formed with an axial bore (5) for communication with a supply of lubricant under pressure and formed with two radial bores (24) which meet the axial bore (5) and extend substantially transversely thereof to the surface of the journal associated with the lower bearing shell (12), and arranged to communicate, during at least some part of the pivoting movement of the connecting rod (7) in operation, with two circumferentially extending rows of bores in the lower bearing shell (12) or with two circumferential slits (25) disposed either in the lower bearing shell (12) or in the journal (4), the circumferential slits (25) being placed outside the heaviest loaded portion of the bearing shell and intersecting with at least two axial lubrication grooves (22) disposed in the bearing surface of the lower bearing shell (12) or in the surface of the journal (4) facing the lower bearing shell (12) and said axial lubrication grooves (22) being tangentially spaced from one another with the heaviest loaded portion of the bearing shell there between."

Two of the dependent claims (7 and 12) define that the bearing

"is positively dimensioned".

The auxiliary request differs from the main request by the deletion of dependent claims 7 and 12 and consequent renumbering of the claims and their references.

V. The following documents played a role for the present decision:

E1: Henshall S.H. "Design and performance of the 58JS3 engine", Motor Ship, Suppl. Feb. 1979, p. 11-27;
E2: GB -A- 380,857;
E3: GB -A- 1 524 757;
E4: GB -A- 2 020 783;
E5: EP -A- 0 199 906;
E11: "Instructions for 50-98 MC Type Engines - Operation" Edition 40D (1996), pages 272-273.

VI. The arguments of appellant 2 can be summarised as follows:

Main request - claim 1 - novelty

The subject-matter of claim 1 lacked novelty in view of each of E1, E2 and E3.

The crosshead bearing of Figure 9 of E1 exhibited all the features of claim 1. In particular, although E1 did not describe the flow of the lubricant in detail, it was clear that in operation some lubricant would flow along the surface of the journal and reach the axial lubrication grooves in the lower bearing shell. Indeed,

the upper axial groove received the lubricant only in this way. Therefore, the subject-matter of claim 1 lacked novelty over E1.

E2 also disclosed all the features of claim 1, since it could be considered that radial bore 31, opening at the separation between bearing cap and saddle, extended to the surface of the journal associated with the bearing cap.

Lastly, in the crosshead of E3 the saddle and the connecting rod were rigidly assembled together to form a whole, so that they could be considered to be "integral" with each other. Moreover, in view of the very broad interpretation that could be given to the term "substantially adjacent", bore 25 could be regarded as "substantially adjacent" to the rear surface of the lower bearing shell. Hence, the flow path shown in Figure 2, or at least one of the alternatives explained in the description, was in accordance with claim 1. Therefore, the subject-matter of claim 1 lacked novelty also in view of E3.

Main request - claim 10 - novelty

The crosshead bearing of claim 10 was not novel in view of each of E4, E1 and E2.

For the same reasons as explained in respect of E3, the saddle and the connecting rod of the crosshead of Figure 2 of E4 were "integral" with each other. Moreover, according to column 3, lines 7-15, groove 17 could be replaced by a circumferentially extending row of bores. Since claim 10 did not define an intersection with axial lubrication grooves for the alternative involving bores, said bores were in accordance with the

claim. Therefore, the subject-matter of claim 10 lacked novelty over E4.

In the crosshead of E1 the lubricant flowed from radial bore 24A to circumferential slit 25A, which was disposed in the lower bearing shell and intersected with at least two axial lubrication grooves 22A in the bearing surface of the lower bearing shell. Since it was not clear that the crosshead of Figure 9 was the same component shown in Figure 8, it could not be said that the axial lubrication grooves and the circumferential slit were in the heaviest loaded portion of the bearing shell. Hence, the subject-matter of claim 10 was not novel over E1.

Although Figures 5 and 6 of E2 did not show the shape of the lubrication grooves and of the openings 29 it was clear that the same bush as in the gudgeon pin was to be used. Said bush was depicted in Figure 3 and exhibited circumferential slits 4, which intersected axial lubrication grooves 13, as stipulated by present claim 10. It was true that in the patent in suit the lubricant flowed from the radial bore to the lubricating shell, whereas in E2 the flow was in the opposite direction. However, these were process features that did not define any difference in terms of structural product features. Since claim 10 was directed to a product, its subject-matter lacked novelty also in view of E2.

Main request - claim 1 - inventive step

Even if novelty were acknowledged for claim 1, its subject-matter did not involve an inventive step starting from E1 or E3.

Starting from E1, the problem to be solved could be considered as being to increase the lubrication of the lower bearing shell. It was obvious, either in view of the common general knowledge of the person skilled in the art or in view of E3, to solve this problem by creating a flow path from the upper radial bore 15A to the axial lubrication grooves in the lower bearing shell, thus increasing the amount of lubricant provided to said axial grooves. Therefore, it was obvious to arrive at the crosshead bearing of claim 1 starting from E1.

Starting from the crosshead of E3, the problem solved by the provision of a saddle integral with the connecting rod was to improve the strength of the crosshead. Crossheads with integral constructions of the saddle and the connecting rod and their advantages in terms of strength were well known at the priority date of the patent in suit. Hence, it was obvious to realise the connecting rod and the saddle of E3 integral with each other.

Main request - claim 10 - inventive step

Even if novelty were acknowledged for claim 10, its subject-matter did not involve an inventive step starting from E4 or E2.

For the same reasons as explained in respect of claim 1, it was obvious to realise an integral construction for the saddle and the connecting rod of E4, thus arriving at the claimed subject-matter starting from E4.

The crosshead bearing of claim 10 differed from that of E2 at most by the provision of circumferential slits

intersecting axial lubrication grooves in the lower bearing shell. However it was at least obvious to adopt this arrangement, which was disclosed in E2 itself for the gudgeon pin, also in the case of the crosshead. Thus, it was also obvious to arrive at the subject-matter of claim 10 starting from E2.

Main request - Article 100(c) EPC

The feature that the axial lubrication grooves are "tangentially spaced from one another" (claim 10) was not literally disclosed in the application as originally filed. The term "tangentially spaced" meant that the bottom of both grooves reached a tangent of the circumference, along which they were spaced. The original application did not disclose grooves arranged in this way. Therefore, the subject-matter of claim 1 extended beyond the content of the application as originally filed.

Main request - Article 100(b) EPC

Claim 1 was excessively broad, with a large number of "and/or" combinations, not all of which were sufficiently disclosed. In particular, in the case of axial lubrication grooves situated on the surface of the journal, it was impossible to connect said axial grooves with the radial bore in the journal by means of a flow path that extended only adjacent to the rear side of the bearing shell, because the bearing surface of the bearing shell would also have to be crossed. Hence, this alternative of claim 1 was not sufficiently disclosed.

Since there was no embodiment disclosed in the application wherein the axial lubrication grooves were

"tangentially spaced", the subject-matter of claim 1 was not sufficiently disclosed also for this reason.

According to claim 5, two diagonally arranged grooves connected the respective diagonal groove with the central bore. However, it was not clear how they could do so. Hence, claim 5 was not sufficiently disclosed.

According to claims 7 and 12 the bearing was "positively dimensioned". The claims did not define the meaning of this expression. The definition to be found in the description, column 2, described a press fit. Hence, it was not clear how a functioning bearing could be realised in this way. Therefore, claims 7 and 12 were not sufficiently disclosed either.

Auxiliary request

There was no additional objection in respect of the auxiliary request.

VII. The arguments of appellant 1 can be summarised as follows:

Main request - claim 1 - novelty

None of the prior-art documents disclosed all the features of claim 1.

The crosshead bearing of Figure 9 of E1 did not exhibit a flow path in accordance with claim 1. The description of E1 did not explain how the lubricant was circulated, while from Figure 9 it was clear that bore 15A was intended to provide lubrication to the upper shell. The lower shell and the axial grooves 22A received the lubricant from bore 24A. This applied also to the upper

axial groove of the lower shell visible in Figure 9, which received the lubricant provided by bore 24A during the movement of the crosshead. Hence, even if under some conditions some lubricant from bore 15A unintentionally reached the axial lubrication grooves, the person skilled in the art would not have considered that there was a flow path between said bore and said grooves. Therefore, the subject-matter of claim 1 was novel over E1.

In the crosshead bearing of E2, shown in Figures 5 and 6, the radial bore did not extend to the surface of the journal associated with the bearing cap. At least for this reason, the subject-matter of claim 1 was novel also in view of E2.

In the crosshead of E3 the saddle and the connecting rod were not "integral" but separate parts. Moreover, both in the embodiment shown in Figure 2 and in those explained in the description the lubricant flowed through bore 25, which could not be considered to be "substantially adjacent" to the bearing surface or the rear side of the lower bearing shell. Thus, the subject-matter of claim 1 was also novel over E3.

Main request - claim 10 - novelty

In the crosshead of E4, like that of E3, the saddle and the connecting rod were not "integral" with each other. Moreover, the circumferentially extending row of bores or slits was not in accordance with claim 10. Hence, the claimed subject-matter was novel over E4.

In the crosshead bearing of E1, which was depicted not only in Figure 9 but also in Figure 8, the circumferential slit and the axial lubrication grooves

were not placed outside the heaviest loaded portion of the bearing shell, as required by claim 10. Hence, the subject-matter of claim 10 was also novel over E1.

The only drawings of E2 relating to the crosshead were Figures 5 and 6. E2 did not disclose that the bush of the gudgeon pin shown in Figure 3 was to be used also for the crosshead. Moreover, since claim 10 stipulated that the axial bore in the journal was "for communication with a supply of lubricant under pressure", the lubricant had to flow from the axial and radial bore to the bearing shell. In E2 it flowed in the opposite direction. Indeed, the bearing of E2 was not suitable for a flow of lubricant as required by claim 10. Therefore, the subject-matter of claim 10 was also novel over E2.

Main request - claim 1 - inventive step

Starting from E1, the person skilled in the art had no reason to create a flow path between bore 15A, which was used to lubricate the upper bearing surface, and the lubrication grooves in the lower bearing shell, which received the lubricant from bore 24A instead.

As to the crosshead of E3, it was designed with the saddle and the connecting rod as separate elements, in order to render possible the flow path of lubricant shown in the drawings and to facilitate mounting of the bearing. It was not obvious to realise an integral crosshead with the same geometry as that of E3.

Main request - claim 10 - inventive step

The subject-matter of claim 10 likewise involved an inventive step.

It was not obvious to realise the crosshead of E4 as an "integral" crosshead, for the same reasons as given in respect of E3.

Starting from E2, there was no reason to reverse the direction of flow of the lubricant.

Main request - Article 100(c) EPC

For the person skilled in the art, it was clear that axial lubrication grooves "tangentially spaced from one another" were axial lubrication grooves spaced along the circumference. The expression "tangentially spaced" was often used in this sense. Other interpretations would be discarded given the context of claim 1. Since the drawings showed axial lubrication grooves spaced along the circumference there was no added subject-matter in claim 1.

Main request - Article 100(b) EPC

The patent in suit disclosed in detail some embodiments covered by claim 1. It was not a problem for the person skilled in the art to extend this teaching to further possible arrangements covered by the claim which made technically sense. Hence, claim 1 was sufficiently disclosed.

As already explained, the "tangentially spaced" axial lubrication grooves of claim 10 were depicted in the drawings.

The objection in respect of the "diagonal groove" in claim 5 was rather a matter of clarity. This feature,

when correctly understood, was also sufficiently disclosed.

It was well known to the person skilled in the art how "positively dimensioned" bearings were to be obtained. Moreover, the description disclosed that a positively dimensioned or "embedded arc" bearing had a non-cylindrical shape of the shell, obtained by choosing a radius of the crosshead journal larger than the radius of the bearing surface of the bearing shell and deforming the shell by running in the bearing. The deformation was rendered possible by the use of the white metal lining mentioned in paragraphs [0017] and [0032]. E11 was provided as evidence that the production of this type of bearing was within the common general knowledge of the person skilled in the art. Thus, claims 7 and 12 were also sufficiently disclosed.

Auxiliary request

The auxiliary request had been amended to meet the objection relating to the "positively dimensioned" bearings.

Reasons for the Decision

1. Main request - claim 1 - novelty

Novelty of claim 1 has been objected to in view of E1, E2 and E3.

1.1 E1 shows a crosshead bearing in Figure 9. This drawing, with additional reference signs (from the statement of grounds of the opponent), is reproduced hereafter:

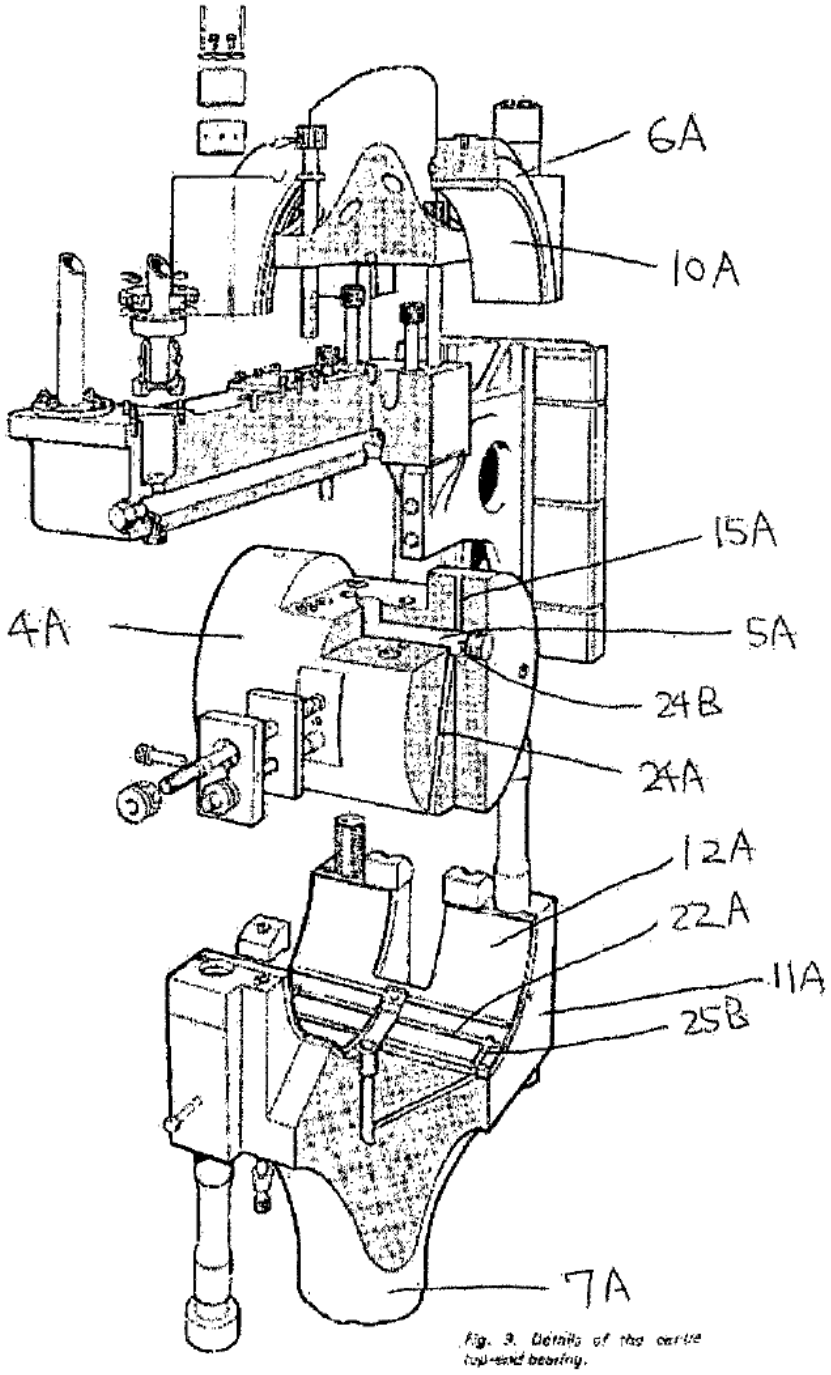


Fig. 3. Details of the earlier top-end bearing.

It is common ground that Figure 9 discloses a crosshead bearing for a large two-stroke engine, the bearing comprising: a crosshead journal (4A), a bearing saddle

(11A) integral with a connecting rod (7A), a lower bearing shell (12A) with a bearing surface received in the bearing saddle, at least two axial lubrication grooves (22A) disposed in the bearing surface of the lower bearing shell, a bearing cap (6A) secured to the bearing saddle, the bearing being rotatable about the crosshead journal, the journal being formed with an axial bore (5A) for communication with a supply of lubricant under pressure and formed with a least one radial bore (15A) which meets the axial bore (5) and extends substantially transversely thereof to the surface of the journal associated with the bearing cap.

In contrast, it is disputed whether there is at least one flow path from the opening of said radial bore 15A extending to the axial lubrication grooves in the lower bearing shell.

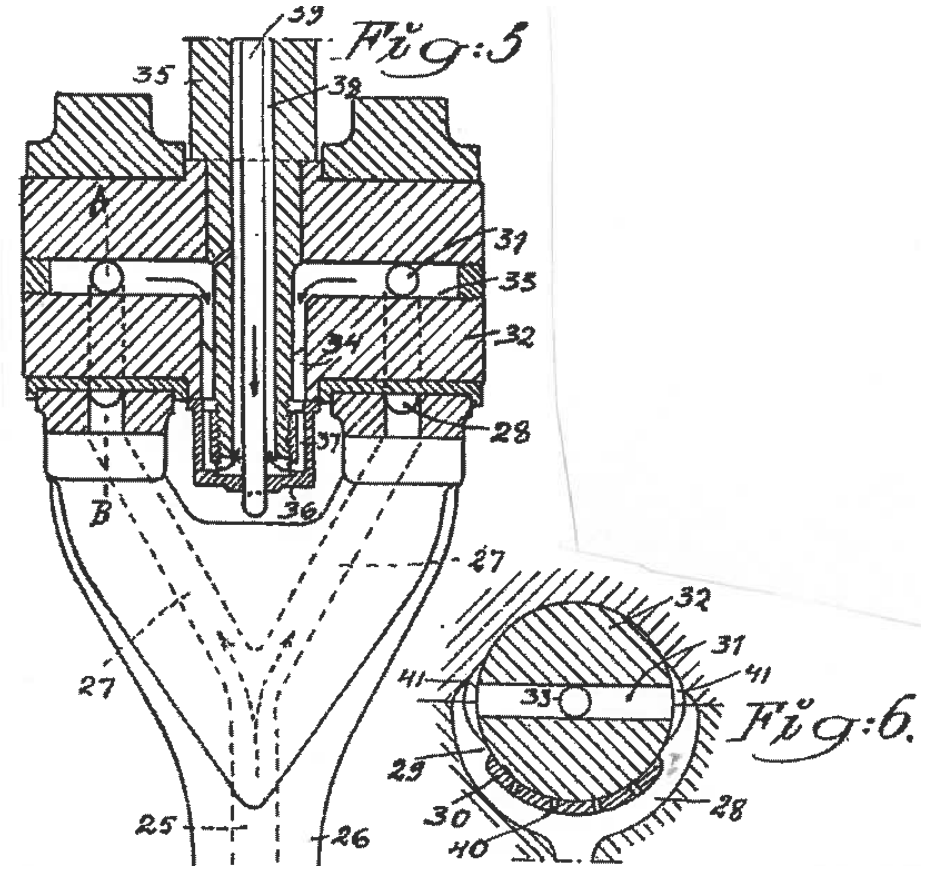
The description of E1 does not provide detailed information as to how the lubricant is circulated. However, from Figure 9 it is clear that bore 15A is designed to provide lubrication to the upper shell, while the lower shell and the grooves 22A receive the lubricant from bore 24A. This applies also to the axial groove of the lower shell visible in Figure 9 spaced circumferentially and upwards from groove 22A, which receives the lubricant provided by bore 24A during the oscillating movement of the crosshead.

Appellant 2 argued that in operation some lubricant might nonetheless flow along the surface of the journal from the opening of bore 15A, thus reaching the axial grooves 22A. However, the Board is of the view that in the context of claim 1, which is concerned with the lubrication of a crosshead, the term "flow path" defines a path that is designed to purposely convey the

lubricant and not a surface along which, depending on the operating conditions, the lubricant may or may not flow. Hence, quite apart from the fact that E1 does not explicitly disclose that some lubricant may flow along the surface of the journal, as submitted by appellant 2, E1 does not disclose a crosshead with a flow path as required by claim 1.

Therefore, the subject-matter of claim 1 is novel over E1.

1.2 E2 relates to the lubrication of a gudgeon pin or a crosshead. The crosshead is depicted in Figures 5 and 6, reproduced below, whereas Figures 1-4 relate to the gudgeon pin.



The crosshead comprises a journal (32), a bearing saddle with a connecting rod (26), a lower bearing shell (30) with a single bearing surface received in the bearing saddle with lubrication grooves disposed in the bearing surface of the lower bearing shell.

The crosshead journal is formed with an axial bore (33) and with one radial bore (31), which meets the axial bore and extends substantially transversely thereof. However, as is visible from Figure 6, said radial bore extends to the separation between bearing cap and saddle. Hence, during part of the movement of the crosshead the opening of the radial bore will be directed solely to the lower bearing shell (while during another part of the movement it will be directed solely to the bearing cap). Therefore, the radial opening does not extend to the surface of the journal "associated with the bearing cap", as stipulated by claim 1, because this expression is understood to indicate the surface of the journal that is in contact only with the bearing cap.

At least for this reason, the subject-matter of claim 1 is novel also in view of E2.

1.3 E3 discloses a crosshead bearing for a large two-stroke engine (page 1, lines 10-12), the bearing comprising a crosshead journal (6), a bearing saddle (2), a lower bearing shell (22) with a bearing surface received in the bearing saddle, at least two axial lubrication grooves or axial lines of lubrication openings (21) disposed in the bearing surface of the lower bearing shell, a bearing cap (1) secured to the bearing saddle, the bearing being rotatable about the crosshead journal, the journal being formed with an axial bore (13) for communication with a supply of lubricant under

pressure and formed with a least one radial bore (16) which meets the axial bore and extends substantially transversely thereof to the surface of the journal associated with the bearing cap, and arranged to communicate, during at least some part of the pivoting movement of the connecting rod in operation, with at least one flow path extending to the axial lubrication grooves in the lower bearing shell (page 2, lines 55-71).

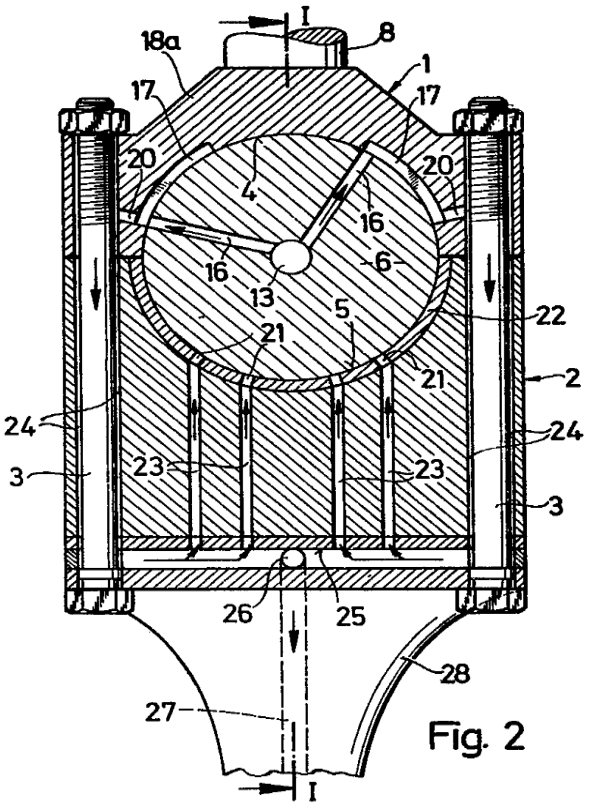


Fig. 2

However, in the crosshead of E3 the saddle (2) and the connecting rod (28) are different parts that are assembled together by means of bolts 3. By contrast, present claim 1 stipulates that the saddle is "integral" with the connecting rod. The term "integral" implies that these two elements are made in one piece or at least joined together in a way that does not

allow them to be separated. This is consistent with the drawings of the patent in suit, showing the saddle and the connecting rod as made in one piece. Therefore, the crosshead bearing of claim 1 differs from that of E3 by having the saddle integral with the connecting rod.

Moreover, in Figure 2 of E3 the lubricant flows from radial bore 16 through passages 24 and bores 25, 23 to the lubrication grooves 21 in the lower bearing shell. Bore 25, which allows the lubricant to be divided into one part directed to the bearing shell and another part directed to the connecting rod (through bore 26), has to be part of the flow path not only in the embodiment shown in the drawings but also in the embodiments discussed in the last paragraph of the description. However, bore 25, which is separated from the lower bearing shell by a completely solid element (the saddle), cannot be considered to be "substantially adjacent", even if a broad interpretation is given to this term, to the bearing surface or the rear side of the lower bearing shell. Thus, the arrangement of the flow path "substantially adjacent" to the bearing surface or the rear side of the bearing shells along all of its length represents a further distinguishing feature of the claimed crosshead bearing.

Accordingly, the subject-matter of claim 1 is also novel over E3.

2. Main request - claim 10 - novelty

Claim 10 has been objected to for lack of novelty in respect of E4, E1 and E2.

2.1 The crosshead of E4, like that of E3, has a saddle (2) and a connecting rod (28) which are different parts

assembled together (see Figures 1 and 2). Hence, for the same reasons as explained above in respect of E3, they are not "integral" with each other as required by claim 10. Therefore, at least for this reason the subject-matter of claim 10 is novel over E4.

2.2 The crosshead of E1 has a circumferential slit disposed in the lower bearing shell and intersecting with at least two axial lubrication grooves (22A) disposed in the bearing surface of the lower bearing shell. However, independently of whether or not the bearing of Figure 9 is the same as is visible in Figure 8 (as submitted by appellant 1), Figure 9 clearly shows that the circumferential slit reaches into the lowest portion of the lower bearing shell, i.e. the heaviest loaded portion of the bearing shell. Therefore, the circumferential slit is not placed outside the heaviest loaded portion of the bearing shell, as required by claim 10. Hence, the subject-matter of claim 10 is novel over E1.

2.3 The drawings of E2 relating to the crosshead are only Figures 5 and 6, which do not show the shape of the lubrication grooves and of the openings 29 in any detail. Contrary to the view of appellant 2, E2 does not disclose that bush 30, representing the lower bearing shell of the crosshead, has to be the same as the bush of the gudgeon pin shown in Figure 3. Therefore, E2 does not directly and unambiguously disclose two circumferentially extending rows of bores in the lower bearing shell or two circumferential slits disposed either in the lower bearing shell or in the journal, the circumferential slits being placed outside the heaviest loaded portion of the bearing shell and intersecting with at least two axial lubrication grooves disposed in the bearing surface of the lower

bearing shell or in the surface of the journal facing the lower bearing shell, and said axial lubrication grooves being tangentially spaced from one another with the heaviest loaded portion of the bearing shell there between.

Moreover, present claim 10 stipulates that the axial bore in the journal is "for communication with a supply of lubricant under pressure". From this feature, the person skilled in the art understands that the axial bore in the journal serves to provide the lubricant from the supply under pressure to the part to be lubricated, i.e. the lower bearing shell. In E2 the lubricant under pressure is provided through the connecting rod 26 to the lower bearing shell 30, and, after lubricating the lower shell, it is conveyed through the openings 29 to the sludge grooves 41, the radial channels 31 and the axial channel 33 in the journal, and finally to the cooling channel of the piston rod (see Figure 5). Hence, in E2 the lubricant does not flow from the radial bore to the lower shell, as required by claim 10, but in the opposite direction. Nor does E2 disclose a crosshead suitable for circulating the lubricant in the direction stipulated by claim 10, because there is no indication that the sections providing cooling of the piston rod and the sludge groove could maintain the pressure of the lubricant necessary for the lubrication of the heavy-loaded lower bearing shell. Therefore, the direction of flow of the lubricant defined in claim 10 provides a further distinguishing structural feature over E2.

Hence, the subject-matter of claim 10 is novel over E2.

3. Main request - claim 1 - inventive step

Objections of lack of inventive step against claim 1 have been raised starting from E1 or E3.

3.1 Starting from E1

In E1 the provision of the lubricant to the upper bearing surface and to the lower bearing surface is kept separate, the former taking place through bore 15A and the latter through bore 24A.

The person skilled in the art, faced with the problem of increasing the lubrication of the lower bearing shell would have acted on the part of the lubrication system directed to said shell, for instance by increasing the diameter of bore 24A.

In contrast, he had no hint, either from his common general knowledge or from E3, to solve said problem by combining the two separate lubrication systems of E1. Only with hindsight of the present invention would he have done that.

Therefore, it was not obvious to provide a flow path according to claim 1 starting from E1.

3.2 Starting from E3

Starting from the crosshead of E3 the problem solved by the provision of a saddle integral with the connecting rod can be seen in improving the strength of the crosshead.

The Board concurs with appellant 2 that crossheads with integral constructions of the saddle and the connecting

rod and their advantages in terms of strength were well known at the priority date of the patent in suit (see for instance E5).

However, for the circulation of the lubricant the crosshead of E3 makes use of the passages formed between the different parts to be assembled. Also the piston rod is easily assembled with the journal by means of nut 10 due to the saddle and the connecting rod being separate parts. Hence, for the crosshead of E3 an integral construction is not an equally viable alternative to the multi-part construction shown in the drawings, but rather this crosshead is designed to take advantage of the fact that the saddle and the connecting rod are different parts to be assembled together.

Thus, when solving the problem above the person skilled in the art would have had no reason to adopt an integral construction of connecting rod and saddle while maintaining unchanged all the other features, in particular the arrangement of the lubrication system. Instead, he would have completely abandoned the construction of E3 by adopting the design of one of the known crossheads with said integral construction.

Hence, it was not obvious to arrive at the crosshead bearing of claim 1 starting from E3.

3.3 Therefore, the subject-matter of claim 1 involves an inventive step.

4. Main request - claim 10 - inventive step

Objections of lack of inventive step against claim 10 have been raised starting from E4 or E2.

4.1 Starting from E4

The crosshead of E4, like that of E3, is designed to exploit the fact that the saddle and the connecting rod are different parts to be assembled together. Hence, for the same reasons as given above, starting from E4 it was not obvious to arrive at the crosshead bearing of claim 10, which also stipulates a saddle integral with the connecting rod.

4.2 Starting from E2

As explained above, the crosshead bearing of claim 10 differs from that of E2 not only by the provision of the circumferential slits intersecting the axial lubrication grooves, but also by the direction of flow of the lubricant.

Since there was no reason to change said direction in E2, it was not obvious to arrive at the claimed crosshead starting from E2 either.

4.3 Therefore, the subject-matter of claim 10 involves an inventive step.

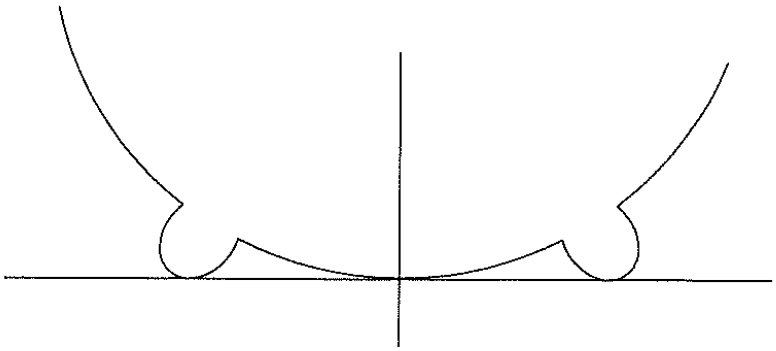
5. Main request - Article 100(c) EPC

It is undisputed that the feature that the axial lubrication grooves are "tangentially spaced from one another" (claim 10) is not disclosed *expressis verbis* in the application as originally filed.

In order to assess whether this feature was originally disclosed, its meaning must first be established.

When describing objects arranged on a cylindrical surface (as is the case of the axial grooves of claim 10) the expression "tangentially spaced" is often used to describe the fact that said objects are spaced along the circumference.

Appellant 2 did not dispute that such circumferentially spaced grooves were originally disclosed in the drawings of the application, but submitted that "tangentially spaced" should rather be understood as meaning that the grooves both reach a tangent of the circumference along which they are spaced, as shown in the drawing below (reproduced from the statement of grounds of appellant 2).



However, this arrangement is not possible when the grooves are arranged in the journal, i.e. directed inwards. Moreover, also in the case of grooves in the bearing shell, as acknowledged by appellant 2 itself (letter of 11 November 2013, page 5), it requires that the grooves are either very close or very deep. Yet, in the claimed crosshead bearing the grooves have the heaviest loaded portion of the bearing shell there between. Hence, they cannot be very close to each other. Moreover, since the thickness of the bearing shell is limited, they cannot be very deep either.

Thus, in the context of claim 1 the person skilled in the art would not interpret the feature in question as submitted by appellant 2.

Therefore, claim 10 does not comprise amendments that extend beyond the content of the application as filed.

6. Main request - Article 100(b) EPC

6.1 Appellant 2 argued that claim 1 was excessively broad, due to the large number of "and/or" combinations. In particular, in the case of axial lubrication grooves situated in the surface of the journal, it would be impossible to connect them with the radial bore by means of flow paths that extended only adjacently to the rear side of the bearing shell, because the bearing surface of the bearing shell would also have to be crossed. Hence this alternative of claim 1 was not sufficiently disclosed.

It is true that claim 1 covers a number of alternatives:
- the bearing may have at least two axial lubrication grooves or axial lines of lubrication openings;
- the lubrication grooves or openings may be disposed on the bearing surface of the lower bearing shell or on the journal;
- the flow path extends along all of its length from the opening of the radial bore at the surface of the journal associated with the bearing cap to the axial lubrication grooves or lines of lubrication openings substantially adjacent to the bearing surface and/or substantially adjacent to the rear side of either the upper or lower bearing shell.

A number of possible configurations can result from combining these possible alternatives. The claim is however not aimed at a philologist but at the person skilled in the art, who would a priori discard those semantically possible configurations which do not make technical sense. Said discarded configurations include the arrangement objected to by appellant 2, since it is evident that, when the lubrication grooves or openings are arranged on the surface of the journal, the flow path cannot be completely situated adjacent to the rear surface of the bearing shells but has to extend, at least in part, adjacent to the bearing surface of the bearing shells (a configuration covered by claim 1).

As it is undisputed that the other possible configurations, which make technical sense and would not be discarded by the person skilled in the art, are sufficiently disclosed, the invention of claim 1 complies with the requirements of Article 83 EPC.

6.2 As explained above, the feature of claim 10 requiring that the axial lubrication grooves are "tangentially spaced" from one another is construed by the person skilled in the art in a way that corresponds to the disclosure of the drawings. Hence, the invention of claim 10 is also disclosed in a manner sufficiently clear and complete for it to be carried out by a person skilled in the art.

6.3 According to claim 5, two diagonally arranged grooves (20') connect the respective diagonal groove (18) with the central bore (23). Appellant 2 argued that it was not clear how they could do that. However, in the drawings (for instance Figure 15) groove 18 is in fact shown as a circumferential groove. Likewise, claims 3 and 4, upon which claim 5 depends, refer to groove 18

as a circumferential groove. It is thus apparent that groove 18 is in reality a circumferential groove, which is incorrectly called a diagonal groove in claim 5. Since there is no problem in carrying out the invention when groove 18 is correctly called a circumferential groove, the issue raised by appellant 2 is actually a matter of clarity (arising from the incorrect terminology used in granted claim 5) and not a matter of sufficiency of disclosure. Hence, it cannot justify the revocation of the patent.

6.4 According to claims 7 and 12 the bearing is "positively dimensioned".

The description mentions bearings which are "negatively dimensioned" and bearings which are "positively dimensioned". The latter type of bearing is described in column 2, lines 10-17 as one where the radius of the crosshead journal is larger than the radius of the bearing surface of the bearing shell. This design is also referred to as an "embedded arc" because it ensures that there is a narrow gap between the bearing surface of the shell and the journal surface all around the circumference of the crosshead journal.

Whereas the definition of an "embedded arc" seems to relate to a bearing arrangement, the conditions relating to the radii given in said passage appear to define a press fit. Hence, these definitions seem to contradict each other and do not clarify what a "positively dimensioned" bearing is and how it is to be obtained.

Appellant 1 submitted that a positively dimensioned or embedded arc bearing had a non-cylindrically shaped shell obtained by choosing a radius of the crosshead

journal larger than the radius of the bearing surface of the bearing shell and deforming the shell by running in the bearing, whereby the deformation is rendered possible by the use of the white metal lining mentioned in paragraphs [0017] and [0032].

However, this procedure is not described in the patent. Also the mention of a white metal lining in paragraphs [0017] and [0032] does not describe any role in the production of positively dimensioned bearings.

Appellant 1 further submitted that the production of positively dimensioned bearings was within the common general knowledge of the person skilled in the art, citing document E11 as evidence. However, E11 is not a document describing the production of positively dimensioned bearings but merely a manual for operating a specific type of engine. Although it mentions the "embedded arc" geometry it does not describe its production, save for stressing the importance, in addition to the white metal coating, of a further overlayer, on which, by contrast, the patent in suit is completely silent.

Thus, on the basis of the evidence on file, the Board is not convinced that the disclosure of the patent, in combination with the common general knowledge of the person skilled in the art, is sufficiently clear and complete for the invention of claims 7 and 12 to be carried out by a person skilled in the art.

Therefore, the patent cannot be maintained as granted.

7. Auxiliary request

The auxiliary request, in which granted claims 7 and 12 have been deleted, meets the sole objection that is an obstacle to maintaining the patent as granted. Thus, the patent can be maintained on the basis of the auxiliary request.

Order

For these reasons it is decided that:

1. The decision under appeal is set aside.

2. The case is remitted to the department of first instance with the order to maintain the patent in amended form on the basis of the following documents:

   description columns 1 to 10 of the patent as granted;

   claims 1 to 11 of auxiliary request I, filed during oral proceedings before the Board;

   drawings figures 1 to 16 of the patent as granted.

The Registrar: The Chairwoman:

N. Schneider P. Acton

Decision electronically authenticated