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Datasheet for the decision of 26 April 2013

Case Number: T 2063/11 - 3.2.04

Application Number: 07015043.8

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Language of the proceedings: EN

Title of invention:
Bearing for refrigerating compressor and refrigerating compressor

Applicant:
DAIKIN INDUSTRIES, LTD.

Headword:

Relevant legal provisions:
EPC Art. 56

Keyword:
Inventive step - (no) - combination invention (no)

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Catchword:

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Case Number: T 2063/11 - 3.2.04

D E C I S I O N
of Technical Board of Appeal 3.2.04
of 26 April 2013

Appellant: (Applicant)	DAIKIN INDUSTRIES, LTD. Umeda Center Building, 4-12, Nakazaki-nishi 2-chome, Kita-ku Osaka-shi, Osaka 530-8323 (JP)
Representative:	Bockhorni & Kollegen Elsenheimerstraße 49 80687 München (DE)
Decision under appeal:	**Decision of the Examining Division of the European Patent Office posted on 14 April 2011 refusing European patent application No. 07015043.8 pursuant to Article 97(2) EPC.**

Composition of the Board:

Chairman: A. de Vries
Members: J. Wright
T. Bokor

Summary of Facts and Submissions

I. The Appellant (applicant) lodged an appeal, received on 08 June 2011, against the decision of the Examining Division, dispatched on 14 April 2011, on the refusal of the application No. 07015043.8 and paid the fee for appeal at the same time. The statement setting out the grounds of appeal was received on 03 August 2011.

The Examining Division held that the application did not meet the requirements of Article 52(1) in combination with Article 56 EPC having regard to the following documents
D1: US-A-5447774 and
D4: DE-A1-3414095.

II. Oral proceedings before the Board were duly held on 26 April 2013.

III. The Appellant requested that the decision under appeal be set aside and a patent be granted on the basis of a set of claims according to a main request filed with letter dated 15 February 2011, or in the alternative, on the basis of one of sets of claims according to 1st to 3rd auxiliary requests filed with letter dated 26 March 2013.

IV. Claim 1 of the main request reads as follows:
"Use of a bearing (1) in a refrigerating compressor, said bearing comprising a porous bronze based alloy (1b) and a resin material (1c) impregnated in pores of said porous bronze based alloy (1b), said porous bronze based alloy (1b) and said resin material (1c) being exposed at a sliding surface (1d),
characterized in that ratio of area of exposure of said porous bronze based alloy (1b) at said sliding surface

(1d) is at least 5% as a lower limit value in view of wear resistance and at most 60% as an upper limit value of seizure resistance and that the refrigerant compressed by the refrigerating compressor is a hydrofluorocarbon based substitute refrigerant not including chlorine."

Claim 1 of the first auxiliary request rewords the characterising portion of the claim as follows, with italics added by the Board to indicate what has been added: "…characterized in that
ratio of area of exposure of said porous bronze based alloy (1b) at said sliding surface (1d) is at least 5% as a lower limit value in view of wear resistance and at most 60% as an upper limit value *in view* of seizure resistance and that the refrigerant compressed by the refrigerating compressor is a hydrofluorocarbon based substitute refrigerant not including chlorine."

Claim 1 of the second auxiliary request rewords the characterising portion of the claim as follows, italics again added to indicate what has been added:"…
characterized in that
ratio of area of exposure of said porous bronze based alloy (1b) at said sliding surface (1d) is at least 5% as a lower limit value in view of wear resistance and at most *30%* as an upper limit value of seizure resistance and that the refrigerant compressed by the refrigerating compressor is a hydrofluorocarbon based substitute refrigerant not including chlorine."

Claim 1 of the third auxiliary request rewords the characterising portion of the claim as follows, italics again added to indicate what has been added:
"…characterized in that

ratio of area of exposure of said porous bronze based alloy (1b) at said sliding surface (1d) is at least 5% as a lower limit value in view of wear resistance and at most *30%* as an upper limit value *in view* of seizure resistance and that the refrigerant compressed by the refrigerating compressor is a hydrofluorocarbon based substitute refrigerant not including chlorine."

V. The Appellant's arguments, which apply to the main and auxiliary requests, may be summarised as follows:

D4 discloses a bearing used in the particular environment of a refrigerating compressor, whereas D1 discloses bearings without mentioning any field of application. Therefore D4 is the closest prior art. Furthermore the skilled person would not consider combining the teachings of D1 and D4 because bearings used in refrigerating compressors require special characteristics only of relevance in this field of application.

Although D1 refers to (a family member of) D4, it does so to highlight a problem with D4, namely that of bearing seizure. Therefore the skilled person would not combine these teachings in order to solve a problem concerning bearing seizure.

Even if the skilled person were to combine the teachings of D1 and D4 they would not arrive at the invention as claimed. Document D1 discloses results of tests on bearings which demonstrate a relationship between bronze exposure area ratios (to total area) at a bearing sliding surface and cutting allowance, cutting allowance being the depth to which the top layer of the bearing has been removed by machining prior to use. D1 does not disclose bearings that are

proven to have appropriate wear and seizure resistance when used in a refrigerating compressor or that would be advantageous when used with a chlorine free refrigerant, therefore the combination of D1 and D4 would not lead to the use of a bearing as claimed. D1 gives a range of experimental values without any suggestion that these would be advantageous. If anything the graphs of figure 1 seem to suggest values above 60% as beneficial.

In this regard the invention can be considered as a selection invention defining ranges of values of percentage exposure of porous bronze area (to total area) at the sliding surface of a bearing which will result in the bearing having optimal wear and seizure resistance when used in a refrigerating compressor.

Reasons for the Decision

1. The appeal is admissible.

2. Background of the Invention and Claim Interpretation

2.1 The application concerns a bearing for a refrigerating compressor, see application as filed, page 1, lines 6 and 7. In the embodiments described in the application, the compressor concerned has a scroll type compressing element, see page 4, lines 13 to 15 and figure 1. The bearings there are often made of porous bronze based alloy as these are less susceptible to corrosion caused by substitute refrigerant, page 2, lines 31 and 32. Resin material present in the pores of the bronze based alloy prevents bearing seizure, see page 3, lines 4 and 5. The main object of the application is to provide a bearing for a refrigerating compressor that is

resistant to seizure under "boundary lubrication" conditions whilst at the same time being resistant to wear, see page 2, lines 4-7. A "boundary lubrication" condition occurs when oil supply to the bearing becomes insufficient, see page 5, lines 10 to 12.

2.2 The main idea of the invention is to define a range of values for the exposure area ratio of bronze with respect to the total area of the sliding surface of a bearing that provides resistance to both seizure and wear, when used in contact with the shaft of a refrigerating compressor, see page 1, line 28 to page 2, line 15. Claim 1 of all requests is now limited to the use of a bearing in a refrigerating compressor.

2.3 Claim 1 of the main request and second auxiliary request include the term "upper limit value of seizure resistance". In claim 1 of the first and third auxiliary requests, the words "in view" have been added to the above term so that the corresponding term of these requests reads "upper limit value *in view* of seizure resistance". The Board interprets the above terms of all requests to mean "upper limit value in view of seizure resistance". Therefore the Board considers claim 1 according to the main request as having the same scope as claim 1 of the first auxiliary request. Likewise the board considers claim 1 according to the second and third auxiliary requests as having the same scope.

3. Inventive Step of all Requests

3.1 It is common ground that document D4, a family member of the citation on description page 1 of the application, can be considered as closest prior art. As

in the application, D4 is concerned with the problem of making a bearing for a refrigerating compressor which can operate under boundary lubrication conditions ("Grenzschichtschmierung"), see page 3, lines 1 to 18 and page 6, lines 8 to 14. D4 particularly concerns a compressor having a scroll type compressing element, see page 3, line 20 to page 4, line 19 and figure 3.

3.1.1 The bearing disclosed in D4, see its abstract and Figure 3, is composed of a porous bronze based alloy ("poröses Lagerteil ... Bronzesystemlegierung") and a filler material ("Verbundmaterial") comprising a lubricant ("Schmiermittel"), see also page 6, lines 13 to 22, where the filler material is a synthetic resin ("Kunstharz").

3.1.2 D4, figures 1 and 2, show comparative cross-sections of a part of a prior art bearing and a bearing according to the teaching of D4. As explained on page 11, lines 7 to 15, the original upper layer of the bearing, which contains no bronze but only the resin/lubricant material, is machined away resulting in a bearing with cross-section as shown in figure 2. It has a sliding surface 41 at which pieces of sintered bronze 20 and the resin/lubricant material 30 are exposed. The machining away of the upper resin/lubricant exposing the bronze structure at the sliding surface avoids excessive wear of the bearing, see page 11, lines 15 to 18. Furthermore, as is explained on page 11, line 27 to page 12, line 2, seizing ("Festfressen") of the bearing is prevented because of the self-lubricating properties of the resin/lubricant material. The Board therefore considers D4 to teach that, if only resin is present at the sliding surface there will be too much wear (but implicitly no risk of seizure) and if only bronze is

present at the sliding the bearing risks seizure (but implicitly will be resistant to wear).

3.2 However, as is stated in the application as filed, page 1, line 27 to page 2, line 1, (a family member of) D4 gives no indication as to the ratio of area of bronze [with respect to the total area] that needs to be exposed at the sliding surface. D4 is furthermore silent as to what refrigerant is to be used in the compressor.

3.2.1 It is therefore common ground that, for all requests, the differing features of the subject-matter of claim 1 with respect to document D4 are the characterising features of the claim. These differing features are: a specific range of values of ratio of area of exposure of porous bronze based alloy at the sliding surface expressed as a percentage [of the total area], (5% to 60% for the main and first auxiliary requests and 5% to 30% for the second and third auxiliary requests); and that the refrigerant used is a hydrofluorocarbon (or in short HFC) based substitute refrigerant not including chlorine (in all requests).

3.3 The technical effect of the specified range of values of ratio area is to provide an acceptable compromise between the bearing wearing too quickly and the bearing seizing up when used in a refrigerating compressor, see page 2, lines 4 to 7. The use of a HFC refrigerant without chlorine, on the other hand avoids destruction of the ozone layer of the atmosphere, see page 1, lines 10 to 14.

3.3.1 The first technical effect relates to the mechanical functioning of the bearing when the compressor is in use, whereas the second technical effect is only

significant should the refrigerant be released into the atmosphere, for example when the compressor is decommissioned. The Board therefore considers that there is no functional reciprocity and no combinative effect beyond the sum of these individual effects.

3.3.2 Although the Appellant has speculated that the chosen refrigerant could influence the required characteristics of the sliding surface of the bearing containing bronze, the Board is not aware of any evidence in the prior art or in the application to support this, nor has the Appellant identified any such evidence. The application as filed merely says that hydrofluorocarbon (HFC) substitute refrigerants are apt to corrode bearings containing aluminium, and that for this reason bronze is used as bearing material, see page 1, lines 15-18. D4 however already uses bronze. The Board therefore concludes that the above technical effects are independent of each other.

3.3.3 On the basis of the above effects, the two differences over D4 are seen to address the following separate objective technical problems: How to provide a bearing for use in the refrigerating compressor of D4 that has both good wear resistance and anti-seizing properties; and how to ensure the refrigerant compressed by the compressor of D4 does not damage or destroy the ozone layer. The skilled person, a mechanical engineer working in the field of refrigerating compressors, must address both these problems.

3.4 Considering the problem of achieving good wear resistance and anti-seizure properties, a first important question is whether the skilled person would look to D1 for a solution to this problem.

3.4.1 The Appellant argues that the refrigerating compressor application necessitates very specific bearing performance, therefore the skilled person would not consider applying the teaching of document D1, which is silent as to any field of application, in the field of refrigerating compressors. Thus the skilled person would never consider combining the teachings of D4 and D1.

3.4.2 The Appellant does not dispute that D1 itself cites (a family member of) document D4, see D1 column 1, lines 28 to 36. The Board agrees with the Appellant that the refrigerating compressor environment, particularly of the scroll type, places particular demands on the bearings used. This is explained in D4, page 3 line 8 to page 4 line 19, which mentions both wear and seizure (page 3, lines 16 and 17), and on page 6, lines 8-12 where the condition of boundary lubrication conditions ("Grenzschichtschmierung") occurring in bearings used in refrigerating compressors is discussed. D1 is expressly concerned with seizure and wear in the context of boundary lubrication, see column 1, opening paragraph and lines 47 to 55.

3.4.3 In view of this, the Board considers that the only reasons for the document D1 to discuss and make reference to document D4 can be because the intended application is the same or one placing comparable demands on the bearing. Therefore the Board considers that the skilled person would understand D1 to concern bearings intended for, or at least suitable for, use in the field of refrigerating compressors. In either case, the Board holds that as a consequence the skilled person would be aware of the teaching of D1 and consider it relevant to bearings used in his technical field of refrigerating compressors. The fact that

document D1 is also concerned with the problem of making a bearing which does not seize under boundary lubrication conditions, see column 1, lines 6 to 14, further supports this viewpoint. The Board therefore considers that the skilled person would consider combining the teachings of D1 and D4.

3.4.4 The Appellant furthermore argues that, since D1 explains that the bearing of (a family member of) D4 has a problem with seizure, see D1, column 1, lines 37 to 44, the skilled person would refrain from combining the teachings of the two documents. This argument could be valid when starting from the document D1 as the closest prior art, as the examining division did. In such a scenario it could be questioned whether the skilled person would look back to a teaching (D4) which D1 wants to improve.

3.4.5 However, the Board agrees with the Appellant that not D1 but D4 represents the closest prior art to the invention. In this case, given the above objective technical problem, the fact that D1 recognises a seizing problem with the bearings of D4 and aims to provide a new bearing having "an excellent anti-seizing property, without adversely affecting wear resistance", see D1 column 1, lines 52 to 55, is a compelling motivation for the skilled person to look to document D1 for a solution to the above problem.

3.4.6 The Board therefore has no doubt that, starting from document D4, the skilled person would consider combining the teachings of D4 and D1 to solve the above problem.

3.5 The next question is whether, in solving this problem, the combined teachings of D4 and D1 would lead the

skilled person to use bearings as claimed in the compressor of D4. The Appellant again does not dispute that D1 discloses bearing products comprising porous bronze impregnated with a synthetic resin, see for example column 3. Nor has he disputed that some of these bearing products exhibit percentage area of exposure of porous bronze based alloy parameters falling within the ranges claimed in claim 1 of all the requests on file, see for example D1, figure 1, bearing products 4-11 with respect to the vertical axis of the graph.

3.5.1 The Board interprets D1, figure 1 in conjunction with table 2, to mean that, in contrast to the tested prior art bearing samples numbered 1 and 2 (represented with crosses on figure 1 and which, according to table 2 and column 4, lines 23-26, seize when the cutting allowance is greater than 50 µm), the bearing samples numbered 4 to 11, with a cutting allowance of between 50 and 200 µm all exhibit satisfactory characteristics of seizure resistance. This can be inferred directly from column 4, lines 26 to 31, where it is stated that the samples 4 to 11 achieve this "without being adversely affected in [terms of] wear resistance". In this regard the Board notes that D1 expressly identifies these samples as the "invention" (table 1) or "products of the invention" (column 2, lines 61 to 63). These samples indeed form the core of D1's teaching. Therefore, the Board holds that not only would the skilled person look toward D1 for solving the above problem, this document also provides him with solutions in the form of the bearing samples of D1 table 2 and figure 1 numbered 4 to 11, having cutting allowances of, for example 50µm, 100µm, 150µm and 200µm. It would therefore be obvious for him to consider these sample for solving the above problem in a refrigerating compressor as in D4.

3.6 The two rightmost graphs in figure 1 of D1 (passing through circle and square points) set out the degree of exposure of porous [bronze] metal % [with respect to the total area] against the amount of cutting allowance for a discrete number of examples based on the invention compositions numbered 4 to 11 in table 1. Reading from the vertical axis of the graph, these samples have a percentage metal exposure at the sliding surface of between approximately 5% and 65%, that is within the range of values of claim 1 of the main and first auxiliary request. Of these samples, a smaller but not inconsiderable number fall within the percentage exposure range of 5 to 30% area of bronze, as claimed in claim 1 of the second and third auxiliary requests. D1 thus teaches discrete values of the area exposure ratio that lie within either of the two claimed ranges.

3.7 The Board holds that, by choosing bearings as in samples 4 to 11 known from D1 figure 1 and table 2 for use in the refrigerating compressor of D4, the skilled person would thus inevitably arrive at a refrigerating compressor which uses bearings having percentage ratios of area of porous bronze based alloy at the cutting surface falling within the ranges of that parameter as claimed in claim 1 of all the Appellants requests.

3.8 The Appellant also argues that, even if D1 does disclose points lying within the ranges of bronze exposure ratios defined in claims of all the requests, the invention can be considered as a selection invention in that the particular ranges claimed are defined by specific end-points that are not known from document D1. These confer on the range an advantageous technical effect in that, for a bearing used in a

refrigerating compressor and with area exposure ratio values within the ranges claimed, result in bearings which have a high seizure resistance, see page 7, lines 1 to 7 and figure 3, whilst at the same time having a high wear-resistance, see page 7, lines 8 to 11 and figure 4. The inventive selection can therefore be seen in defining these end-points, beyond which bearings are not useful for the particular application of a refrigerating compressor.

3.8.1 The case law relevant to selection inventions with respect to parameter ranges is reviewed in the Case Law of the Boards of Appeal (CLBA), 6th edition 2010, I.C. 4.2. In section I.C.4.2.1 CLBA, three necessary criteria are given for rendering a selected range of parameters within a known range novel. These are that:

(a) the selected sub-range should be narrow;
(b) the selected sub-range should be sufficiently far removed from the known range illustrated by means of examples;
(c) the selected area should not provide an arbitrary specimen from within the prior art, i.e. not a mere embodiment of the prior art description, but another invention (purposive selection).

3.8.2 The present range fulfills none of these criteria.The range of 5% to 60% of the main and first auxiliary requests covers most of the range of the two rightmost graphs in figure 1 of D1, the narrower range of 5% to 30% of the second and third auxiliary requests about half that prior range, and can thus hardly said to be narrow vis-a-vis the prior art range. Moreover, they are not in any way removed from the prior art range as illustrated by the discrete values shown in figure 1 of D1 because they in fact *include* many of them. Finally,

the claimed range has the same intended purpose as that of the samples in D1, namely preventing seizure without adversely effecting wear resistance, cf. page 2, lines 22 to 30 and page 3, lines 6 to 19, of the application as filed, and column 4, lines 23 to 35 of D1.

3.9 In the light of the above the Board concludes that the first characterising feature of claim 1 of all requests, namely that relating to ratio of area of exposure of porous bronze based alloy at the sliding surface, lacks inventive step with respect to D4 and D1.

3.10 As for the second difference, the Appellant does not dispute that it was known at the priority date of the application to replace refrigerants containing chlorine with HFC refrigerants without chlorine as the former were known to be harmful to the ozone layer, see also page 1, lines 10 to 14, of the application as filed. Indeed in some jurisdictions the use of substitute refrigerants not including chlorine is compulsory. This has not been challenged by the Appellant. For this reason alone the use of such a substitute to the very same end must be considered obvious.

3.10.1 Whilst the application as filed discloses that such substitute refrigerants cause corrosion of aluminium, see page 1, lines 15 to 17, the Appellant has not provided evidence to suggest that the same is true for bronze based alloys. The Board is therefore unable to identify any reason why the skilled person would be dissuaded from using the bearings disclosed in D1 with such a refrigerant, as the Appellant has argued.

3.10.2 On the contrary, the Board derives from the application as filed page 1, lines 16 to 21 referring to D4's

family member that material containing bronze had already been studied as the material of bearings using replacement refrigerants not including chlorine at the relevant date of the application. Neither D1 nor D4 hint at any incompatibility between bronze based bearings and hydrofluorocarbon substitute refrigerants not including chlorine.

3.11 Summarising, the Board holds that the skilled person would use bearings of the samples numbers 4 to 11 disclosed in tables 1 and 2 and figure 1 of D1 in the refrigerating compressor known from document D4 as a matter of obviousness. Furthermore the skilled person would obviously use a hydrofluorocarbon substitute refrigerant not including chlorine for compression in the compressor of D4. In so doing the skilled person would arrive at the subject matter of claim 1 of all of the requests on file in an obvious manner. The Board concludes that the subject matter of claim 1 of all requests lacks inventive step, Article 52(1) with Article 56 EPC.

Order

For these reasons it is decided that:

The appeal is dismissed.

The Registrar: The Chairman:

G. Magouliotis A. de Vries

Decision electronically authenticated