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Datasheet for the decision of 10 May 2016

Case Number: T 1819/12 - 3.3.05

Application Number: 05024929.1

Publication Number: 1657326

IPC: C25D1/00, C25D11/04, C22C21/02, F02F3/10, F16J1/02, F16J1/04

Language of the proceedings: EN

Title of invention:
Aluminium-piston at least partially covered with an alumina film

Patent Proprietor:
AISIN SEIKI KABUSHIKI KAISHA

Opponents:
KS Kolbenschmidt GmbH
Federal-Mogul Nürnberg GmbH

Headword:
Aluminium piston/AISIN SEIKI KABUSHIKI KAISHA

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

Keyword:
Inventive step - main request (no) - auxiliary request 1 (yes)

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Decisions cited:

Catchword:

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Case Number: T 1819/12 - 3.3.05

D E C I S I O N
of Technical Board of Appeal 3.3.05
of 10 May 2016

Appellant: (Opponent 1)	KS Kolbenschmidt GmbH Karl-Schmidt-Strasse 74172 Neckarsulm (DE)
Representative:	Greif, Thomas Thul Patentanwaltsgesellschaft mbH Rheinmetall Platz 1 40476 Düsseldorf (DE)
Respondent: (Patent Proprietor)	AISIN SEIKI KABUSHIKI KAISHA 1, Asahi-machi 2-chome Kariya-shi, Aichi-ken 448-8650 (JP)
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Party as of right: (Opponent 2)	Federal-Mogul Nürnberg GmbH Nopitschstrasse 67 90441 Nürnberg (DE)
Representative:	Hoffmann Eitle Patent- und Rechtsanwälte PartmbB Arabellastraße 30 81925 München (DE)
Decision under appeal:	**Decision of the Opposition Division of the European Patent Office posted on 26 June 2012 rejecting the opposition filed against European patent No. 1657326 pursuant to Article 101(2) EPC.**

Composition of the Board:

Chairman J.-M. Schwaller
Members: A. Haderlein
P. Guntz

Summary of Facts and Submissions

I. Opponent 1 (appellant) lodged an appeal against the decision of the opposition division rejecting the oppositions against European patent No. 1 657 326. The patent concerns an aluminium piston at least partially covered with an alumina film.

II. The opposition division held that the grounds for opposition mentioned in Article 100(b) and 100(a) in conjunction with Articles 52(1) and 54 and 56 EPC did not prejudice the maintenance of the patent as granted, having regard in particular to the following documents:

D1: RU 2 056 515 C1
D2: Kurze, P., "*Micro Arc/Spark Anodizing - What is that?*", Galvanotechnik 8/2003
D3: Sundararajan, G., and Rama Krishna, L, "*Mechanisms underlying the formation of thick alumina coatings through the MAO coating technology*", Surface and Coatings Technology 167 (2003), pages 269 to 277
D6: WO 00/05493 A1.

In the present decision, for documents D1 and D6 reference will be made to their respective translations (referred to as D1' and D6' in the impugned decision).

III. In its letter dated 1 March 2013, the respondent replied to the grounds of appeal and filed an auxiliary request.

IV. The board issued a communication drawing the parties' attention to the fact that D1 disclosed anodic micro-arc oxidation as the preferred oxidation process, as well as a piston having improved abrasion characteristics.

V. Under cover of its letter dated 11 April 2016 the respondent filed an auxiliary request 2.

VI. At the oral proceedings before the board, the respondent referred to:

D12: Test results submitted with letter dated 8 March 2012 in preparation for the oral proceedings before the opposition division.

VII. Claim 1 of the main request (patent as granted) has the following wording:

"*1. A piston (1) having a piston body (10) made of aluminium or an aluminium alloy,*
at least a predetermined portion of the surface of the piston body (10) being covered with an oxide film (17) formable by means of plasma oxidation treatment,
characterized in that
and the predetermined portion of the surface is at least one of a piston ring portion (12, 13, 14) for contacting with a piston ring, a piston skirt portion (15) for contacting with a cylinder, and a pin boss portion (16) for contacting with a piston pin, the amount of γ-alumina contained in the oxide film (17) is equal to or more than 5% by weight and equal to or less than 99.5% by weight,
the amount of α-alumina contained in the oxide film (17) is equal to or more than 0.5% by weight and equal to or less than 95% by weight, and
the oxide film (17) has a Vickers hardness (HV) of between 1200 and 1400."

VIII. The sole independent claim 1 of auxiliary request 1 corresponds to claim 1 of the main request and further includes the following feature:

"*wherein the thickness of the oxide film (17) is 10 to 20 µm*".

IX. The arguments of the appellant may be summarised as follows:

Main request

While D6 could also be considered the closest prior art, D1 appeared to be more appropriate for this purpose. The subject-matter of claim 1 differed from D1 only in the Vickers hardness (HV). The skilled person would always strive to make the oxide film as thin as possible, as this would make the process less costly. Apart from the film thickness, other parameters of the oxidation process such as the composition of the underlying aluminium alloy or the composition of the electrolyte influenced the hardness of the film. D2 taught to decrease the thickness of the piston according to D1. When looking for an alternative, the skilled person would not stick to the optimum thickness of at least 100 µm disclosed in D1 and would envisage thinner oxide films.

Auxiliary request 1

Essentially the same arguments applied. Furthermore, the patent did not disclose an effect for the thickness range 10 to 20 µm. Figure 4 of D3 taught that the film thickness could be decreased while still achieving reasonable hardness values. D2 taught that maximum thicknesses of 200 µm were obtained, implying that any thickness below that value was also possible. Moreover, the same passage disclosed an HV value of up to 1500. Therefore, it was obvious to work in the claimed thickness range.

X. The arguments of the respondent may be summarised as follows:

Main request

The closest prior art was D1. The piston of claim 1 differed from that disclosed in D1 by having a Vickers hardness (HV) of between 1200 and 1400. The problem to be solved was to provide a piston having a good balance between abrasion resistance, seizure resistance and surface roughness. The balance was better than that of the piston known from D1, as evidenced by D12. D12 admittedly disclosed neither the process for obtaining the test pieces nor properties thereof, such as the thickness or the aluminium alloy of the base material. When submitting D12 the respondent had decided not to disclose this information for commercial reasons.

The piston of D1 was likely to have a hardness of 2000 to 2500 in view of Figure 4 of D3, and in view of D2. There was no indication to work at lower HV values as evidenced by D6. D2 was a document from a different technical field; it did not give any hint to apply its teaching to a piston according to D1. D3 disclosed thicknesses of 20 to 90 µm and HV values of 1000 to 1800 and taught that at lower final coating thicknesses the HV decreased. In D1 a minimum thickness of 100 µm was required. The skilled person would not have deviated from this teaching, i.e. would not have decreased the thickness of the coating in order to achieve lower HV values. Morever, D2 could not be considered a general teaching since the HV values disclosed therein related to a specific product, i.e. KEPLA-COAT®. It was not contested that numerous further parameters such as the composition of the underlying aluminium alloy or the composition of the electrolyte influenced the hardness of the coating obtained.

Auxiliary request 1

Apart from the arguments provided with respect to the main request, there was no hint in the prior art to provide the piston of D1 with an oxide film as thin as 10 to 20 µm and having an HV value within the claimed range. D1 taught that best results were obtained at a minimum thickness of 100 µm, whereas D6 disclosed a minimum thickness of 50 µm and a minimum hardness of 1530.

XI. Requests

The appellant requested that the decision under appeal be set aside and that the European patent be revoked.

The respondent requested that the appeal be dismissed or, in the alternative, that the patent be maintained in amended form on the basis of auxiliary request 1, filed with the letter of 1 March 2013, or on the basis of auxiliary request 2, filed with the letter of 11 April 2016.

Reasons for the Decision

1. Main request - inventive step

1.1 Invention

The invention concerns a piston having a piston body made of aluminium or an aluminium alloy (see paragraph [0001] and granted claim 1 of the patent in suit).

1.2 Closest prior art

Both parties consider D1 to be a suitable starting point for the discussion of inventive step. In the written proceedings, the appellant also proposed D6 as closest prior art but did not pursue this approach any further at the oral proceedings before the board.

D1 uncontestedly discloses all features of claim 1 except the hardness as called for in claim 1. Moreover, the patent (see paragraphs [0007] and [0010]) is concerned with improved properties of a piston, in particular with improved abrasion resistance, which is also aimed at in D1 (see page 3, third paragraph, last sentence). Conversely, D6 is concerned with a method for applying a coating requiring less energy (page 3, second paragraph). D6 also mentions reduction of friction and decrease in wear, but in the context of the discussion of D1 (D6, page 1, Prior Art section, second paragraph). Furthermore, D6 at least does not explicitly disclose the composition of the aluminium oxide of the coating in terms of α-alumina and γ-alumina content called for in claim 1 and moreover rather teaches away from the claimed HV values, since it discloses a microhardness of "not less than 15 GPa", corresponding to an HV value of 1530 (see paragraph

[0006] of the patent in suit).

For these reasons, the closest prior art is represented by document D1.

The parties agree that the subject-matter of claim 1 differs from the disclosure of D1 only in that the oxide film has a hardness of between 1200 and 1400 HV.

1.3 Problem

The problem underlying the patent in suit is to improve abrasion resistance (see in particular paragraph [0010]).

1.4 Solution

The patent proposes to solve this problem by means of a piston having a piston body made of aluminium or an aluminium alloy characterised in that the Vickers hardness is between 1200 and 1400.

1.5 Success of the solution

1.6 The piston known from D1 already shows excellent abrasion characteristics (see page 3, third paragraph, last sentence). D1 discloses anodic micro-arc oxidation as the preferred oxidation process, which is the same process as in the patent in suit (cf. paragraph [0006], wherein it is stated that plasma oxidation corresponds to micro-arc oxidation; see also D3, Introduction, first paragraph, and D2, section 1.5). The patent in suit is silent about the composition and hardness of the comparative example and also about the corresponding properties of the example according to the invention. Furthermore, the comparative example is said to have been carried out using (conventional) anodic oxidation (column 6, line 18), whereas the example according to the invention was carried out using plasma oxidation, the treatment which is also used in D1 (see above). The piston disclosed in D1 thus comes closer to the claimed piston than the comparative example of the patent in suit, since the oxide film of D1 is obtained by the same process as the oxide film of the example according to the invention.

It is therefore not credible that the problem of improving abrasion resistance is solved.

1.7 Reformulation of the problem

1.7.1 For the above reasons, the problem needs to be reformulated.

1.7.2 According to the respondent, the problem should be reformulated so as to achieve a better balance between seizure resistance, surface roughness and abrasion resistance. The corresponding effects were described in the patent, in particular in paragraph [0029]. D12 showed that this problem was effectively solved.

1.7.3 The board notes that D12 is of little probative value. In particular, D12 discloses, neither the process according to which the test pieces were obtained nor their properties, such as the thickness of the oxide film. It is therefore not possible to establish whether the purported effect of improved "wear ratio" as stated in D12 is due to the hardness only or also results from other parameters. Moreover, D12 appears to relate only to wear, i.e. abrasion resistance, but is silent about other properties such as seizure resistance and surface roughness. The board also notes in this context that by increasing the thickness of the oxide film the surface roughness is generally increased (see D2, section 3.1, last sentence; cf. also the patent in suit, last full sentence in column 1). The oxide film in claim 1 not being restricted in thickness, claim 1 also encompasses pistons having a rather rough surface. Thus, in view of these considerations and in view of the low probative value of D12 it is not credible that the claimed piston leads to an improved balance between seizure resistance, surface roughness and abrasion resistance.

1.7.4 Hence, the problem is reformulated and consists in the provision of an alternative or further piston.

1.8 Obviousness

1.8.1 According to the respondent, in the light of Figure 4 of D3 the HV value of the oxide film in D1 was likely to be of the order of 2000 to 2500.

The board is not convinced by this argument. First, D1 only discloses that the oxide film may be obtained by micro-arc or plasma oxidation (page 3, third paragraph, last sentence), but is silent about the process parameters. Second, Figure 4 of D3 refers to the "peak hardness", i.e. the hardness measured at a distance of 10 µm from the substrate-film interface (page 272, left-hand column, first paragraph) and not to the hardness at the surface of the coating. which is lower than the "peak hardness" (page 271, right-hand column, last paragraph). Third, the oxide film of D3 has a significantly different composition (see section 3.4: "a <u>small</u> proportion of α-Al_2O_3 also present", emphasis added) from that of D1 (page 3, third paragraph: "α-Al_2O_3 (35-40 %)"). Thus, D3 does not support the conclusion that the oxide film disclosed in D1 has HV values of around 2000 to 2500. Also, the respondent's reference to D2, page 8, section 2.2, third paragraph, in which reference is made to "Russian processes", does not support the conclusion that such high HV values are obtained in patent application D1, whose inventors and applicants appear to be of Russian nationality. D2 refers to "Russian processes" in the context of the type of current (AC) and the current densities used, which are said to be higher than in other processes using DC voltage. D2 teaches that the use of AC instead of DC in these processes entails higher current densities but results in the same film-formation rates. No conclusion can be drawn from this passage with respect to hardness. Hence D1 does not disclose any HV values, and the question to be answered by the board is whether it was obvious to the skilled person to arrive at HV values within the claimed range when starting from D1.

1.8.2 It is undisputed that, apart from the thickness of the oxide film, the skilled person was aware that other parameters such as the composition of the aluminium alloy of the piston or the composition of the electrolyte influence the hardness of the oxide film (cf. D2, sections 1.1 and 2.2, and D3, page 269, sentence bridging the left-hand and right-hand columns).

1.8.3 D2 discloses that using a particular micro-arc or plasma oxidation process (cf. page 3, last paragraph) an oxide film having a composition comparable to the one of D1 with thicknesses of up to 200 µm and showing HV values of up to 1500 is obtained (page 10, section 3.2.2, second paragraph). In view of the problem to be solved, i.e. to provide an alternative or further piston, the skilled person would therefore at least have tried to vary the process parameters such as the alloy composition or the electrolyte composition and would eventually have arrived at HV values falling within the claimed range of 1200 to 1400. Moreover, faced with this least ambitious problem of finding an alternative or further piston, the skilled person would even have considered thicknesses below 100 µm. While it is true that D1 teaches that best results are obtained at thicknesses of 100 to 300 µm, it does not teach that below these values the results obtained would be unacceptable. In particular, claim 1 of D1 does not require a minimum thickness of 100 µm. So, even if the respondent were right in that it would have been necessary to decrease the thickness of the oxide film of D1 in order to arrive at HV values called for in claim 1 of the main request, the skilled person faced with the problem to be solved would also have used thicknesses of below 100 µm, all the more so as smaller thicknesses directly translate into shorter process durations, since the duration of the oxidation process is directly proportional to the oxide film thickness (see D2, section 2.2, second paragraph, last sentence, and third paragraph, last sentence).

1.8.4 According to the respondent, the skilled person would not have consulted D2 since it was from a technical field not related to the technical field of D1. The board disagrees. D1 relates to combustion engines (page 1, section 54) and to engine elements having a surface layer (section 57, third and fourth paragraphs). D2 relates to a more general technical field, i.e. surface treatment for corrosion and wear resistance (page 2, first paragraph), and for this reason alone it would have been consulted by the skilled person. Moreover, D2 explicitly makes reference to the "vehicle industry" (page 14, second paragraph). Also for this reason the skilled person would have considered the teachings of D2, since he was aware that in this technical field abrasion or wear is especially critical in moving parts of a combustion engine.

1.8.5 Further according to the respondent, the skilled person would not have combined the teachings of D2 and D1, since the part disclosing the HV values of up to 1500, i.e. section 3.2.2, related to a specific material called KEPLA-COAT®.

For the board, this argument is not persuasive. The material referred to in this passage of D2 is said to consist of up to 60% α-alumina, the remainder consisting of γ-alumina and boehmite, whereas the oxide film in D1 is said to consist of 35-40% α-alumina, 40-50% γ-alumina and mullite. The compositions of the oxide films of D1 and D2 are therefore comparable at least with respect to their α-alumina, of which the skilled person was aware that it is responsible for the hardness of the oxide film.

1.8.6 Thus, the subject-matter of claim 1 was obvious in view of D1 and D2.

2. Auxiliary request 1 - inventive step

2.1 For the invention, the closest prior art, the problem, the solution and the success of the solution, see 1.1 to 1.5 *supra*.

2.2 Reformulation of the problem

2.2.1 The problem is to be reformulated for the reasons set out at 1.5 *supra*.

2.2.2 The problem consists in the provision of an alternative piston having a high degree of abrasion resistance, seizure resistance and surface smoothness. This problem is indeed solved since the patent discloses a piston according to claim 1 of the auxiliary request 1 having a thickness of 10 µm (i.e. within the claimed range) and showing the above-mentioned properties (see column 6, lines 15 and 16; paragraphs [0026], [0027] and [0029]).

2.3 Obviousness

2.3.1 D2 teaches that thicknesses usually employed are between 40 and 60 µm (section 3.2.2). D2 therefore does not teach to apply thicknesses of as low as 20 µm in the piston according to D1 in order to provide an alternative piston having a high degree of abrasion resistance, seizure resistance and surface smoothness. It is true that D2 discloses the possibility of having thicknesses of up to 200 µm (*loc. cit.*). But this cannot be construed as a pointer to the skilled person to work below the limits usually employed as stated above. Moreover, there is no evidence that the person skilled in the art, even when applying thicknesses of 10 to 20 µm, would inevitably arrive at a piston having a hardness in the range of 1200 to 1400 HV as required by claim 1.

2.3.2 D3 discloses final oxide film thicknesses of as low as 20 µm, but teaches that the maximum hardness measured in these conditions is below 1000 HV (see in particular "Figure 4", variation in microhardness as a function of the final oxide film thickness). Thus, D3 fails to point the skilled person towards working in the claimed thickness and hardness ranges when aiming at solving the problem posed.

2.3.3 D6 discloses a piston having an oxide film which is at least 50 µm thick and has "a microhardness of not less than 15 GPa" (page 2, third paragraph from the bottom), corresponding to an HV value of 1530 (see paragraph [0006] of the patent in suit). Thus, D6 does not give any hint at a thickness and a hardness falling within the claimed ranges.

2.3.4 It follows that the subject-matter of claim 1 of auxiliary request 1 was not obvious in view of the state of art. The requirements of Article 56 EPC are therefore met. The same holds true for dependent claims 2 to 4, which relate to specific embodiments of the piston according to claim 1.

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 auxiliary request 1, filed with the letter of 1 March 2013, and a description to be adapted.

The Registrar: The Chairman:

C. Vodz J.-M. Schwaller

Decision electronically authenticated