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Datasheet for the decision of 13 April 2021

Case Number: T 1099/19 - 3.2.04

Application Number: 07859717.6

Publication Number: 2123914

IPC: F04C2/10

Language of the proceedings: EN

Title of invention:
OIL PUMP ROTOR

Applicant:
Aisin Seiki Kabushiki Kaisha

Headword:

Relevant legal provisions:
EPC Art. 123(2), 84, 111(1)
RPBA 2020 Art. 11
EPC R. 137(5)

Keyword:

Amendments - allowable (yes)
Claims - clarity - main request (yes) - product-by-process claims
Appeal decision - remittal to the department of first instance (yes)
Amendments of application - allowable (yes)

Decisions cited:

Catchword:

Europäisches Patentamt
European Patent Office
Office européen des brevets

Beschwerdekammern

Boards of Appeal

Chambres de recours

Boards of Appeal of the
European Patent Office
Richard-Reitzner-Allee 8
85540 Haar
GERMANY
Tel. +49 (0)89 2399-0
Fax +49 (0)89 2399-4465

Case Number: T 1099/19 - 3.2.04

D E C I S I O N
of Technical Board of Appeal 3.2.04
of 13 April 2021

Appellant: (Applicant)	Aisin Seiki Kabushiki Kaisha 1, Asahi-machi 2-chome, Kariya-shi, Aichi 448-8650 (JP)
Representative:	Kramer Barske Schmidtchen Patentanwälte PartG mbB European Patent Attorneys Landsberger Strasse 300 80687 München (DE)
Decision under appeal:	**Decision of the Examining Division of the European Patent Office posted on 20 September 2018 refusing European patent application No. 07859717.6 pursuant to Article 97(2) EPC.**

Composition of the Board:

Chairman	C. Kujat
Members:	G. Martin Gonzalez
	W. Van der Eijk

Summary of Facts and Submissions

I. The appeal lies from the decision of the examining division of the European Patent Office, posted on 20 September 2018 concerning refusal of the European Patent Application No. 07859717.6 pursuant to Article 97(2) EPC.

II. The applicant as appellant lodged an appeal against this decision, which was received on 16 November 2018, and simultaneously paid the appeal fee. The statement setting out the grounds of appeal was received on 18 January 2019.

III. The examining division held that claim 1 of the main and sole request filed on 12 January 2018 was not clear. It concluded that the application and the invention to which it related, did not meet the requirements of the EPC, and refused the application.

IV. The appellant requests that the decision is set aside and that a patent is granted based on the main request, or auxiliarily on the basis of one of the first or second auxiliary requests, all filed with the statement setting out the grounds of appeal, or as third auxiliary request to grant a patent on the basis of the set of claims filed on 12 January 2018.

V. Independent claim 1 of the main request reads as follows (additions and deletions with regard to the request underlying the impugned decision highlighted by the board):

"1. An oil pump rotor comprising:

an inner rotor (10) formed with n (n: a natural number) external teeth (11), and an outer rotor (20) formed with n+1 internal teeth (21) which are in meshing engagement with each of the external teeth (11), wherein ,
the oil pump rotor is adapted to be used in an oil pump which ~~includes~~ has a casing (50) having an suction port (40) for drawing in fluid and a discharge port (41) for discharging fluid and which conveys the fluid by drawing in and discharging the fluid due to changes in volumes of cells (30) formed between surfaces of the internal teeth (21) and surfaces of the external teeth (11) during rotations of the rotors (10, 20) under meshing engagement therebetween,
characterized in that
a tooth profile (U_{in}) of the external teeth (11) of the inner rotor (10) is ~~corrected in a radial direction~~ formed by a correction in a circumferential direction and by a correction in a radial direction applied to a tooth profile (U') defined by a mathematical curve, with the correction in a circumferential direction being applied while maintaining a distance between a radius R_{A1} of an addendum circle A_1 and a radius R_{A2} of a tooth groove circle A_2, the mathematical curve ~~is~~ being one of a cycloid, an envelope of circular arcs centered on a trochoid, and a circular-arc-shaped curve in which the addendum portion and the tooth groove portion are defined by two circular arcs that are in contact with each other, ~~in which the tooth profile of the external tooth (11) of the inner rotor (10) is corrected in a radial direction,~~ in the correction in the circumferential direction a first correction ratio γ_1 when a portion outwardly of the circle C_1 of radius R_{C1} which satisfies $R_{A1}>R_{C1}>R_{A2}$ is corrected is applied, and a second correction ratio γ_2 when a portion inwardly of the circle C_1 is corrected is applied,

$\gamma_1=\theta_1/\theta'_1$ being the inverse ratio of an angle θ'_1 before the correction and the angle θ_1 after the correction with the angle formed by a half line which connects the center O_1 of the inner rotor and one end of the curve that defines the shape of the portion outwardly of the circle C_1 and by a half line which connects the center O_1 of the inner rotor and the other end of the curve, $\gamma_2=\theta_2/\theta'_2$ being the inverse ratio of an angle θ'_2 before the correction and the angle θ_2 after the correction with the angle formed by a half line which connects the center O_1 of the inner rotor and one end of the curve that defines the shape of the portion inwardly of the circle C_1 and by a half line which connects the center O_1 of the inner rotor and the other end of the curve,

since the coordinates (X_{10}, Y_{10}) of the shape of the portion U'_1 outwardly the circle C_1 are expressed as $(R\cos\theta_{11}, R\sin\theta_{11})$ when the distance between these coordinates and the center O of the inner rotor is R and the angle which the straight line passing through the center O of the inner rotor and the coordinates makes with the X-axis is θ_{11}, the coordinates (X_{11}, Y_{11}) for the corresponding shape of the portion U_1 outwardly of the circle C_1, which is obtained by correcting in the circumferential direction, is expressed as $(R\cos(\theta_{11}*\gamma_1),R\sin(\theta_{11}*\gamma_1))=(R\cos\theta_{12},R\sin\theta_{12})$ using the correction ratio γ_1, where θ_{12} is the angle which the straight line that passes through the center O of the inner rotor and the coordinates (X_{11}, Y_{11}) makes with the X-axis,

since the coordinates (X_{20}, Y_{20}) of the shape of the portion U'_2 inwardly the circle C_1 are expressed as $(R\cos\theta_{11}, R\sin\theta_{11})$ when the distance between these coordinates and the center O of the inner rotor is R and the angle which the straight line passing through

the center O of the inner rotor and the coordinates makes with the X-axis is θ_{21}, the coordinates (X_{21}, Y_{21}) for the corresponding shape of the portion U_2 outwardly of the circle C_1, which is obtained by correcting in the circumferential direction, is expressed as $(R\cos(\theta_{21}*\gamma_2),R\sin(\theta_{21}*\gamma_2))=(R\cos\theta_{22},R\sin\theta_{22})$ using the correction ratio γ_2, where θ_{22} is the angle which the straight line that passes through the center O of the inner rotor and the coordinates (X_{21}, Y_{21}) makes with the X-axis, and
if the number of teeth (the number of the external teeth) of the inner rotor before and after the correction in the circumferential direction is n' and n, n' and n being respectively natural numbers, the equation $n'*(\theta'_1+\theta'_2)=n*(\theta_1+\theta_2)$ holds, and
in the correction in the radial direction, when a portion outwardly of the circle D_1 of radius R_{D1} which satisfies $R_{A1}\geq R_{D1}\geq R_{C1}\geq R_{D2}\geq R_{A2}$ is corrected, a shape of an addendum is defined by a curve formed by Equations (1) to (4), and when a portion inwardly of the circle D_2 of radius R_{D2} is corrected, a shape of a tooth groove is defined by a curve defined by Equations (5) to (8)
wherein

$$R_{12}=(X_{11}^2+Y_{11}^2)^{1/2}\ , \qquad (1)$$

$$\theta_{12}=\arccos(X_{11}/R_{12})\ , \qquad (2)$$

$$X_{12}=\{(R_{12}-R_{D1})*\beta_{10}+R_{D1}\}*\cos\theta_{12}, \qquad (3)$$

$$Y_{12}=\{(R_{12}-R_{D1})*\beta_{10}+R_{D1}\}*\sin\theta_{12}, \qquad (4)$$

where, (X_{11}, Y_{11}) are coordinates of the shape of the addendum before the correction in the radial direction, (X_{12}, Y_{12}) are coordinates of the shape of the addendum after the correction in the radial direction, R_{12} is a distance from the center of the inner rotor to the coordinates (X_{11}, Y_{11}), θ_{12} is an angle which the straight line which passes through the center of the

inner rotor and the coordinates (X_{11}, Y_{11}) makes with an X-axis, and β_{10} is a corrective coefficient for the correction, and

wherein

$R_{22}=(X_{21}^2+Y_{21}^2)^{1/2}$, (5)

$\theta_{22}=\arccos(X_{21}/R_{22})$, (6)

$X_{22}=\{R_{D2}-(R_{D2}-R_{22})*\beta_{20}\}*\cos\theta_{22}$, (7)

$Y_{22}=\{R_{D2}-(R_{D2}-R_{22})*\beta_{20}\}*\sin\theta_{22}$, (8)

where, (X_{21}, Y_{21}) are coordinates of the shape of the tooth groove before the correction in the radial direction, (X_{22}, Y_{22}) are coordinates of the shape of the tooth groove after the correction in the radial direction, R_{22} is a distance from the center of the inner rotor to the coordinates (X_{21}, Y_{21}), θ_{22} is an angle which a straight line which passes through the center of the inner rotor and the coordinates (X_{21}, Y_{21}) makes with the X-axis, and β_{20} is a corrective coefficient for the correction

~~characterized in that a correction ratio $\gamma_1=\theta_{12}/\theta_1$ for the portion outwardly of the circle D_1 satisfies $\gamma < 1$, and a correction ratio $\gamma_2 = \theta_{22}/\theta_2$ for the portion inwardly of the circle D_2 satisfies $\gamma_2 < 1$, where, θ_1 is the angle for the shape of the addendum before the correction and θ_2 is the angle for the shape of the tooth groove before the correction."~~

The other independent claim 6 has corresponding features to claim 1, albeit formulated in terms of a process of making an oil pump rotor.

VI. The appellant argued as follows:

Claim 1 of the main request is clear. Independent claim 1 according to the main request is a combination of original claims 1, 2 and 3 with a further definition of the correction in a circumferential direction based on

the disclosure in paragraphs [0024] to [0026]. A search should have been carried out on (original) claim 1 and corresponding dependent claims, and refusing to search (original) claim 3 was not justified. A patent should be granted based on the main request filed with the statement setting out the grounds of appeal.

Reasons for the Decision

1. The appeal is admissible.

2. *Background*

The invention concerns an oil pump rotor with an inner rotor and an outer rotor. A tooth profile of the external teeth of the inner rotor is formed by a correction in a circumferential direction and by a correction in a radial direction. These corrections are applied to a tooth profile which is defined by a mathematical curve selected from the group of a cycloid, an envelope of circular arcs centered on a trochoid, and a circular-arc-shaped curve in which the addendum portion and the tooth groove portion are defined by two circular arcs that are in contact with each other. These corrections make it possible to increase the discharge rate of the oil pump without increasing its rotor size, and to provide an oil pump rotor with reduced pulsation and noise level (application, paragraph 10).

3. *Clarity*

The appellant-applicant disputes the decision's finding that the subject-matter of independent claim 1 is not clear.

3.1 It is common ground that the corrections are applied to the tooth profile before the inner rotor of the oil pump is manufactured, and that claim 1 may be considered a product-by-process claim (impugned decision, item 20 of the reasons, fourth and seventh paragraphs).

3.2 The Board also endorses the examining division's observation that a change in the number of teeth resulting from the correction cannot be identified on the inner rotor once it is manufactured. In that respect, it is worth noting that independent claim 1 also encompasses embodiments in which the number of teeth is not altered by the circumferential correction (i.e. when γ_1 equals $1/\gamma_2$).

3.3 However, the Board is not convinced that "the substantial claimed features of the product ... cannot be identified" (item 21 of the reasons).

3.3.1 In accordance with established jurisprudence, with regard to product-by-process claims, the requirement of clarity means that the skilled person should be able to determine, either from the claim alone or, by construction of the claim in the light of the description, or by construction in the light of the skilled person's common general knowledge, which identifiable and unambiguous technical features are imparted to the product by the process by which it is defined (CLBA, 9th edition 2019, II.A.7.1).

3.3.2 In the present case, the correction in a circumferential direction and the correction in a radial direction are applied to a tooth profile defined by a specific mathematical curve. According to claim 1, this mathematical curve is either a cycloid, an

envelope of circular arcs centered on a trochoid, or a circular arc shaped curve in which the addendum portion and the tooth groove portion are defined by two circular arcs that are in contact with each other. Examples of these three types of mathematical curves are shown in figures 4, 8 and 9, respectively.

3.3.3 According to common general knowledge, a cycloidal gear profile is based on the epicycloid and hypocycloid curves, which are the curves generated by a circle rolling around the outside and inside of another circle, respectively (see Wikipedia, "Cycloid gear").

Once the correction in the circumferential direction and the correction in the radial direction are carried out, the tooth profile of the external teeth of the internal rotor will deviate from a cycloidal gear profile. The reason is that the correction in the circumferential direction (by multiplication with the correction ratios γ_1 and γ_2) is applied to the entire angular width of a given tooth, i.e. both to its angular width θ'_1 outwardly of the circle C_1 and its angular width θ'_2 inwardly of the circle C_1 (see figure 1). In contrast to that, the correction in the radial direction (by multiplication with the corrective coefficients β_{10} and β_{20}) is applied only to those parts of the radius outwardly of the circle D_1 and inwardly of the circle D_2 (see formulas (3), (4), (7) and (8)), while the remaining parts of the radius, between R_{D1} and R_{D2}, are not corrected. In other words, the resulting corrected tooth profile of the internal rotor after correction is no longer a cycloidal gear profile.

The same logic applies to the final tooth profiles resulting from such corrections applied to a tooth profile defined by an envelope of circular arcs

centered on a trochoid, or a circular-arc-shaped curve in which the addendum portion and the tooth groove portion are defined by two circular arcs that are in contact with each other.

3.3.4 The Board therefore concludes that the skilled person is able to determine, either from the claim alone or, by construction of the claim in the light of the description, or by construction in the light of the skilled person's common general knowledge, that the final tooth profile of the external teeth of the inner rotor is defined by a mathematical curve which is not a cycloid, not an envelope of circular arcs centered on a trochoid, and not a circular-arc-shaped curve in which the addendum portion and the tooth groove portion are defined by two circular arcs that are in contact with each other. These features may be broad (which can be an issue for novelty and/or inventive step), but they are clear.

3.4 The above reasoning also applies to independent claim 6 *mutatis mutandis*. Therefore, the Board is of the opinion that the main request meets the requirements of Article 84 EPC.

4. Amendments

4.1 The subject matter of claim 1 is a direct combination of original claims 1 and 2 (the mathematical curve corrected to a cycloid in view of paragraph 62), with further features taken from paragraphs 24 and 25 (the correction ratios γ_1 and γ_2 and the coordinates X_n, Y_n for the correction in the circumferential direction) and 26 (the number of teeth) of the original description.

Thus, the Board concludes that claim 1 does not contain added subject matter extending beyond the application as filed, Article 123(2) EPC.

Since the subject matter of the other independent claim 6 corresponds to that of claim 1, it likewise meets the requirements of Article 123(2) EPC.

4.2 The additional features incorporated into amended claims 1 and 6 for specifying the correction in the circumferential direction were present in original claim 3. While original claims 1 and 2 were considered completely searchable, claim 3 was not searched by the search division (see Sheet C of the Supplementary Partial European Search Report).

Pursuant to Rule 137 (5) EPC, amended claims may not relate to subject-matter not searched in accordance with Rule 62a or Rule 63 EPC. However, the Board finds present claim 1 (including all features from original claims 1 and 3) to be clear and compliant with Article 84 EPC, see above. The Board thus considers that the objections of lack of clarity forming the basis for the partial search report are not justified, and that the limitation of the search is to be regarded in the present case as not compliant with Rule 63 EPC, at least for the features of present claim 1. As the partial search was not in accordance with Rule 63 EPC, Rule 137(5) EPC, second sentence, cannot be invoked to refuse amended claim 1.

5. *Remittal*

The appellant requested that the Board should grant a patent based on the main request, and subordinated thereto, oral proceedings before the Board.

5.1 In accordance with Article 111(1) EPC, second sentence, the Board of Appeal may either exercise any power within the competence of the department which was responsible for the decision appealed or remit the case to that department for further prosecution. Since the main purpose of the appeal proceedings is to give a losing party a possibility to challenge a decision on its merits (see G0010/91, point 18), remittal in accordance with Article 111(1) EPC has normally been considered by the Boards in cases where a decision was issued solely upon a particular issue (e.g. novelty) and leaves other substantive issues e.g. regarding inventive step undecided. This existing practice realizes the primary object of appeal proceedings to review the decision under appeal in a judicial manner as expressed in Art 12(2) RPBA 2020.

5.2 In the present case, the application was refused solely on the basis of lack of clarity of claim 1 as filed on 12. Januar 2018 (auxiliary request 3 in appeal), and the requirements of novelty and inventive step were not yet considered by the examining division. In the Board's view that constitutes special reasons (further to fundamental deficiencies) that justify a remittal of the case to the examining division in accordance with Article 11 RPBA 2020. Since the subject-matter of the independent claims of the main request complies with Article 84 EPC, there was no need for the Board to consider the auxiliary requests.

Order

For these reasons it is decided that:

1. The decision under appeal is set aside.

2. The case is remitted to the examining division for further prosecution.

The Registrar: The Chairman:

G. Magouliotis C. Kujat

Decision electronically authenticated