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D E C I S I O N
of 8 July 1994

Case Number: T 0276/91 - 3.3.2

Application Number: 86306439.0

Publication Number: 0213882

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Title of invention:
Closed mixing machines

Applicant:
Kabushiki Kaisha Kobe Seiko Sho

Opponent:
-

Headword:
Mixing machines/KABUSHIKI KAISHA

Relevant legal norms:
EPC Art. 56
EPC R. 88

Keyword:
"Correction (allowed) - obvious error"
"Inventive step - unobvious solution"

Decisions cited:
G 0011/91

Catchword:
-



Case Number: T 0276/91 - 3.3.2

D E C I S I O N
of the Technical Board of Appeal 3.3.2
of 8 July 1994

Appellant: Kabushiki Kaisha Kobe Seiko Sho
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Decision under appeal: Decision of the Examining Division of the European
Patent Office dated 5. December 1990 refusing
European patent application No. 86 306 439.0
pursuant to Article 97(1) EPC.

Composition of the Board:

Chairman: P. A. M. Lançon
Members: A. J. Nuss
C. E. M. Holtz

Summary of Facts and Submissions

- I. European patent application No. 86 306 439.0 was filed on 20 August 1986 and published under No. 0 213 882.
- II. On 5 December 1990, the Examining Division issued a decision refusing the application under Article 97(1) EPC for failure to comply with Article 56 EPC. The decision was based on seven claims, received on 25 June 1990.
- III. In its decision the Examining Division held that the claimed mixing machine lacked inventive step having regard to the disclosures of Figure 2 of document (1) GB-A-2 024 635 and/or Figures 3 and 8 of document (2) GB-A-2 072 028. Although in present Claim 1 the rotation speed of the rotors was specified, this feature was not a structural element and could thus not delimit the scope of the claimed subject-matter over that disclosed in (1) and/or (2). Furthermore, the Examining Division took the view that the drawings of the known mixing machines made it obvious that the required ratio α of the tip clearance to the rotor diameter could lie near or within the range of 0.015 to 0.04.
- IV. The Appellant lodged an appeal against this decision.

In the statement setting out the grounds, the Appellant made reference to Figures 10 and 11 of the application documents and argued that the requirements regarding the ratio α and the rotation speed of the rotors took the operating conditions in the mixing machine of the invention out of the region of operating conditions of a conventional mixing machine. It was accepted that document (1) and document (2) both disclosed such conventional mixing machines. Although it was furthermore accepted, that any rotor could be made with

any particular clearance in a housing, and thus the ratio of tip clearance to rotor diameter could be in any range which one might care to formulate, there was no suggestion in the prior art documents that for the said ratio a particular range should be selected for any purpose, thus also not for that of the presently claimed invention, namely to achieve advantageously reduced mixing times as a result of increased rotor speeds. It was in any case not permissible to measure the drawings of a citation in order to produce a value anticipating the α -values mentioned in the present claims.

- V. The Appellant requested that the decision under appeal be set aside and that as a main request, a patent be granted on the basis of the (single) apparatus claim received on 21 February 1994.

The Appellant further requested, in a letter dated 28 March 1994, correction under Rule 88 EPC to replace on page 9, line 5 of the original application the term "chamber" by "rotor".

- VI. The present (single) claim is identical to the originally filed apparatus claim; it reads as follows:

"1. A mixing machine comprising a closed mixing chamber and a pair of oppositely rotatable rotors disposed in parallel in the chamber, each rotor having at least one longer vane and at least one shorter vane, wherein:

(1) the ratio α of a tip clearance h_0 to a rotor diameter R (h_0/R) is given by $0.015 < \alpha < 0.04$;

(2) the rotation speed of the rotors is in the range 70 - 250 rpm;

(3) the ratio of the speed of the one rotor to that of the other is in the range 1.0 - 1.2;

(4) the rotor length/diameter ratio is in the range 1.2 - 2.2;

(5) the rotor inclusion angle is in the range 15° - 35°;

(6) the rotor vane length ratio L_s/L_l is in the range 0.1 - 0.48;

(7) the helix angle θ_l is in the range 20° - 45°, and

(8) the helix angle θ_s is in the range 0° - 45°, where L_s is the length of the longer vane, θ_s is the helix angle of the shorter vane, and θ_l is the helix angle of the longer vane."

Reasons for the Decision

1. The appeal is admissible.
2. *Correction under Rule 88 EPC*
 - 2.1 In regard of the request for correction under Rule 88 EPC (see point V above), it is pointed out that, as stated in decision G 11/91 of the Enlarged Board of Appeal (OJ EPO 1993, 125, point 2 of the Reasons), the skilled person must be in a position objectively and unambiguously to recognise the incorrect information using common general knowledge. The said decision further states that "a correction under Rule 88, second sentence, EPC is of a strictly declaratory nature. The corrected information merely expresses what a skilled person, using common general knowledge, would already derive on the date of filing from **the parts of a**

European patent application, seen as a whole, relating to the disclosure (emphasis added).... it follows that the parts of a European patent application relating to the disclosure must ... on the date of filing contain such an **obvious** error that a skilled person is in no doubt that this information is not correct and - considered objectively - cannot be meant to read as such" (see point 4 and 5 of the Reasons).

2.2 The phrase directly concerned by the requested amendment is part of a listing relating to the description of a series of figures; it reads as follows:

"Figure 8 is a chart showing the effects of the ratio (α) of tip clearance to **chamber** (emphasis added) diameter on the relationship between the rate of shear γ_{\max} at a rotor tip and the corresponding mixing time with a uniform quality of mixture (Mooney viscosity is 75), in the master batch mixing of the carbon black,"

In addition to this, Figures 9 to 11 are briefly commented as follows:

"Figure 9 is a chart showing the effects of the ratio α on the relationship between γ_{\max} and the mixing time....,"

"Figure 10 is a chart similar to Figure 8...."

"Figure 11 is a chart similar to Figure 9...", .

2.3 As pointed out by the Appellant, the application document as originally filed consistently refers to the term $\alpha=h_0/R$ as the ratio of tip clearance to **rotor** diameter. In particular, the paragraphs of the description explaining the physical and mathematical background for the use of the ratio $\alpha=h_0/R$ in context

with the presently claimed invention (see in particular page 5, lines 11/17; page 7, lines 20/22; page 8, lines 12/13; page 13, lines 2/3 and page 15, line 31) correctly refer to R as the **rotor** diameter. In view of the detailed explanations on page 15, lines 3 to 32 of the original application establishing in respect of the said ratio α - i.e. a parameter depending on the maximum rate of shear γ_{\max} as shown by Figures 8 and 9 - a direct relationship with the results reported in Figures 10 and 11 in the same way as in Figures 8 and 9, the ratio $\alpha = h_0/R$ is necessarily the ratio of the tip clearance to the **rotor** diameter R. Any skilled person would therefore immediately realise that the term "chamber diameter" used at one occasion in connection with the definition of α is not only erroneous but should read "rotor diameter".

Therefore, the amendment consisting in changing on page 9, line 5 of the application document the term "chamber diameter" into "rotor diameter" is an allowable correction under Rule 88, second sentence, EPC.

3. *Amendments*

By submitting the single claim according to the present main request the Appellant has reinstated the originally filed apparatus claim so that there are no longer any amendments to be considered under Article 123 EPC.

4. *Novelty*

None of the prior art documents cited in the European Search Report discloses **all** the features of the apparatus claim according to the main request. Novelty of the subject-matter can accordingly be acknowledged, all the more since the Examining Division raised only a

vague and unsubstantiated objection in its communication pursuant to Article 96(2) and Rule 51(2) EPC. It is thus not necessary to deal with this matter in detail.

5. *Inventive step*

5.1 The application concerns a closed mixing machine suitable for mixing rubber or plastic materials.

5.2 The Board can see no reason to query that items (4) to (8) of the apparatus claim according to the present main request concern nothing else than known features of a so-called **conventional** mixing machine as disclosed in either document (1) or document (2). Although in the decision under appeal and in the statement of grounds of appeal no distinction was made between these two disclosures when discussing inventive step, the Board regards document (2) as the closest state of the art. This document not only relates to a closed mixing machine for mixing rubber or plastic but it further mentions the flow rate of material through the tip clearance, one of the essential characteristics when discussing the performance of the now claimed mixing machine. Thus, this prior art discloses all the structural features of the present Claim 1 with the exception of the claimed ratio α of the tip clearance to the rotor diameter, i.e. $0.015 < \alpha < 0.04$ (cf. claims, page 1, lines 5 to 19; page 2, line 26 to page 3, line 2; page 4, line 48 ff. and Figures 15).

5.3 According to the introductory paragraphs of (2), the function of the type of mixers described therein is based on the general concept that, in the mixing chamber, the charged material is subjected to shearing action by passing through the clearance between the tip of the rotor and the chamber walls causing micro-dispersion as well as a mixing action (when moved by the

respective vanes back and forth within the chamber) resulting in a macro-dispersion of the additives in the material to be treated (cf. page 1, lines 9 to 19). Taking into account this general concept, it is stated that an object is to provide a two vane rotor for the closed type mixer/kneader, which has a high macro dispersion power inherent to the two vane rotor along with a plasticizing power (shear action) comparable to that of the four vane rotor (cf. page 1, lines 33 to 37).

On the basis of theoretical considerations concerning the shape of two vane rotors, it is then demonstrated that the shearing and mixing actions can be explained solely by the shape of one of the rotor vanes, which characterizes the mixing and kneading actions of the apparatus as a whole (cf. page 2, lines 9 to 25).

As regards the effect of the vane shape on the shearing action, calculations show inter alia that - taking into account a flow stream between parallel plates formed by the surface of the respective rotor elements and the inner wall of the chamber - in order to increase the shearing action on the material, it is necessary to increase the flow rate of material through the tip clearance of the vane. It is stated that for this purpose the axial length of the longer vane is increased since the velocity and tip clearance are determined by the size of the machine and operation condition" (cf. page 2, lines 9 up to page 3, line 2).

As regards factors which might influence the mixing action on the material further calculations show that it is inter alia necessary to take also into account the

flow rate along the vane. In this context it is assumed that the rotation speed of the rotor is 60 rpm (cf. in particular page 3, lines 37 to 62).

As an overall result of these studies document (2) finally proposes in order to meet the requirements mentioned at the beginning that at least one vane of a two vane rotor has a ratio of vane length (l) to the total length (L) of the rotor (l/L) of 0.6 to 0.9, a "twist angle" of 10° to 40° and an overlap rate of 0.2 to 0.8 relative to the other vane (cf. page 4, lines 13 to 47 and Figure 10).

According to a worked example such a rotor has indeed a shearing action equivalent to that of the four vane rotor, an energy efficiency standing between the former two vane and four vane rotors and a chemicals dispersing ability equivalent to that of the former two vane rotor (cf. page 5, lines 8 to 54).

- 5.4 As stated in the originally filed application, it has been shown that the design conditions of a conventional machine i.e. one as described in document (2), are such that **for all practical purposes the value of α does not exceed 0.015** (cf. page 13, lines 7 to 10 as well as Figures 2 and 3).
- 5.5 In the light of this prior art, the technical problem to be solved by the european application can be seen in providing an apparatus with an improved micro-dispersion capacity.

This problem is solved by the apparatus as defined in present Claim 1, in particular by the ratio α of the tip clearance h_0 to the rotor diameter R in the range of $0.015 < \alpha < 0.04$, whereby the rotation speed of the rotors is necessarily in the range of 70 to 250 rpm.

Having regard to Figures 10 and 11 of the present application showing the dependency of the mixing time on the rate of shear with the ratio α and the rotation speed of the rotors as functional parameters, the Board is satisfied that the stated problem has been plausibly solved.

- 5.6 It remains to consider whether or not the said solution involves an inventive step.

As indicated above, one of the technical problems underlying (2) is to improve the overall mixing and kneading performance of the apparatus by taking into account tip clearance, the helical configuration and length of the vanes as well as a velocity parameter and the quantity of the material passing through different regions between the rotor body and the walls of the mixing chamber.

Although, with hindsight it might seem obvious or trivial to merely further optimize tip clearance and rotor diameter in combination with the operating conditions, it is, however, important to note that document (2) only takes into account that the tip clearance and velocity are values determined by the size of the machine and operating condition which have to remain unchanged. This document could therefore neither provide the slightest hint to modify the tip clearance nor does it suggest to change the operation conditions with respect to the rotation speed. There is also no incentive to consider as useful a parameter establishing a relationship between tip clearance and rotor diameter when trying to improve the micro-dispersion capacity. Moreover, it is to be noted that a constructional modification of rotor diameter and tip clearance as proposed by the application in suit is far from being the only solution available. As set out in the

application in suit, when improving the micro-dispersion capacity of a mixing machine for rubber material, two different basic arrangements could be envisaged, namely

- (i) increasing the shearing stress in an overall cross section normal to the rotor axis while enlarging the shearing region,
- (ii) increasing the opportunity for the material to pass through the shearing region so that the shearing stress is higher than a predetermined minimum shearing stress near the rotor tip.

Both arrangements would clearly require individual realization involving not only numerous possibilities of constructional modifications of the mixing machine but also different operating conditions neither described nor suggested in (2).

Consequently, when trying to solve the above stated problem, the only **concrete** teaching available to the skilled person in respect of some constructional features relevant for improving the mixing performance of the apparatus consisted in those explicitly indicated in (2), namely to modify the length and/or helical angle and/or the contour of the vanes as such. In the absence of any other concrete information, he was thus at loss to know which of numerous possible embodiments covered by (i) and (ii) could be successfully investigated.

- 5.7 In order to provide a mixing and kneading machine which accomplishes a thorough intermingling irrespective of the kind of the materials document (1) proposes similarly a construction such that a ratio of the length of the short vanes along the axis direction of the rotors to that of the long vanes is selected within the range of 0.48 to 0.1 and that a ratio of the axial

thrust acting on the material by the short vane to that by the long vane is determined within the range of 0.7 to approximately 0.

- 5.8 The same applies to the other documents cited in the European Search Report which documents propose to modify the length, the cross-sectional area and the contour of the rotor vanes as such. Consequently no combination of these documents with the teaching of (2) could lead the skilled person to the solution now claimed.
- 5.9 The Board would like to stress that, as discussed above, it is the **combination of a structural element and the change in operation conditions**, namely the apparatus parameter $\alpha = h_0/R$ comprised in a particular range in combination with the operating condition of a higher rotor rotation speed than normally used, which leads in the present case to an improved micro-dispersion capacity of the mixing apparatus and renders the claimed apparatus non-obvious with respect to the prior art. It is a well-accepted principle that under particular circumstances the essence of a physical entity such as an apparatus cannot be comprehended without taking into account conditions under which it is operated. Accordingly, the rotation speed of the rotor (i.e. item (2) of the claim) being an essential feature of the invention, it could not be left out of consideration.
- 5.10 It follows from the above that the subject-matter of the apparatus claim according to the main request involves an inventive step in the sense of Article 56 EPC.

Order

For these reasons it is decided that:

1. The decision under appeal is set aside.

2. The case is remitted to the first instance with the order to grant a patent in the following version:
 - pages 1 to 8 and 10 to 19 as originally filed
 - page 9 received on 30 March 1994
 - Claim 1 received on 21 February 1994
 - sheets 1/13 to 13/13 as originally filed.

The Registrar:

The Chairman:

P. Martorana

P. A. M. Lançon