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**Datasheet for the decision
of 26 July 2017**

Case Number: T 1906/13 - 3.5.03

Application Number: 05017763.3

Publication Number: 1628177

IPC: G05B19/416

Language of the proceedings: EN

Title of invention:

Finishing machine for removing a burr

Applicant:

FANUC CORPORATION

Headword:

Finishing machine for removing a burr/FANUC

Relevant legal provisions:

EPC Art. 56

RPBA Art. 12(4)

Keyword:

Inventive step - main request and first and second auxiliary requests (no)

Admissibility - third auxiliary request (no)

Decisions cited:

G 0010/93, T 0361/08, T 0144/09

Catchword:



Beschwerdekammern
Boards of Appeal
Chambres de recours

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Case Number: T 1906/13 - 3.5.03

D E C I S I O N
of Technical Board of Appeal 3.5.03
of 26 July 2017

Appellant: FANUC CORPORATION
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Decision under appeal: **Decision of the Examining Division of the
European Patent Office posted on 19 March 2013
refusing European patent application
No. 05017763.3 pursuant to Article 97(2) EPC.**

Composition of the Board:

Chairman F. van der Voort
Members: K. Schenkel
P. Guntz

Summary of Facts and Submissions

I. This appeal is against the decision of the examining division refusing European patent application No. 05017763.3, publication number EP 1 628 177 A.

II. The reasons given for the refusal were that the subject-matter of claims 1 and 2 of a main request and an auxiliary request did not involve an inventive step (Articles 52(1) and 56 EPC) having regard to the disclosure of:

D1: US 5 331 770 A

and the common general knowledge of the person skilled in the art.

III. In its decision and in two communications, the examining division referred to the following document concerning the use of a machining tool for measuring the surface shape of a workpiece:

D4T: English translation of JP 04 122546 A (D4).

It was common ground that D4T represented the prior art, *in casu* D4.

IV. In the statement of grounds of appeal, the appellant requested that the decision under appeal be set aside and that a patent be granted on the basis of the claims of the main request or, in the alternative, of the auxiliary request, both as decided on by the examining division, or that the case be remitted to the department of first instance. Oral proceedings were conditionally requested.

- V. In a communication following a summons to oral proceedings, the board, without prejudice to its final decision, raised objections under Article 52(1) EPC in conjunction with Article 56 EPC in respect of the subject-matter of claims 1 and 2 of the main request and the auxiliary request, when starting out from document D1 and taking into account the teaching of document D4T and the common general knowledge of the person skilled in the art. Further, objections under Article 84 EPC were raised in respect of claims 1 and 2 of the auxiliary request.
- VI. With a letter dated 26 June 2017, which crossed with the board's communication, the appellant filed two further sets of claims by way of second and third auxiliary requests, together with arguments in support of these requests.
- VII. With a further letter dated 24 July 2017, the appellant filed, in response to the board's preliminary opinion, new sets of claims of first to third auxiliary requests.
- VIII. Oral proceedings were held on 26 July 2017.

The appellant requested that the decision under appeal be set aside and that a patent be granted on the basis of the claims of the main request as filed with the letter dated 13 December 2012 or, in the alternative, the claims of one of first to third auxiliary requests, all as filed with the letter of 24 July 2017.

The appellant withdrew its further auxiliary request that the case be remitted to the examining division.

At the end of the oral proceedings, after due deliberation, the chairman announced the board's decision.

IX. Claim 1 of the main request reads as follows:

"A finishing machine for finishing a workpiece (5), which is arranged outside a robot (1), by the robot (1) attached to a machining tool (4) so that a shape of the workpiece (5) can be close to a target shape, characterized in that the finishing machine comprises:

a means for making a moving path of the machining tool attached to the robot based on a target shape CAD data of the workpiece which is found from a workpiece CAD data;

a means for finding a position of the workpiece with respect to the robot by obtaining an image of the workpiece by a visual sensor arranged at a predetermined position or a visual sensor attached to the robot;

a force measurement means (3) for measuring a force acting between the machining tool (4) and the workpiece (5);

a tracer control means (21) for tracing a surface of the workpiece (5) along the moving path by using the force measurement means (3) while the machining tool (4) is being pushed onto the workpiece (5) at a predetermined force;

a surface shape acquisition means (22) for acquiring a surface shape of the workpiece (5) when a contact position of the machining tool (4) with the workpiece (5) is calculated from the position and posture of the machining tool (4), which is executing the tracing operation by the tracer control means (21), and the result of this calculation is recorded;

a comparing means (24) for comparing the surface shape of the workpiece (5), which has been acquired by the surface shape acquisition means (22), with the target shape; and

a machining means (25) for machining the workpiece (5) along the moving path corrected by the result of comparison made by the comparison means (24), while the position of the machining tool (4) is controlled so that the workpiece (5) shape becomes close to the target shape;

the machining means (25) is designed to find a start position, in which a difference between the initial surface shape and the target shape of the workpiece (5) exists, and an end position of a burr (6), in which the difference between the initial surface shape and the target shape of the workpiece (5) does not exist, and also finds a height of the burr (6) by a tracing passage obtained by the tracer control means (21) according to the result of the comparison made by the comparison means (24), and

to calculate the number of times of cutting to remove the burr (6) and a cutting movement pattern for removing the burr (6) so as to move from the start position to the end position of the burr (6) according to the height of the burr (6) and the setting depth of cut after the machining tool (4) is moved from the end position to the next start position of the burr (6), and

the machining means (25) makes and executes a machining program for removing the burr (6) according to the cutting movement pattern."

- X. Claim 1 of the first auxiliary request differs from claim 1 of the main request in that, in the ninth paragraph, the wording

"and also finds a height of the burr"

has been replaced by

"and also finds the highest height of the burr"

and in that, in the tenth paragraph, the wording

"according to the height of the burr"

has been replaced by

"according to the highest height of the burr".

- XI. Claim 1 of the second auxiliary request differs from claim 1 of the main request in that, at the end, the following wording has been added:

"wherein the force measurement means (3) is a force sensor (3) attached to the robot (1), and the finishing machine operates while the machining tool (4) and the workpiece (5) positively come into contact with each other when force control is conducted using the force sensor (3) in the process of executing tracer control".

- XII. Claim 1 of the third auxiliary request differs from claim 1 of the second auxiliary request in that, at the end, the following wording has been added:

"wherein a force in the pushing direction is detected by the force sensor (3) in the process of tracer control, and the contact position of the machining tool (4) with the workpiece (5) is corrected and recorded according to a flexure of the robot (1) estimated by the detected force in the pushing direction".

Reasons for the Decision

1. Main request - claim 1 - inventive step

1.1 The present application is concerned with a finishing machine for scanning the surface of a workpiece in order to detect a burr on it and for removing the burr. The closest prior art is considered to be represented by document D1, which also discloses a finishing machine.

1.2 D1, using the language of claim 1, discloses a finishing machine for finishing a workpiece, which is arranged outside a robot, by the robot attached to a machining tool (see Fig. 1 and column 3, lines 39 to 42), so that the shape of the workpiece can be close to a target shape (see the abstract and column 5, lines 57 to 61), the finishing machine comprising:

a) a means for making a moving path of the machining tool attached to the robot based on a target shape Computer Aided Design data of the workpiece, which is found from workpiece Computer Aided Design data (see column 5, lines 39 to 51, and column 3, lines 45 to 50, the board being of the view that the use of a computer for recording and transferring the design shape data implies the use of a computer aid and, hence, that the design shape data may be referred to as CAD data);

b) a means for finding a position of the workpiece with respect to the robot (see column 10, lines 11 to 19, it being noted that the step of inputting "a positional relation between the robot and the workpiece" to the robot controller implies the presence of means for finding this positional relation);

c) a force measurement means for measuring a force acting between the machining tool and the workpiece (see column 3, lines 39 to 42);

d) a tracer control means for tracing a surface of the workpiece along the moving path by using a surface shape measuring sensor (see column 4, lines 2 to 6, FIG. 19, step "SHAPE MEASURING SENSOR IS MOVED ALONG TRACE LINE");

e) a surface shape acquisition means for acquiring a surface shape of the workpiece, wherein the result is recorded (see column 5, lines 33 to 38 and lines 57 to 61, it being noted that, since, in the next step, the data is to be compared, it is implicit that the surface shape data is stored and, hence, recorded);

f) a comparing means for comparing the surface shape of the workpiece, which has been acquired by the surface shape acquisition means, with the target shape (see column 5, lines 57 to 61); and

g) a machining means for machining the workpiece along the moving path corrected by the result of comparison made by the comparison means, while the position of the machining tool is controlled so that the workpiece shape becomes close to the target shape (see column 10, lines 21 to 33);

h) the machining means is designed to find a start position, in which a difference between the initial surface shape and the target shape of the workpiece exists, and an end position of a burr, in which the difference between the initial surface shape and the target shape of the workpiece does not exist, and also finds a height of the burr by a tracing passage obtained by the tracer control means according to the result of the comparison made by the comparison means (N.B.: The measured surface is divided into a non-excessive and an excessive portion, i.e. a burr, which is automatically scraped off, see the abstract and

column 5, lines 57 to 61, which implies that the start and end positions of the burr are identified. Further, the feed speed for scraping off the burr may be controlled based on the cross-sectional area of the burr, which implies that the height of the burr is known for calculating the cross-sectional area, cf. column 4, lines 24 to 28. Further, Figs 5 and 6 respectively show marks for a start and an end position and explicitly mention the width and the height of a burr), and

i) to calculate the number of times of cutting to remove the burr and a cutting movement pattern for removing the burr so as to move from the start position to the end position of the burr according to the height of the burr and the setting depth of cut after the machining tool is moved from the end position to the next start position of the burr (it being noted that if the cross-sectional area of the burr is significantly large, it is removed by a plurality of feed operations, i.e. times of cutting, which implies that the number thereof needs to be calculated, which necessarily takes into account the setting depth of cut, see column 7, lines 60 to 66), and

j) the machining means makes and executes a machining program for removing the burr according to the cutting movement pattern (see column 10, lines 29 to 33).

1.3 The subject-matter of claim 1 thus differs from the finishing machine disclosed in D1 in that according to claim 1:

i) the means for finding a position of the workpiece with respect to the robot includes a visual sensor arranged at a predetermined position or a visual sensor

attached to the robot, the visual sensor being suitable for obtaining an image of the workpiece; and

ii) the tracer control means is capable of tracing the surface of the workpiece along the moving path by using the force measurement means while the machining tool is being pushed onto the workpiece at a predetermined force; and

the surface shape acquisition means is capable of acquiring the surface shape of the workpiece when a contact position of the machining tool with the workpiece is calculated from the position and posture of the machining tool, which is executing the tracing operation by the tracer control means.

1.4 Re i): D1 does disclose that the positional relation between the finishing machine and the workpiece is input, but does not specify how it is determined. In order to implement the finishing machine of D1, the skilled person would therefore need to find a way to determine the positional relation between the finishing machine and the workpiece.

Re ii): A technical effect of this distinguishing feature is that the machining tool itself can be used for acquiring the surface shape of the workpiece, instead of a dedicated device, like a laser spot sensor or an image recording sensor as referred to in D1, column 4, lines 42 to 49, and column 5, lines 21 to 24.

1.5 Starting out from D1, the technical problem underlying the subject-matter of claim 1 may thus be seen in technically implementing the step of determining the positional relation between the finishing machine and the workpiece and in simplifying the process of acquiring the surface shape of the workpiece.

1.6 Re i): In order to determine the positional relation between the finishing machine and the workpiece, the latter has to be captured. At the priority date of the application in suit, optical sensors for capturing workpieces were known, see for example D1, column 5, lines 21 to 24, and D4T, section "Problems to be solved by the invention".

The skilled person, when faced with the problem of finding a way of determining the positional relation between the workpiece and the machining tool, would therefore have considered using an optical sensor. The use of an optical sensor further implies that its position is known, either by arranging it at a predetermined position or by attaching it to the robot, and that an image is taken.

Re ii): The skilled person, starting out from D1 and faced with the second part of the above-mentioned problem, would consider document D4T, since it relates to recognising a workpiece surface shape and to removing burrs on the workpiece.

More specifically, D4T discloses a workpiece surface shape recognition system which includes a machining tool held by a robot arm, in which a force sensor between the wrist of the robot and the tool is used for acquiring the shape of the workpiece, including burrs (see D4T, point (b) in section "Embodiments" and claim 1). D4T mentions that the recognition of shapes, such as burrs, is thereby simplified (see D4T, section "Problems to be solved by the invention").

Hence, the skilled person, faced with the problem of simplifying the process of acquiring the surface shape

of the workpiece, would apply the teaching of D4T and use the machining tool together with the force sensor as surface shape acquisition means. This implies that the machining tool gets in contact with the workpiece and that the contact position is calculated from the position and posture of the machining tool. Further, it is considered evident for a person skilled in the art that, in use, the machining tool is to be pushed with a predetermined force against the workpiece, in order to obtain reproducible measurements, whilst preventing damage to the workpiece or the machining tool.

1.7 The skilled person faced with the above-mentioned technical problem would therefore apply the teaching of D4T to the finishing machine of D1, by using the machining tool together with a force sensor for tracing the surface of the workpiece, and would, using his common general knowledge, chose a visual sensor for finding the position of the workpiece. He would thus arrive without exercising inventive skill at a finishing machine which includes all the features of claim 1.

1.8 The appellant argued essentially as follows:

i) D4T did not disclose a continuous tracing operation; the tool was repeatedly sent at low speed in the direction of the workpiece, thereby determining a series of contact points only.

ii) Further, D1 and D4T did not suggest that the force measurement means was a force sensor attached to the robot, and that the finishing machine was operated while the machining tool and the workpiece came positively into contact with each other and force

control was conducted using the force sensor in the process of executing tracer control.

iii) The skilled person had to disregard the teaching of D1 and replace the optical sensor for measuring the surface shape of the workpiece.

iv) In D1, the position of the excessive portion, i.e. the burr, was pointed out by an operator, whereas in the finishing machine according to claim 1 the start position and the end position as well as the height of the burr were found by the machine. D1 did not disclose that a start position and an end position of the burr and a height of the burr were found by the tracing passage.

The board is however not convinced by these arguments, for the following reasons:

re i): Claim 1 does not specify that the tracing operation is continuous; the surface of the workpiece is traced along a moving path, while the machining tool is being pushed onto the workpiece. This does not exclude a discrete tracing with multiple tracing points, which could also be obtained by repeatedly sending the tool in the direction of the workpiece.

re ii): Claim 1 does not specify that the force measurement means is a force sensor attached to the robot. The board notes, however, for the sake of argument, that D4T discloses in claim 1 that a force sensor is provided between the tool and the wrist of the robot. A positive contact between the workpiece and the tool is also not mentioned in claim 1. However, for tracing the surface by means of the force sensor and the tool, a positive contact between the tool and the

workpiece is a prerequisite and is thus implicitly disclosed by D4T.

re iii): The board notes that a simplification and, in general, any technical improvement of an existing system usually imply changes to be made to the existing system.

re iv): D1 discloses that the operator points out a position at which an excessive portion may be formed on the workpiece and inputs a positional relation between the robot and the workpiece, so that a measuring sequence shape of the finishing robot for measuring the surface of the burr is determined (column 10, lines 11 to 19). The operator does not point to the burr itself. The burr or, in the language of D1, the excessive portion is determined by measuring the surface shape of the workpiece (column 5, lines 57 to 61).

1.9 For the above reasons, the board concludes that the subject-matter of claim 1 does not involve an inventive step (Articles 52(1) and 56 EPC).

1.10 The main request is therefore not allowable.

2. *First auxiliary request - claim 1 - inventive step*

2.1 D1 discloses determining the height of the burr for calculating the number of times of cutting and a cutting movement pattern (see point 1.2 above). Since the height which is determined is not limited to a height at a specific location, determining the height of the burr in D1 includes determining the highest height.

Claim 1 of the first auxiliary request (see point X above) thus does not add to claim 1 of the main request a limitation which is not disclosed by D1.

2.2 In view of the above, the board concludes that the subject-matter of claim 1 of the first auxiliary request does not involve an inventive step (Articles 52(1) and 56 EPC).

2.3 The first auxiliary request is therefore not allowable.

3. *Second auxiliary request - claim 1 - inventive step*

3.1 As already mentioned in point 1.8 (see re ii) above, D4T discloses in claim 1 that a force sensor is attached to the robot between the tool and the robot's wrist. For tracing the surface of the workpiece by means of the force sensor and the tool, as disclosed by D4T, it is a prerequisite that, in the process of executing tracer control, the machining tool and the workpiece come positively into contact with each other. Further, D4T discloses that the force sensor sends digital values of the forces and moments to a control device and that these signals are used to detect the burrs (page 4, lines 2 to 7) and, hence, that force control is conducted in the process of tracer control.

Consequently, the additional features in claim 1 of the second auxiliary request compared with claim 1 of the main request (see point XI above) are at least implicitly disclosed in D4T.

3.2 The appellant argued that the amendments made to claim 1 emphasise the continuous contact between the tool and the workpiece, in contrast to the disclosure of D4T, which relates to discrete contact points.

The board, however, cannot see how the amendments express a continuous contact during the tracing operation and is therefore not convinced by this argument.

3.3 For the above reasons, the board concludes that the subject-matter of claim 1 of the second auxiliary request does not involve an inventive step (Articles 52(1) and 56 EPC) either.

3.4 The second auxiliary request is therefore not allowable.

4. *Third auxiliary request - claim 1 - admissibility*

4.1 This auxiliary request was filed shortly before the oral proceedings before the board. It is thus an amendment to the appellant's case within the meaning of Article 13(1) RPBA.

In accordance with Article 13(1) RPBA, any amendment to a party's case after it has filed its grounds of appeal may be admitted and considered at the board's discretion. Following T 361/08 (point 13 of the reasons) and T 144/09 (point 1.17 of the reasons), in exercising its discretion under Article 13(1) RPBA, the board considers it appropriate to take into account the provision of Article 12(4) RPBA, which reads: "Without prejudice to the power of the Board to hold inadmissible facts, evidence or requests which could have been presented or were not admitted in the first instance proceedings, everything presented by the parties under (1) shall be taken into account by the Board if and to the extent it relates to the case under appeal and meets the requirements in (2)".

- 4.2 The amendments made to claim 1 (see point XII above) include features which were part of dependent claim 5 as filed and which relate to a correction of the contact point according to a flexure of the robot, estimated by the detected force in the pushing direction.
- 4.3 The board notes that in the first instance proceedings, at the end of the oral proceedings, the applicant confirmed that he had no further requests. It was therefore clear that the applicant did not wish to submit any further amendments or requests in the examination procedure, including a request based on the subject-matter of original claim 5.
- 4.4 If the request were admitted now, the board would be forced either to examine the claim itself with respect to D1 and the other documents on file, or to remit the case for further prosecution. The first option would run contrary to the purpose of appeal proceedings (see G 10/93, OJ EPO 1995, 172, point 4 of the reasons), which is essentially to examine the correctness of the first instance decision rather than to give a ruling on substantive matters which have not previously been examined (this indeed being essentially the reason why the boards are empowered under Article 12(4) RPBA to not admit requests not presented before the first instance). The second option would run entirely contrary to the requirement for procedural efficiency.
- 4.5 The appellant argued that the added features were disclosed in a claim on file from the beginning, that the request was neither surprising nor complicated, and that the board was in a position to deal with it.

The board disagrees. The feature of correcting the contact point based on the flexure of the robot is a substantial amendment relating in general to robot mechanics. It is not intrinsically tied to the detection and removal of burrs and leads the discussion of inventive step in a completely new direction.

4.6 Consequently, the board decided to not admit the third auxiliary request (Article 12(4) RPBA).

5. Conclusion

As there is no allowable request, it follows that the appeal must be dismissed.

Order

For these reasons it is decided that:

The appeal is dismissed.

The Registrar:

The Chairman:



G. Rauh

F. van der Voort

Decision electronically authenticated