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Datasheet for the decision of 9 July 2015

Case Number: T 0319/12 - 3.2.05

Application Number: 06801211.1

Publication Number: 1943086

IPC: B29C70/38

Language of the proceedings: EN

Title of invention:
Systems and Methods for In-Process Vision Inspection for Automated Machines

Applicant:
The Boeing Company

Relevant legal provisions:
EPC 1973 Art. 56
RPBA Art. 13

Keyword:
Inventive step - main request (no)
Late-filed auxiliary requests - admitted (no)

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Case Number: T 0319/12 - 3.2.05

D E C I S I O N
of Technical Board of Appeal 3.2.05
of 9 July 2015

Appellant: (Applicant)	The Boeing Company 100 North Riverside Plaza Chicago IL 66066-2016 (US)
Representative:	Malcolm David Elkin Boult Wade Tennant Verulam Gardens 70 Gray's Inn Road London WC1X 8BT (GB)
Decision under appeal:	**Decision of the Examining Division of the European Patent Office posted on 12 August 2011 refusing European patent application No. 06801211.1 pursuant to Article 97(2) EPC.**

Composition of the Board:

Chairman	M. Poock
Members:	S. Bridge
	D. Rogers

Summary of Facts and Submissions

I. The appellant (applicant) lodged an appeal against the decision of the examining division refusing European patent application No. 06 801 211.1.

The examining division held that claims 1 and 8 lack an inventive step (Article 56 EPC 1973).

II. Oral proceedings were held before the board of appeal on 9 July 2015.

III. The final requests of the appellant were to set the decision under appeal aside and, as a Main Request, to grant a patent upon the basis of the claims filed under cover of a letter dated 17 June 2011, or alternatively, upon the basis of the claims of either the First Auxiliary Request (Amended), or the Second Auxiliary Request, both filed at the oral proceedings on 9 July 2015.

IV. Claim 1 according to the main request reads as follows:

"A head assembly (110) adapted to perform a manufacturing operation on a workpiece, comprising:
a tool moveable relative to the workpiece and adapted to perform the manufacturing operation on the workpiece; and
an inspection unit (160) operatively positioned proximate the tool and moveable with the tool relative to the workpiece (142), the inspection unit being adapted to perform a vision inspection of a portion of the workpiece upon which the tool has performed the manufacturing operation simultaneously with the performance of the manufacturing operation on the workpiece,

characterised in that the inspection unit includes:
a camera (162) adapted to monitor an area at least partially including the portion of the workpiece upon which the tool has performed the manufacturing operation; and
a processor operatively coupled to the camera and adapted to receive an image from the camera and to analyze the image to determine a presence of a defect within the area monitored by the camera; and wherein the tool includes a feed assembly adapted to feed a tape from a tape supply onto the workpiece, the feed assembly having a rotatable compaction roller adapted to apply the tape onto the workpiece; and wherein the inspection unit further includes:
a drive roller engaged with the compaction roller and rotatable by the compaction roller; and
an encoder (166) operatively coupled to the drive roller by a drive member, the encoder adapted to provide a position indication to the processor to allow a location of a defect to be determined by the processor; and
wherein the inspection unit further includes at least one of:
a laser (176) having a lens assembly adapted to provide at least one laser stripe on the workpiece within the area monitored by the camera; and
an illuminating source (172) adapted to illuminate the workpiece within the area monitored by the camera."

V. Claim 1 according to the first auxiliary request (amended) reads as follows:

"A system (100) adapted to perform a manufacturing operation on a workpiece (142), comprising:
a plurality of head assemblies (110) adapted to perform the manufacturing operation, and

a translation platform (130) coupled to the head assemblies, the translation platform being adapted to operatively position each head assembly proximate the workpiece and to systematically move the head assembly along a translation path proximate the workpiece,

each head assembly comprising:

a tool moveable relative to the workpiece and adapted to perform the manufacturing operation on the workpiece; and

an inspection unit (160) operatively positioned proximate the tool and moveable with the tool relative to the workpiece (142), the inspection unit being adapted to perform a vision inspection of a portion of the workpiece upon which the tool has performed the manufacturing operation simultaneously with the performance of the manufacturing operation on the workpiece, wherein the inspection unit includes

a camera (162) adapted to monitor an area at least partially including the portion of the workpiece upon which the tool has performed the manufacturing operation;

a processor operatively coupled to the camera and adapted to receive an image from the camera and to analyze the image to determine a presence of a defect within the area monitored by the camera; and wherein the tool includes a feed assembly adapted to feed a tape from a tape supply onto the workpiece, the feed assembly having a rotatable compaction roller adapted to apply the tape onto the workpiece; and wherein the inspection unit further includes:

a drive roller engaged with the compaction roller and rotatable by the compaction roller;

an encoder (166) operatively coupled to the drive roller by a drive member, the encoder

adapted to provide a position indication to the processor to allow a location of a defect to be determined by the processor; and

wherein the inspection unit further includes at least one of:

a laser (176) having a lens assembly adapted to provide at least one laser stripe on the workpiece within the area monitored by the camera and

an illuminating source (172) adapted to illuminate the workpiece within the area monitored by the camera,

characterized in that

the system further comprises a central computer operatively coupled to the head assemblies and adapted to receive the one or more defect indications and corresponding images determined by the processors of the head assemblies, and archive the one or more defect indications and corresponding images; and

a projection system operatively coupled to the central computer and adapted to receive position information corresponding to the one or more defect indications, and to project a defect identifier onto the workpiece at a location corresponding to the one or more defect indications."

VI. Claim 1 according to the second auxiliary request only differs from claim 1 according to the first auxiliary request (amended) in that "*only*" is inserted before "*the one or more defect indications*" and the expression "*determined by the processors of*" is replaced by "*from*" so that the first characterising feature reads as follows (underlining added by the board):

" the system further comprises a central computer operatively coupled to the head assemblies and adapted to receive only the one or more defect indications and corresponding images from the head assemblies, and archive the one or more defect indications and corresponding images;".

VII. The following documents are referred to in the present decision:

D2: EP-A-1 503 206;
D4: US-A-5,032,211.

VIII. The arguments of the appellant in the written and oral proceedings can be summarised as follows:

Main request

The subject-matter of claim 1 differs from the disclosure of document D2 in terms of the features relating to the drive roller and the encoder. These features must be considered in combination and address the problem of improving the inspection system, and do so by obtaining a defect location needed for the laser projection system. The improvement consists of expressing the location of the defects in terms of coordinates with respect to the workpiece and making these available to the processor.

In the apparatus disclosed in document D2, a defect is only marked directly by spraying it with ink or paint. This can be achieved by calibrating the ink jet printer with respect to the camera and thus does not require obtaining a location of the defect in terms of absolute workpiece coordinates. Therefore, the location of the

defect relative to the workpiece is not determined in the apparatus of document D2 and document D2 does not disclose means for obtaining and storing the location of the defect relative to the workpiece.

The term "*location*" used in paragraph [0065] is out of context with paragraphs [0063] to [0065] and corresponding figures 7 and 8, because all other items of the defect table can be obtained from the camera image alone. As figure 7 discloses means for "*adjusting the area of inspection*", the term "*location*" refers to the location of the displayed image area. Thus, document D2 does not suggest obtaining the location of the defect on the workpiece. Alternatively, the skilled person would disregard the term "*location*" in paragraph [0065] as an unclear term or as an error.

Even if document D2 did suggest obtaining the location of the defect relative to the workpiece, the skilled person would not arrive at the subject-matter of claim 1, because there are only two possibilities:

- attaching the encoder directly to the compaction roller which would not be practical, because it would take up additional space thus limiting the freedom of movement of the head assembly; and
- adopting the solution set out in document D4 in which the encoder is provided on the last driven roller 34 for taking up the backing tape.

Neither possibility results in the subject-matter of claim 1. Therefore, providing a drive roller engaged with the compaction roller and coupled to the encoder involves an inventive step, because it allows the encoder to be located remotely to the compaction roller. This has advantages in that the portion of the head assembly around the compaction roller and workpiece can be kept compact so as to avoid the head

assembly colliding with the workpiece, especially during manoeuvres over tight internal curved surfaces.

The subject-matter of claim 1 according to the main request involves an inventive step.

First auxiliary request (amended) and second auxiliary request

The feature "*the system further comprises a central computer … adapted to … archive the one or more defect indications and corresponding images*" of the respective claims 1 of these requests is clear, because the skilled person (skilled in the art of computing) knows that *to archive* means that the manufacturing data is kept during the lifetime of the manufactured product for consultation in case of a product failure.

This feature of the claims 1 is clear and these requests should thus be admitted into the proceedings.

Reasons for the Decision

Main request

1. *Objection of lack of inventive step, Article 56 EPC 1973*

1.1 Document D2 constitutes the closest prior art. The subject-matter of claim 1 only differs therefrom in that "*the inspection unit further includes:*
a drive roller engaged with the compaction roller and rotatable by the compaction roller; and
an encoder operatively coupled to the drive roller by a drive member, the encoder adapted to provide a position

indication to the processor to allow a location of a defect to be determined by the processor". This was not contested by the appellant.

1.2 The application as filed only discloses generally that "*the vision unit advantageously performs visual inspections of the manufacturing operation during the performance of the manufacturing operation by the head assembly. Thus, embodiments of the invention advantageously reduce the labor and expense associated with performing inspections during manufacturing operations, including the manufacture of composite components, improving the production rate and efficiency, and reducing cost, in comparison with the prior art systems and methods*" (application as published paragraph [0021], last two sentences). However, such advantages are already known from the prior art system disclosed in document D2 (see paragraph [0068]).

The application as filed does not disclose any specific advantages resulting from the use of an encoder operatively coupled to the compaction roller via a drive roller. The advantages advanced by the appellant concerning maintaining the freedom of movement of the head assembly when a potentially bulky encoder can be positioned out of the way by driving it indirectly off the compaction roller, are neither disclosed in, nor implied by, the description of the application in suit.

In the absence of the explicit or implied mention of such advantages in the description, this effect cannot be considered for the formulation of the objective technical problem.

1.3 Contrary to the appellants' position, paragraph [0065] of document D2 suggests obtaining the location of the defect relative to the workpiece for display in the user interface:

Document D2 discloses that user controls (Figures 7 and 8, bottom left "*Adjust area of inspection*") allow the user to adjust or shift the viewing area within the window 81 so as to simultaneously display both the bright field 69 and the dark field 71 (paragraph [0063]) and that the user can further adjust the parameters related to the maximum allowable defects (paragraph [0064]). However, neither of these passages, nor figures 7 and 8 disclose or discuss the location of the viewing area. Thus there is no basis in document D2 for associating the term "*location*" with the location of the viewing area.

Instead the term "*location*" is always used in document D2 when referring to the location of the defect on the composite structure (paragraphs [0046], [0049] and [0050]).

Thus when paragraph [0065] of document D2 further discloses that "*in addition to displaying images of the composite structure 22, the display screen 80 also includes a defect table 82 which lists the discovered defects and provides information for each defect, such as location, size, and the like*" there is no doubt that the term "*location*" relates to the "*information for each defect*" and thus cannot be anything else than the location of the defect on the composite structure 22. Thus the term "*location*" as used in paragraph [0065] does not constitute an unclear term or an error and the skilled person has no reason to disregard it as such.

It was further argued on behalf of the appellant that according to the invention the location of the defects has to be expressed in terms of coordinates with respect to the workpiece for marking by the (laser) projection system. However, although the use of x-y coordinates is mentioned in the description (page 8, lines 1 to 3), there is no indication concerning the coordinate system in which these are expressed and claim 1 does not state any such requirement. The prior art manner of determining the location of the defects used in document D2 already allows these to be marked by the (ink) projection system used therein. Thus, this argument is not persuasive.

1.4 The objective problem arises when the skilled person starting from document D2 seeks to implement the invention disclosed therein and thus has to provide means for the user interface to display the location of each detected defect.

1.5 As paragraph [0059] of document D2 discloses that the "*user interface 76 [~~that~~] is in communication with the processor 66*", the skilled person will necessarily seek to provide means which allow a location of a defect to be determined by the processor for display by the associated user interface.

The use of an encoder to be driven off the compaction roller 20 of the head assembly (figure 2) of document D2 comes within the normal practice of the skilled person (a mechanical engineer skilled in the art of automated tape deposition machines), because the encoder is used for its normal purpose and any technical effect resulting therefrom can be readily contemplated in advance as providing a solution to the problem of providing means necessary for the user

interface to display the location of each detected defect (via the processor) and in accordance with paragraph [0065] of document D2. Thus the feature of claim 1 that the "*encoder [is] adapted to provide a position indication to the processor to allow a location of a defect to be determined by the processor*" does not go beyond stating the normal use of such an encoder.

The provision of an intermediate drive roller does not require an inventive step either, because there are only two possibilities, namely, the encoder is driven off the compaction roller either directly, or indirectly via an intermediate (drive) roller. These possibilities are known to the skilled person as part of his general mechanical engineering knowledge and the respective advantages of these possibilities can be readily contemplated in advance. Making the appropriate choice according to circumstances forms part of the usual practice of the skilled person and does not require an inventive step.

The advantage advanced by the appellant, that a remote location of a bulky encoder with respect to the compaction roller allows the portion of the head assembly around the compaction roller and workpiece to be kept compact so as to avoid the head assembly colliding with the workpiece has no basis in the application in suit: As already noted above, neither this problem nor the advanced advantage are disclosed or implied. Thus, this argument is not persuasive.

Similarly, the fact that document D4 discloses yet another solution for positioning the encoder in the particular case when the tape is supported on a backing, does not invalidate the above conclusions.

1.6 In consequence, the subject-matter of claim 1 according to the main request lacks an inventive step (Article 56 EPC 1973).

First auxiliary request (Amended) and Second auxiliary request

2. *Admissibility*

The respective claim 1 of the first auxiliary request (amended) and the second auxiliary request include i.a. the characterising feature that:

"*the system further comprises a central computer … adapted to … archive the one or more defect indications and corresponding images*".

The term "*archive*" used therein is not clear, because the verb *to archive* (understood to mean *to place or store in an archive*), leaves open what constitutes the required archive. The description does not provide any further indications either. The meaning advanced on behalf of the appellant (in terms of keeping manufacturing data during the lifetime of the manufactured product and consulting in case of a product failure) is not disclosed in the description and, furthermore, relates to a data storage policy. Such a policy does not *a priori* constitute a technical apparatus feature of the claimed system as such, because such a policy only consists of a certain manner of using a computer storage device.

As conventional computer systems comprise a variety of storage devices, it is not clear when a particular computer storage device constitutes (or is intended as) such an archive, or not, since there are no technical features for identifying such an archive, for example,

in terms of requirements concerning a particular type, location or storage lifetime. Although it was alleged on behalf of the appellant, that a skilled person knows what *to archive* means in a computing context, no supporting arguments or evidence was provided. Thus the distinction between conventional computer storage and an "*archive*" is indeterminate and leaves the skilled person unable to determine whether he is practicing the claimed invention or not. Therefore, the above feature does not meet the clarity requirements of article 84 EPC.

In consequence, the respective claim 1 of the first auxiliary request (amended) and the second auxiliary request does not prima facie meet the requirements of the EPC.

The board notes that amongst other formal objections the lack of clarity of the term "*archive*" was raised in the discussion of the first auxiliary request (first filed with the letter dated 9 June 2015 and withdrawn during the oral proceedings of 9 July 2015). Nevertheless this feature has been maintained in the first auxiliary (amended) and second auxiliary request. The board therefore exercises its discretion under article 13(1) RPBA to not admit these requests.

Order

For these reasons it is decided that:

The appeal is dismissed.

The Registrar: The Chairman:

D. Meyfarth M. Poock

Decision electronically authenticated