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Datasheet for the decision of 3 May 2023

Case Number: T 0733/21 - 3.2.03

Application Number: 18172323.0

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IPC: B22F3/105, B33Y50/02

Language of the proceedings: EN

Title of invention:
DEVICE FOR CONTROLLING ADDITIVE MANUFACTURING MACHINERY

Applicant:
Honeywell Federal Manufacturing
& Technologies, LLC

Headword:

Relevant legal provisions:
EPC Art. 83
RPBA 2020 Art. 12(2), 12(4), 13(2)

Keyword:
Sufficiency of disclosure - (no)
Amendment to case - amendment overcomes objection (no)
Amendment after summons - cogent reasons (no)

Decisions cited:

Catchword:

Europäisches Patentamt
European Patent Office
Office européen des brevets

Beschwerdekammern

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Case Number: T 0733/21 - 3.2.03

D E C I S I O N
of Technical Board of Appeal 3.2.03
of 3 May 2023

Appellant: (Applicant)	Honeywell Federal Manufacturing & Technologies, LLC 14520 Botts Road Kansas City, MO 64147 (US)
Representative:	Uexküll & Stolberg Partnerschaft von Patent- und Rechtsanwälten mbB Beselerstraße 4 22607 Hamburg (DE)
Decision under appeal:	**Decision of the Examining Division of the European Patent Office posted on 21 December 2020 refusing European patent application No. 18172323.0 pursuant to Article 97(2) EPC.**

Composition of the Board:

Chairman	C. Herberhold
Members:	G. Patton
	D. Prietzel-Funk

Summary of Facts and Submissions

I. The applicant (appellant) lodged an appeal against the examining division's decision to refuse European patent application No. 18 172 323.0 on the basis of insufficiency of disclosure of the invention in accordance with the then main request and what were then auxiliary requests 1 to 4 (Article 83 EPC).

II. With the statement setting out the grounds of appeal, the appellant in the appeal proceedings maintained the requests discussed in the decision under appeal, and filed additional auxiliary requests 5 to 7.

III. The Board presented its preliminary, non-binding, opinion on these requests by a communication pursuant to Article 15(1) RPBA 2020 dated 22 December 2022.

In response, the appellant filed auxiliary request 8 by letter dated 3 April 2023.

During the oral proceedings before the Board held on 3 May 2023, the appellant filed auxiliary request 9. Details of the oral proceedings are set out in the minutes.

IV. At the end of the oral proceedings, the appellant requested

that the decision under appeal be set aside and that a patent be granted based:

- on the claims of the main request or of auxiliary requests 1 to 7, all requests filed with the statement setting out the grounds of appeal, the main request and auxiliary requests 1-4

corresponding to the requests underlying the impugned decision, respectively, or
- on the claims of auxiliary request 8 filed by letter dated 3 April 2023, or
- on the claims of auxiliary request 9 filed during the oral proceedings before the Board on 3 May 2022.

The appellant also requested that the case be remitted to the examining division in the event that the Board arrived at the conclusion that the requirements of Article 83 EPC were met.

V. Independent claim 1 of the **main request** reads as follows, with the feature lettering used in the decision under appeal (point 10):

(a) A computing device (10) for controlling the operation of an additive manufacturing machine (12), the computing device (10) comprising:
(b) a memory element (14) configured to store a three-dimensional model of a part (20) to be manufactured, the three-dimensional model defining a plurality of cross sections (44) of the part (20); and
(c) a processing element (16) in electronic communication with the memory element (14), the processing element (16) configured to
(d) receive the three-dimensional model of the part (20) to be manufactured from the memory element (14),
(e) determine a plurality of paths (46), one path (46) across a surface of each cross section (44), each path (46) including a plurality of parallel lines (48),

(f) receive an ambient processing temperature for a material used to manufacture the part (20),
(g) determine a material processing temperature for each point along each line (48) of each path (46),
(h) determine an energy balance for each point along each line (48) of each path (46) necessary to maintain the material processing temperature,
(i) determine a plurality of process settings to control scanning of a radiation beam (18) along the path (46) of each cross section (44),
(j) wherein determining the process settings comprises determining a plurality of radiation beam powers, one radiation beam power for each line (48) of each path (46), such that the radiation beam power increases non-linearly with respect to a length of the line (48),
(k) wherein determining the process settings comprises determining a plurality of radiation beam scan speeds, one radiation beam scan speed for each line (48) of each path (46), such that the radiation beam scan speed is a function of the material processing temperature, the length of the line (48), and a radiation beam power for the line (48),
(l) wherein the radiation beam scan speed increases non-linearly with respect to the radiation beam power for the line (48), and
(m) wherein the energy balance includes a relationship between the energy required from the radiation beam (18) to maintain the material processing temperature and the loss of energy in the material due to radiation, convection, conduction, or vaporization.

Independent claim 1 of each of **auxiliary requests 1 to 6** does not comprise any amendment modifying or further specifying features (h) and (m), which are at issue in

the reasons given below. Thus the exact wording of said claims 1 is irrelevant.

In comparison with feature (m) of claim 1 of the main request, feature (m7) of independent claim 1 of **auxiliary request 7** reads as follows (the added feature is shown in bold):

(m7) wherein the energy balance includes a relationship between the energy required from the radiation beam (18) to maintain the material processing temperature and the loss of energy in the material due to radiation, convection, conduction, or vaporization, **and the ambient processing temperature**.

Feature (h) is unamended in claim 1 of auxiliary request 7 and the other amendments are irrelevant to the decision as they do not further specify features (h) and (m7), which are at issue in the reasons given below.

In comparison with feature (h) of claim 1 of the main request, feature (h8) of independent claim 1 of **auxiliary request 8** reads as follows (the deleted feature is shown in strike-through and the added features are shown in bold):

(h8) determine **a plurality of process settings** ~~an energy balance~~ for each point along each line (48) of each path (46) necessary to maintain the material processing temperature, **wherein said process settings are based on a relationship between the energy required from the radiation beam (18) to maintain the material processing temperature and the loss of energy in the material**

due to radiation, convection, conduction, or vaporization,

Feature (m) is deleted in claim 1 of auxiliary request 8 and the other amendments are irrelevant as they do not further specify feature (h8), which is at issue in the reasons given below.

In comparison with feature (h) of claim 1 of the main request, feature (h9) of independent claim 1 of **auxiliary request 9** reads as follows (the deleted feature is shown in strike-through and the added feature is shown in bold):

(h9) determine **a plurality of process settings** ~~an energy balance~~ for each point along each line (48) of each path (46) necessary to maintain the material processing temperature,

Feature (m) is deleted in claim 1 of auxiliary request 9 and the other amendments are irrelevant as they do not further specify feature (h9), which is at issue in the reasons given below.

VI. The following document considered in the examination proceedings is relevant to the present decision:

D2: W. J. SAMES et al.: "The metallurgy and processing science of metal additive manufacturing", International Materials Reviews, vol. 61, no. 5, 7 March 2016 (2016-03-07), pages 315-360, XP055398013, ISSN: 0950-6608, http://dx.doi.Org/10.1080/09506608.2015.1116649

VII. The appellant's arguments relevant to the present decision are provided in the reasons for the decision below.

Reasons for the Decision

1. Main request

1.1 According to the decision under appeal, points II.12.1, II.12.1.2, II.12.4 and II.12.5, the requirements of sufficiency of disclosure were regarded as not met due *inter alia* to the lack of guidance for implementing the determination of the energy balance according to features (h) and (m). The skilled person was faced with an undue burden of developing modelling or simulation techniques to obtain the energy balance.

1.2 With its written submissions, the appellant argued that the details of the energy balance according to feature (m) were described in paragraph [0079] of the application as originally filed. As claimed in feature (m) of claim 1, the energy balance could include or involve a relationship between the energy required from the electron beam (18) to maintain the material processing temperature and the loss of energy in the material due to radiation, convection and the like. In other words, the material processing temperature of each point could be equal, proportional or related to the energy received from the electron beam minus the energy loss of the material. Since the material processing temperature was constant for each point along the path (46) of each cross section (44), if the energy loss varied from point to point, then the energy from the electron beam (18) could be varied as well to compensate. For example, if the energy loss increased, then the energy from the electron beam could be

increased by an equal, proportional or relative amount. Alternatively, if the energy loss decreased, then the energy from the electron beam could be decreased by an equal, proportional or relative amount. It was also obvious that energy from the electron beam was influenced by the ambient processing temperature, e.g. the temperature at which the material and the build tank were held while each cross section of the part was being formed. If the ambient processing temperature was high, then the energy from the electron beam could be decreased.

As described in paragraph [0005] of the application as originally filed, the heating and cooling behaviour of the raw material could result from the intrinsic thermal conductivity properties of the metals and alloys used. The metals and alloys with higher thermal conductivity cooled more rapidly than those with lower thermal conductivity. It was obvious that these characteristics could be obtained by measuring the material temperature at various combinations of length of the line, power of the electron beam and scan speed of the electron beam under different conditions, i.e. different raw materials and different ambient conditions.

1.3 The Board is not convinced by the appellant's arguments.

Features (h) and (m) of claim 1 require that the energy balance be determined. However, the application as originally filed does not comprise any indication as to how to determine this essential parameter. Paragraphs [0079] and [0005] of the application as originally filed referred to by the appellant do not give any indication or teaching in this respect, in particular

in the context of different scan strategies (see D2, section "Scan strategy", pages 326 and 327 and Figure 16 on page 327). Document D2, which is a review of the recent knowledge in the present technical field of metallurgy and processing science of metal additive manufacturing, confirms the difficulty of "*predicting thermo-mechanical cycles, solidification, solid-state transformation, residual stress, geometric distortion and mechanical properties as a function of existing and emerging AM* [additive manufacturing] *processes*" (see page 333, first paragraph of section "Modelling and Simulation"; see also decision under appeal II.12.1.2). D2 does not provide any indication or teaching regarding how to determine the energy balance, and nor has the appellant provided any evidence of the skilled person's common general knowledge in this respect. Hence the skilled person is not able to carry out steps (h) and (m) of claim 1 of the main request on the basis of the application as originally filed or their common general knowledge.

1.4 At the oral proceedings before the Board, the appellant argued that the skilled person knew how to maintain the material processing temperature according to feature (m) by analogy with other technical fields such as drilling, welding or room heating. A user reduced or increased the drilling speed depending on the difficulties encountered during drilling. A welder increased the welding energy input when the material to be welded was not sufficiently molten, or decreased the welding energy input when the temperature was high enough. A user turned up the thermostat to raise the temperature of a room or turned it down to lower it. Thus, by analogy, the person skilled in the art of additive manufacturing knew how to compensate for the loss of energy in the material due to radiation,

convection, conduction or vaporization according to feature (m). A temperature measuring device could be used in a known manner to indicate the actual temperature of the material in order to adapt the energy provided from the electron beam for the compensation of the energy loss. The system could even be automated. Therefore the skilled person knew how to carry out features (h) and (m) of claim 1.

1.5 The Board does not share the appellant's view.

The appellant's argument - which was presented for the first time at the oral proceedings before the Board - *de facto* concerns a regulation mechanism. It represents an amendment of the appeal case for which the appellant failed to provide any cogent reasons justifying exceptional circumstances. Regardless of the possible issue of admissibility of this late-filed argument into the proceedings, the Board considers that such a regulation mechanism and the temperature measurements involved are neither included in claim 1 nor described in the application as originally filed. According to features (a) and (c) the computing device according to claim 1 comprises a processing element which is **configured to determine** the energy balance. This is different from the simple feedback-driven regulation mechanisms to which the appellant referred. Indeed, claim 1 requires determining, i.e. calculating, the energy balance, and the processing element, which is part of the claimed device, performs the required determination. The term "determine" is used throughout the entire application as originally filed to specify that the value to be determined is obtained through calculations or through retrieving from a lookup table or database (see, for instance, paragraph [0080]). The application as originally filed, however, does not

comprise any indication as to how to calculate or obtain a lookup table or database for the energy balance. In this respect, the appellant confirmed at the oral proceedings before the Board that the plots of Figures 7 and 8 did not include or show the energy balance, but only concerned the relations between the electron scan speed, the electron beam power and the lengths of the lines of the path according to features (i) to (l) of claim 1.

1.6 In view of the above, there is no reason to deviate from the finding in points II.12.1, II.12.1.2, II.12.4, II.12.5 and II.13 of the decision under appeal that the application as originally filed is insufficiently disclosed for the skilled person to carry out the claimed invention according to the main request (Article 83 EPC).

2. Auxiliary requests 1 to 4

2.1 Claims 1 of of each of auxiliary requests 1 to 4 comprise features (h) and (m) of claim 1 of the main request discussed under point 1 above. It was undisputed by the appellant that the amendments performed in claim 1 of each of auxiliary requests 1 to 4 do not modify or further specify said features (h) and (m) at issue.

2.2 The appellant, having been informed at the oral proceedings of the Board's conclusions on the main request, did not contest that the same reasons and conclusions as those given above for the main request also apply to claim 1 of each of auxiliary requests 1 to 4.

2.3 As a result, there is no reason to deviate from the finding in points II.14 to II.17 of the decision under appeal that the application as originally filed is insufficiently disclosed for the skilled person to carry out the claimed invention in accordance with auxiliary requests 1 to 4 (Article 83 EPC).

3. Auxiliary requests 5 to 7

3.1 Auxiliary requests 5 to 7 were filed by the appellant for the first time with its statement setting out the grounds of appeal. As a consequence, they do not meet the requirements of Article 12(2) RPBA 2020 and are to be considered as an amendment according to Article 12(4) RPBA 2020.

3.2 As for auxiliary requests 1 to 4, the appellant, having been informed at the oral proceedings of the Board's conclusions on the main request, did not contest that the same reasons and conclusions as those given above for the main request also apply to claim 1 of each of auxiliary requests 5 to 7. As a matter of fact, it was undisputed by the appellant that the amendments made in said claims 1 of each of auxiliary requests 5 to 7 do not further specify how to determine the energy balance. Amended feature (m7) of claim 1 of auxiliary request 7, which comprises that the ambient processing temperature is also taken into account for the energy balance, does not further help in this respect.

As a result, auxiliary requests 5 to 7 are not suitable to overcome the objection of insufficiency of disclosure put forward in the decision under appeal, and hence are not admitted into the proceedings (Article 12(4) RPBA 2020).

4. Auxiliary request 8

4.1 Auxiliary request 8 was filed by the appellant for the first time by letter dated 3 April 2023, i.e. after notification of the summons. Thus its admittance into the appeal proceedings is subject to the conditions set out in Article 13(2) RPBA 2020.

4.2 The appellant argued that the amendments made in claim 1 of auxiliary request 8 aimed at overcoming the objection of insufficiency of disclosure raised by the Board in its communication with respect to features (h) and (m) relating to the "energy balance".

4.3 The objection at issue based on features (h) and (m) had, however, already been raised and discussed during the examination proceedings and is part of the decision under appeal, see point 1.1 above. The appellant failed to point out any additional arguments that the Board might have introduced by its communication with respect to this objection. Therefore the Board considers that auxiliary request 8 could and should have been filed at the latest with the statement setting out the grounds of appeal, if not during the examination proceedings, e.g. at the oral proceedings before the examining division, see minutes thereof, points 3.2.2, 3.2.4 and 3.7. Thus there are no cogent reasons justifying exceptional circumstances for filing auxiliary request 8 after receipt of the Board's communication.

Furthermore, the Board considers that the amendments introduced in claim 1 of auxiliary request 8 do not enable the objection of insufficiency of disclosure held valid against the main request and auxiliary requests 1 to 7 to be overcome. Feature (h8) (see point

V above) consists in a mere paraphrasing of features (h) and (m) by deleting and replacing the expression "energy balance" by "a plurality of process settings". Thus feature (h8) relates to "a plurality of process settings" which is defined in the same manner as the energy balance of features (h) and (m) of claim 1 of the main request. However, as with the "energy balance", no further information is provided in claim 1 of auxiliary request 8 or in the application as originally filed on how to determine the "plurality of process settings". As a consequence, the application as originally filed is still insufficiently disclosed for the skilled person to carry out the claimed invention in accordance with auxiliary request 8.

4.4 In view of the above, auxiliary request 8 is not admitted into the appeal proceedings, in accordance with Article 13(2) RPBA 2020.

5. Auxiliary request 9

5.1 Auxiliary request 9 was filed by the appellant during the oral proceedings before the Board. Thus its admittance into the appeal proceedings is subject to the conditions set out in Article 13(2) RPBA 2020.

5.2 Amended feature (h9) of claim 1 of auxiliary request 9 corresponds to feature (h8) of claim 1 of auxiliary request 8 without any further reference to what the plurality of process settings should be based on, in particular the loss of energy. Therefore feature (h9) is even broader than feature (h8) and still does not provide any indication as to how to determine the plurality of process settings.

As a result, it was undisputed by the appellant that the same reasons as those provided under point 4 above for auxiliary request 8 also apply to the admittance of auxiliary request 9.

5.3 Thus auxiliary request 9 is not admitted into the appeal proceedings, in accordance with Article 13(2) RPBA 2020.

6. Remittal

Since none of the appellant's requests are allowable or admissible, the appeal is unallowable. Thus the appellant's request to remit the case to the examining division for further prosecution in the event that the requirements of Article 83 EPC were met is moot.

Order

For these reasons it is decided that:

The appeal is dismissed.

The Registrar: The Chairman:

C. Spira C. Herberhold

Decision electronically authenticated