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**Datasheet for the decision  
of 2 October 2025**

**Case Number:** T 1489/23 - 3.5.06

**Application Number:** 16756824.5

**Publication Number:** 3356068

**IPC:** B22F3/105

**Language of the proceedings:** EN

**Title of invention:**

SYSTEM AND METHOD FOR ADDITIVE MANUFACTURING PROCESS CONTROL

**Patent Proprietor:**

General Electric Company

**Opponent:**

Renishaw plc

**Headword:**

Spark Plume/RENISHAW

**Relevant legal provisions:**

EPC Art. 100(b), 83

**Keyword:**

Sufficiency of disclosure - over the whole scope (no)

**Decisions cited:**

G 0001/24, T 0019/90

**Catchword:**

As to the serious doubts substantiated with verifiable facts required for an objection of insufficient disclosure, see reasons 12 to 15



**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

Case Number: T 1489/23 - 3.5.06

**D E C I S I O N**  
**of Technical Board of Appeal 3.5.06**  
**of 2 October 2025**

**Appellant:** Renishaw plc  
(Opponent) New Mills, Wotton-Under-Edge  
Gloucestershire, GL12 8JR (GB)

**Representative:** Matthews, Paul  
Renishaw plc  
Patent Department  
New Mills  
Wotton-under-Edge, Gloucestershire GL12 8JR (GB)

**Respondent:** General Electric Company  
(Patent Proprietor) 1 River Road  
Schenectady, NY 12345 (US)

**Representative:** Reddie & Grose LLP  
The White Chapel Building  
10 Whitechapel High Street  
London E1 8QS (GB)

**Decision under appeal:** **Decision of the Opposition Division of the  
European Patent Office posted on 15 June 2023  
rejecting the opposition filed against European  
patent No. 3356068 pursuant to Article 101(2)  
EPC.**

**Composition of the Board:**

**Chairman** Martin Müller  
**Members:** T. Alecu  
K. Kerber-Zubrzycka

## **Summary of Facts and Submissions**

- I. The appeal lies from the decision of the Opposition Division to reject the opposition. The patent was opposed on the grounds of Article 100(a) and (b) EPC.
- II. The Opponent (Appellant) appealed and requested that the decision be set aside and that the patent be revoked.
- III. The Proprietor (Respondent) requested that the appeal be dismissed and that the patent be maintained as granted, or that the patent be maintained on the basis of one of two auxiliary requests.
- IV. The decision was taken during oral proceedings.
- V. The following documents are referred to below:  
  
E5: WO95/11100 A1  
E6: US5961859 A  
E9: Investigation into spatter behaviour during selective laser melting of AISI 316L stainless steel powder; Liu, Yang, Mai, Wang, Song  
E11: Process Monitoring and Control for Laser Materials Processing - An Overview; Kaierle, Abels, Kratzsch  
E14: Detection of weld defects by high speed imaging of the vapor plume; Brock, Tenner, Klämpfl, Hohenstein, Schmidt
- VI. Claim 1 of the patent defines:

*A method of process control for an additive manufacturing system, comprising the steps of:*

*monitoring a spark plume (60) created during manufacture of an article (40) in a system according to any of claims 7-9;*

*capturing at least one image of the spark plume (60);*

*deriving image data from the at least one image;*

*feeding the image data into a statistical process control module; and*

*generating an alert if the image data exceeds a pre-determined control limit.*

- VII. Claim 1 of the first auxiliary request differs from that of the patent as granted by the addition of the following feature:

*wherein:*

*the image data includes at least one of plume shape, plume height, plume width, plume area, and plume orientation.*

- VIII. Claim 1 of the first auxiliary request differs from that of the patent as granted by the addition of the following features:

*wherein:*

*the step of monitoring the spark plume (60) occurs in real-time;*

*the image data includes at least one of plume shape, plume height, plume width, plume area, and plume orientation.*

## Reasons for the Decision

### *The patent as granted*

1. The patent relates to additive manufacturing process control, in particular for Selective Laser Sintering (SLS). In SLS a laser is used as the power source to sinter powdered material (e.g. metal) in successive layers, thereby forming a 3D object layer by layer (paragraphs 1 and 2).
  - 1.1 According to the patent, known SLS systems used openloop control *"with no direct feedback for any inprocess quality factors such as powder recoating, recoater shape, powder uniformity, laser welding uniformity and table Z-height position"*. If a defect was created, it could only be seen after the manufacturing was complete, possibly days later, resulting in wasted resources (paragraph 3).
  - 1.2 The patent proposes *"real-time statistical process control monitoring and control"* (paragraph 4). It relies on monitoring the *"spark plume"* created during sintering. An image of the spark plume is taken, image data is extracted from the image, and this data is fed to a statistical process control module. An alert is generated *"if the image data exceeds pre-determined control limits"* (paragraph 7).
  - 1.3 The patent further specifies that *"the image data may include various plume characteristics such as plume shape, plume height, width, area, orientation and light intensity"* (see paragraphs 22 and 23, see figure 2).

*Claim interpretation*

2. The interpretation of several terms in the claims was controversial between the parties.
3. The Appellant questioned whether the claimed image data necessarily related to characteristics of the spark plume. More specifically (see statement of grounds of appeal, reasons 2.1.1 and 2.1.2) it argued that the claimed image data could relate to information in other parts of the image containing the spark plume, e.g. the melt bed, because the claim only defines that image data is "derived from" the image containing the plume.
4. The Board disagrees with the Appellant's interpretation. The claimed features must be interpreted in the context of the claim as a whole and in view of the description (G 1/24).
  - 4.1 The claim sets out a method of process control, with a step of monitoring a spark plume. The Board is of the opinion that the skilled person would thus understand that the derived data serves to monitor the spark plume, i.e. it is related to characteristics thereof.
  - 4.2 This interpretation is also consistent with the description, which only discloses the use of data related to characteristics of the spark plume and does not indicate that any other data from the image might be used (see above, points 1.2 and 1.3).
5. Also at issue was the interpretation of the term "*spark plume*", because, according to the Appellant, it does not have an accepted definition in the art (statement of grounds of appeal, points 1.2.1). The Appellant (statement of grounds of appeal, point 1.1.(i)) pointed

out that the sintering process creates plasma, spatter, and condensate, and the patent does not define which of these are to be considered as part of the spark plume.

5.1 The Opposition Division construed the "spark plume" to be "a cloud of incandescent particles" (decision, reasons 1.4.1), and appeared to consider that neither plasma nor spatter create a spark plume as claimed (decision, reasons 3.4.3 and 3.4.10).

5.2 On the basis of the submitted evidence, the Board accepts that the term is indeed not defined in the art. The documents at hand consider different types of ejected particles that form visible plume-like shapes, and some use the term "plume" in this context, but none of them defines the term "spark plume". For instance:

E5 (page 17) refers to "a plasma (laser-excited atomic states of the cover gas that radiate emissions during energy decay) or a plume (vaporized or particulate material emitted from powder surface that glows due to heat or florescence);

E6 (column 1, lines 18 to 20) states that "This vapor and the surrounding gases are ionized by the extreme heat and form a plasma plume";

E9 (figures 4 and 5) and E11 (figure 1) show respectively "spatter" and "plasma" which spark and could be said to form a "plume"; and

E14 (figure 1) discusses a "vapor plume".

5.3 Since the patent does not define the term either, the Board takes the view that the term "spark plume" is to be taken to cover any (combination) of matter created

by the sintering process, as cited above, to the extent it "sparks" and its shape may be said to be "plume"-like.

6. The parties agreed that the claim could not be construed as an "arbitrary collection of features" (see, e.g., the statement of grounds of appeal, point 1.2.2). Specifically, they agreed that the generated alert had to be interpreted in the context of the claimed "process control for an additive manufacturing system" as meaningful in the sense that it indicated that something might go or is going wrong during the manufacturing process, even though no specific malfunction, anomaly or defect is claimed (see the decision, reasons 1.4.2, and again the statement of grounds of appeal, point 1.2.2).

- 6.1 The Board agrees with this interpretation because the claimed method relates to *process control*, which, in the skilled person's understanding, aims at maintaining the process parameters in a range guaranteeing a certain quality in the manufacturing process. This interpretation is further supported by the patent specification (see points 1.1. and 1.2 above, see also paragraph 20).

*Article 100(b) EPC*

*The arguments of the parties*

7. The Appellant argued (see e.g. statement of grounds of appeal, pages 4 to 8) that the claimed invention was not sufficiently disclosed because:

- (a) it did not disclose how to analyse the image of the spark plume so as to derive characteristics of the

"spark plume", since the term "spark plume" did not have a definite meaning (as discussed above) and since the patent did not disclose how to extract reliable information from such an image, which was not trivial; and because

- (b) it did not disclose how to derive meaningful control limits, since the patent neither established that characteristics of the plume spark are correlated with any malfunctions, anomalies or defects nor taught how to devise an experiment to determine the control limit in individual circumstances (differing e.g. in production method, powder type or manufactured product).

8. In brief, for the Appellant, the patent was only an invitation to carry out research and "*[t]he teaching of the Patent can be summarised as: look at the cloud of sparks generated by the process because there may be [] useful information encoded in it. However, there is no teaching of what defines a cloud of sparks or what useful information can be determined or even evidence that such useful information exists*" (statement of grounds of appeal, last paragraph on page 6).
9. The Respondent stated that the Appellant had not discharged its burden of proof according to which, following established case law of the boards of appeal (e.g. T 19/90, reason 3.3) according to which claims can only be objected to for lack of sufficiency if there are serious doubts substantiated by verifiable facts.
10. In substance, both the Respondent (see reply, point 3.3) and the Opposition Division were of the opinion that the person skilled in the art was capable of

carrying out the invention based on common general knowledge.

- 10.1 The person skilled in the art knew how to set up a system to capture images of the spark plume and how to extract its extent and characteristics such as width and height (the Respondent refers to figures 1 and 2 of the patent). With reference to the cited prior art documents, the Opposition Division was in particular of the opinion that "*image capturing and analysis of phenomena [...] are known in the art and software is available*" (decision, page 6, top).
  
- 10.2 The control limits could be determined by the skilled person through routine experimentation by analysing data on spark plumes under suitable manufacturing conditions, and deriving limits between normal and abnormal values (decision 1.4.2).
  
11. During the oral proceedings before the Board the Respondent argued that the invention was based on the insight that the spark plume was an indicator of in-quality process factors (see the patent, paragraph 20: "*[...] such as powder recoating, re-coater shape, powder uniformity, laser welding uniformity and lift table height position accuracy*"). The patent also explained which characteristics could be used (paragraph 22: "*[...] such as plume shape, plume height, width, area, orientation and light intensity*"). This was sufficient information for the person skilled in the art, who could carry out the invention on the basis of routine experimentation with the disclosed characteristics.

*Serious doubts substantiated by verifiable facts*

12. The Respondent stated that the Appellant had not discharged its burden of proof regarding insufficiency of disclosure, without much reasoning and without giving any specific legal basis for its objection. However, the Board understands the Respondent to question the particular way in which sufficiency of disclosure had been challenged.
  
13. The EPC requires that the invention be sufficiently disclosed (Article 100(b) respectively 83 EPC). The burden to ensure this is on the Patentee (respectively Applicant).
  
- 13.1 This means that the patent or application must teach what the skilled person is supposed to do in order to carry out the invention, which includes achieving any relevant technical effects, over the whole scope of the claims.
  
14. An objection to sufficiency, as any other objection, has to be reasoned. This burden is on the one raising the objection. It must explain in which way the disclosure is deficient.
  
- 14.1 To justify an objection, one may contest factual allegations in the disclosure (e.g. that certain things can be done in a certain way or that a technical effect is effectively achieved), or one may point out to gaps in the disclosure, i.e. to information, which is missing from the disclosure but required for the skilled person to carry out the invention over the full scope of the claims.

- 14.2 For either argument to be convincing, it must raise "serious doubts" regarding sufficiency of disclosure. They cannot be limited to mere allegations of insufficiency, but must be reasoned in a way allowing the deciding body to evaluate, i.e. "verify" their merit.
- 14.3 To make an objection of the "first type", it may be appropriate to submit evidence showing that an alleged fact is actually incorrect.
- 14.4 It may be less straightforward to provide evidence to substantiate an objection of the "second type", because establishing a "gap" in the disclosure is similar to "proving a negative". For the same reason, it is unclear to what extent an objection of the latter type can be based on "verifiable facts".
- 14.5 In the present case the Opponent has pointed to specific information missing from the disclosure and the common general knowledge in the art (see points 7 and 8 above). The corresponding arguments explaining the breadth of the claim language and what would be required of the skilled person to carry out the claimed invention across its full breadth were in part verifiable (e.g. as regards the meaning of "spark plume" in the art), and otherwise sufficiently substantiated for the Board to assess them.
15. In the Board's judgement, therefore, the Appellant has provided sufficient reasons to substantiate its objection of insufficient disclosure.

The Board's opinion

*Teaching and common general knowledge*

16. The Board agrees with the Respondent that the patent teaches that the spark plume may be an indicator for in-process quality factors and also that it provides a list of characteristics that may be useful as indicators.

16.1 The Board is also of the opinion that the person skilled in the art would be capable of extracting specifically given image characteristics from suitably "derived" image data using common-place image processing tools. This is part of the common general knowledge, as the Opposition Division also concluded.

17. Considering the cited prior art, which links various plume constituents to possible manufacturing defects (see e.g. E6 or E9), the Board is also convinced (though not from what the patent discloses) that at least some useful information exists in the image of the spark plume.

17.1 It is also clear that for some instances, the success of the claimed method is predictable. E.g. absence of any plume, whatever its type, will normally signify a problem. But the claim is not restricted to such "extreme" cases. Rather, the patent is directed to "standard" cases in which one can measure e.g. width or height of the spark plume.

*Gaps in disclosure*

18. The patent does not

- (a) define the intended meaning of the term "spark plume", i.e. which incandescent matter (plasma, spatter, condensate) is to be monitored;
- (b) disclose which characteristics of the so-defined spark plume are (not just *may be*) useful as indicators, and for *which* quality factors; or
- (c) provide any evidence to that effect.

Based on the evidence on file, this missing information is not part of common general knowledge.

- 19. In order to carry out the claimed invention, the person thus needs to proceed by experimentation, as also argued by the Respondent.
- 19.1 Because the patent provides no working examples, the person skilled in the art has to make three choices without any guidance, namely which "plume" constituents to identify in the image, which characteristics to derive from that image, and in view of which quality factors to assess abnormality of the derived characteristics.
- 19.2 These choices cannot be arbitrary but must allow for a meaningful alert to be issued (see above point 6, and this for all types of manufacturing processes (e.g. powder type) and products.
- 19.3 Deciding when an alert is meaningful is also a difficulty in itself. A statistical analysis is necessary, which may be alluded to ("*statistical process control module*"), but which is also not properly disclosed.
- 20. The complexity of the task that the person skilled in the art needs to accomplish is therefore of combinatorial nature, and without any guarantee of

success. It does not appear trivial to make appropriate selections for a large number of quality factors, manufacturing processes and products. It is not even clear which quality factors may be reflected at all in any of the plume characteristics. It may be possible with reasonable effort to find parameter combinations which work for some cases, but it appears difficult to identify such cases beforehand.

20.1 In the Board's judgment, the successful accomplishment of this task by the person skilled in the art requires a considerable effort and goes well beyond routine experimentation. It amounts therefore to an undue burden.

21. The Board concludes that the claimed invention is insufficiently disclosed for it to be carried out, over its full breadth, by the person skilled in the art.

*Auxiliary requests*

22. The above conclusion applies to the auxiliary requests as well.

23. The Respondent argued, for both requests, that the express limitation on the characteristics to be used considerably reduced the burden on the person skilled in the art when carrying out the invention. This was the case, because the person skilled in the art only had to try out the specifically mentioned characteristics.

24. The Board is not convinced. On the one hand, the burden might be "significantly" reduced but remains very large indeed. More importantly however, listing the characteristics does not overcome the lack of

information as to which characteristic of which plume constituents is to be monitored to provide meaningful alerts for which type of quality factors in the context of a given build process and product.

## Order

### For these reasons it is decided that:

1. The decision under appeal is set aside.
2. The patent is revoked.

The Registrar:

The Chairman:



L. Stridde

Martin Müller

Decision electronically authenticated