PATENT COOPERATION TREATY

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INTERNATIONAL SEARCHING AUTHORITY

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PCT

WRITTEN OPINION OF THE INTERNATIONAL SEARCHING AUTHORITY

(PCT Rule 43*bis*.1)

Date of mailing
(day/month/year) see form PCT/ISA/210 (second sheet)

Applicant's or agent's file reference
see form PCT/ISA/220

FOR FURTHER ACTION
See paragraph 2 below

International application No.	International filing date *(day/month/year)*	Priority date *(day/month/year)*
PCT/EP2018/065565	12.06.2018	13.06.2017

International Patent Classification (IPC) or both national classification and IPC
INV. B22F3/105 B33Y10/00 B33Y30/00 B29C64/20 B29C64/277 B29C64/264 B29C64/268

Applicant
MUSEVIC, NATASA

1. This opinion contains indications relating to the following items:

- ☒ Box No. I Basis of the opinion
- ☐ Box No. II Priority
- ☐ Box No. III Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
- ☐ Box No. IV Lack of unity of invention
- ☒ Box No. V Reasoned statement under Rule 43*bis*.1(a)(i) with regard to novelty, inventive step and industrial applicability; citations and explanations supporting such statement
- ☐ Box No. VI Certain documents cited
- ☒ Box No. VII Certain defects in the international application
- ☒ Box No. VIII Certain observations on the international application

2. **FURTHER ACTION**

If a demand for international preliminary examination is made, this opinion will usually be considered to be a written opinion of the International Preliminary Examining Authority ("IPEA") except that this does not apply where the applicant chooses an Authority other than this one to be the IPEA and the chosen IPEA has notifed the International Bureau under Rule 66.1*bis*(b) that written opinions of this International Searching Authority will not be so considered.

If this opinion is, as provided above, considered to be a written opinion of the IPEA, the applicant is invited to submit to the IPEA a written reply together, where appropriate, with amendments, before the expiration of 3 months from the date of mailing of Form PCT/ISA/220 or before the expiration of 22 months from the priority date, whichever expires later.

For further options, see Form PCT/ISA/220.

Name and mailing address of the ISA:	Date of completion of this opinion	Authorized Officer
European Patent Office P.B. 5818 Patentlaan 2 NL-2280 HV Rijswijk - Pays Bas Tel. +31 70 340 - 2040 Fax: +31 70 340 - 3016	see form PCT/ISA/210	Traon, Nicolas Telephone No. +31 70 340-0

WRITTEN OPINION OF THE INTERNATIONAL SEARCHING AUTHORITY

International application No.
PCT/EP2018/065565

Box No. I Basis of the opinion

1. With regard to the **language**, this opinion has been established on the basis of:

   ☒ the international application in the language in which it was filed.

   ☐ a translation of the international application into , which is the language of a translation furnished for the purposes of international search (Rules 12.3(a) and 23.1 (b)).

2. ☐ This opinion has been established taking into account the **rectification of an obvious mistake** authorized by or notified to this Authority under Rule 91 (Rule 43*bis*.1(a))

3. ☐ With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, this opinion has been established on the basis of a sequence listing:

   a. ☐ forming part of the international application as filed:

      ☐ in the form of an Annex C/ST.25 text file.

      ☐ on paper or in the form of an image file.

   b. ☐ furnished together with the international application under PCT Rule 13*ter*.1(a) for the purposes of international search only in the form of an Annex C/ST.25 text file.

   c. ☐ furnished subsequent to the international filing date for the purposes of international search only:

      ☐ in the form of an Annex C/ST.25 text file (Rule 13*ter*.1(a)).

      ☐ on paper or in the form of an image file (Rule 13*ter*.1(b) and Administrative Instructions, Section 713).

4. ☐ In addition, in the case that more than one version or copy of a sequence listing has been filed or furnished, the required statements that the information in the subsequent or additional copies is identical to that forming part of the application as filed or does not go beyond the application as filed, as appropriate, were furnished.

5. Additional comments:

Box No. V Reasoned statement under Rule 43*bis*.1(a)(i) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Yes:	Claims	9-12, 16
	No:	Claims	1-8, 13-15, 17-23
Inventive step (IS)	Yes:	Claims	12
	No:	Claims	1-11, 13-23
Industrial applicability (IA)	Yes:	Claims	1-23
	No:	Claims	

2. Citations and explanations

see separate sheet

Box No. VII Certain defects in the international application

The following defects in the form or contents of the international application have been noted:

see separate sheet

Box No. VIII Certain observations on the international application

The following observations on the clarity of the claims, description, and drawings or on the question whether the claims are fully supported by the description, are made:

see separate sheet

Re Item V

Reasoned statement with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1 References

Reference is made to the following documents:

D1: EP 2 937 163 B1 (JEOL LTD [JP]) 3 May 2017 (2017-05-03)cited in the application

D2: US 2016/228991 A1 (RYAN DANIEL J [US] ET AL) 11 August 2016 (2016-08-11)

D3: US 2016/031156 A1 (HARKNESS WILLIAM A [US] ET AL) 4 February 2016 (2016-02-04)cited in the application

2 Novelty (Art. 33(2) PCT)

The present application does not meet the criteria of Article 33(2) PCT, because the subject-matter of claims 1-8, 13-15 and 17-23 is not new for the following reasons:

2.1 Independent claims

2.1.1 Claims 1 and 17

The present novelty objection in view of document D1 is based on the unclear feature "curved three-dimensional intersection volume" as raised in section 5.5 of the present communication.

Document D1 discloses a machine for additive manufacturing of three-dimensional objects (see cl. 1 and fig. 1-3), the machine comprising:
a first source (8) of particles with mass emitting a first beam (L_1) (see cl. 1 and fig. 1); a first control signal which manages the first source (8) of particles with mass via a control unit (11) and causes the creation of the said predetermined beam (L_1) (see cl. 1 and fig. 1); a second source (9) of particles with mass emitting a second beam (L_2) (see cl. 1 and fig. 1); a second control signal which manages the second source (9) of particles with mass via a control unit (12) and causes the creation of said predetermined

beam (L_2) (see cl. 1 and fig. 1), a vacuum chamber (2) (paragraph [0021] and fig. 1);
wherein
the control signal for controlling the first source (8) and the control signal for controlling the second source (9) are mutually arranged in a timely manner and created in a way in which two or more predefined clusters emitted from different sources (8,9) overlap in a predefined volumetric part of a printing space of the machine (1) (see fig. 2) and in this way create a curved three-dimensional intersection volume inside of which a melting volume occurs where the sum of energies of the predefined individual clusters exceeds the energy threshold required for melting of a powdered material located in the melting volume (see fig. 2), and said sum of energies therefore causes melting of the powdered material (see paragraph [0034] and fig. 2),
and further in that each particle source (8,9) is equipped with its own system of magnetic lenses for managing divergence and deflection of said beams (L_1,L_2) (see fig. 2).

2.1.2 **Claims 13 and 18**

Document D2 discloses a machine for additive manufacturing of three-dimensional objects (see fig. 7), wherein the powdered material (A,C) and/or melted powdered material is transported onto the already printed object part with an electrostatic pull between the powdered material (A,C) and already printed object part using a control signal and a control unit controlling a switch for creating electric connection between conductive needle and higher electric potential and a switch for creating electric connection between conductive needle and lower electric potential (see fig. 7).

Furthermore, the subject-matter of claims 13 and 18 is also disclosed in document D3 (see fig. 11).

2.1.3 **Claim 14**

Document D2 discloses a machine for additive manufacturing of three-dimensional objects, wherein excessive charge are removed from an already printed object part through a conductive needle which is connected electrically to the surface of the already printed object part and controlled with a control unit via a control signal (see fig. 8).

2.1.4 **Claim 15**

Document D2 discloses a method for additive manufacturing of three-dimensional objects comprising the following steps (see paragraphs [0042], [0043], [0052], [0053] and fig. 4-7):
a print preparation and a printing process wherein during the print preparation using a simulator and based on print specifications and machine specifications (see paragraphs [0042], [0043], [0052], [0053] and fig. 4-7), a spatial division of a digital file of the three-dimensional object is conducted followed by creation of a control file using a generator (see paragraphs [0042], [0043], [0052], [0053] and fig. 4-7), said control file managing all assembly part of the machine with the use of dedicated control signals via control units for the purpose of gradual fabrication of the three-dimensional object (see paragraphs [0042], [0043], [0052], [0053] and fig. 4-7), wherein final object is fabricated with gradual fabrication of individual constituent parts and with assembling of said constituent parts in a specific sequence until the final object is fabricated (see paragraphs [0042], [0043], [0052], [0053] and fig. 4-7)
wherein
an individual constituent part of final fabricated three-dimensional object is a three-dimensional print volume with an enclosed curved surface (see paragraphs [0042], [0043], [0052], [0053] and fig. 4-7).

2.2 **Dependent claims 2-8 and 19-23**

2.2.1 **Dependent claims 2-8**

Furthermore, document D1 also prejudices the novelty of the subject-matter of the following claims:

- claims 2-3 (see cl. 1 and fig. 1-3)
- claims 4-5 (see cl. 1)
- claim 6 (see fig. 1-3)
- claims 7-8 (see fig. 1)

2.2.2 **Dependent claims 19-23**

Furthermore, document D2 also prejudices the novelty of the subject-matter of the following claims:

- claim 19 (see fig. 6-7)
- claims 20-23 (see fig. 7)

3 Inventive step (Art. 33(3) PCT)

The present application does not meet the criteria of Article 33(1) PCT, because the subject-matter of claims 1-11 and 13-23 does not involve an inventive step in the sense of Article 33(3) PCT for the following reasons:

3.1 Claims 1-8, 13-15 and 17-23

The subject-matter of claims 1-8, 13-15 and 17-23 does not involve an inventive step, because the technical features disclosed in these claims are already suggested in documents D1, D2 and D3.

3.2 Claims 9-11 and 16

Claims 9, 10 and 16 describe a machine/method for additive manufacturing wherein the powdered material is transported to the melting area with the use of a magnetic field created with a plurality of windings.

In closest prior art document D2, the powdered material is transported to the melting area through acoustic levitation (see cl. 3).

However, magnetic levitation is described for the same purpose as an obvious alternative to acoustic levitation in document D3 (see paragraph [0008]).

Therefore, the person skilled in the art would consider the magnetic levitation as suggested in document D3 in the machine/method for additive manufacturing disclosed in document D2 as an standard design option.

Furthermore, the additional features described in claim 11 are already suggested in document D2 (see fig. 7).

4 **Positive opinion in regard to claim 12**

The combination of the features of dependent claim 12 is neither known from, nor rendered obvious by, the available prior art. The reasons are as follows:

Indeed, none of documents D1 to D3 discloses a machine for additive manufacturing three dimensional objects, wherein the material is transported to the melting area through magnetic levitation via windings and wherein the melting area is defined as a curved volume corresponding to the intersection of at least two particle sources characterized by a divergence and a deflection.

For these reasons, the subject-matter of claim 12 is new within the meaning of Art. 33(2) PCT.

The technical effect induced by the features of the subject-matter of claim 12 is to define a curved melting volume in magnetic levitation to accurately define the three-dimensional shape of the feature being melted.

In closest prior art D2, the electron beams irradiate two different areas and do not overlap. There is no hint in document D2 that would encourage the person skilled in the art to intersect the two electron beams of D2 to melt the powder material.

In Document D3, the material is extruded and then transported through acoustic or magnetic levitation.

Even if overlapping two electron beams is suggested in document D1, D1 treats of a layer by layer process contrary to the subject-matter of claim 12, wherein powder in levitation is irradiated.

For these reasons the person skilled in the art would not combine the teaching of closest prior art document D2 with the teaching of document D1 to accurately define the three-dimensional shape of the feature being melted.

Therefore, the subject-matter of claim 12 involves an inventive step within the meaning of Art. 33(3) PCT.

Re Item VII

Certain defects in the international application

5 Acknowledgement of the prior art

Document D2 should be identified in the description and the relevant background art disclosed therein should be briefly discussed.

Re Item VIII

Certain observations on the international application

6 Clarity (Art. 6 PCT)

The application does not meet the requirements of Article 6 PCT, because claims 1, 9, 11, 13-18 and 20-23 are not clear for the following reasons:

6.1 Claims 1, 9, 13 and 14 [Multiple claims of same category]

Although claims 1, 9, 13 and 14 have been drafted as separate independent claims, they appear to relate effectively to the same subject-matter and to differ from each other only with regard to the definition of the subject-matter for which protection is sought and/or in respect of the terminology used for the features of that subject-matter. The aforementioned claims therefore lack conciseness and as such do not meet the requirements of Article 6 PCT.

6.2 **Claims 15-18 [Multiple claims of same category]**

Although claims 15-18 have been drafted as separate independent claims, they appear to relate effectively to the same subject-matter and to differ from each other only with regard to the definition of the subject-matter for which protection is sought and/or in respect of the terminology used for the features of that subject-matter. The aforementioned claims therefore lack conciseness and as such do not meet the requirements of Article 6 PCT.

6.3 **Claims 1 and 15 [Missing essential features - Part 1]**

It is clear from the description that the present application describes a machine/method for additive manufacturing three-dimensional objects, wherein the objects is manufactured by melting powder material in a melting pool defined by the volume intersection of particle sources.

Therefore, such a manufacturing step is possible if the powder material levitates in the build chamber in order to that the powder material may be irradiated by the plurality of particle sources, and in order that the melt pool define a three-dimensional curved volume.

This clarity objection would be overcome by adding the subject-matter of:

- claims 9, 11 and 12 to the subject-matter of claim 1, and
- claims 16 and 17 to the subject-matter of claim 15.

6.4 **Claims 1 and 15 [Missing essential features - Part 2]**

The patent applicant agrees in the description of the present application on page 5, lines 1-9 that the machine/method for additive manufacturing three-dimensional objects of the present application differs from the machine/ method for additive manufacturing three-dimensional objects disclosed in document D3 in that the printed object part is "mechanically supported, and the magnetic levitation is used for transport and application of the powdered material into a predefined melting volume". Therefore, this distinguishing feature over the prior art document should be part of the independent claims.

This clarity objection would be overcome by adding the subject-matter of:

- claim 13 to the subject-matter of claim 1, and
- claim 18 to the subject-matter of claim 15.

6.5 **Claims 1, 11, 15, 17 and 20-23 [Unclear features]**

The expressions "curved surface" or curved volume" used in claims 1, 11, 15, 17 and 20-23 is vague and unclear and leaves the reader in doubt as to the meaning of the technical feature to which it refers, thereby rendering the definition of the subject-matter of said claim unclear, Article 6 PCT.

This clarity objection would be overcome by mentioning that the curved volume "is not a two-dimensional layer with a specific height and not a small point with a permanently fixed size" as mentioned on page 7, lines 17-23 of the present application. Furthermore, it appears that these technical features would be clear if the machine and the method for additive manufacturing three dimensional objects concern magnetic levitation of powder material being melted in the intersection of at least two particle beams.

6.6 **Conclusion of Item VIII**

The present application would be considered as clear if claims 1 and 15 are drafted as follows:

Claim 1 = original claims 1, 9 ad 11-13

Claim 15 = original claims 15-18