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(54) Title: METHOD FOR REMOVING LOOSE RESIDUES, ESPECIALLY IN THE MANUFACTURE OF A HOUSING OF A SANITARY FITTING

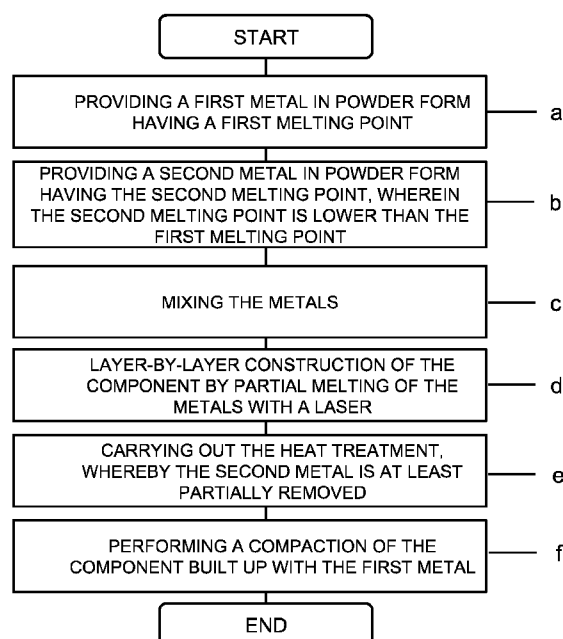


Fig. 1

(57) Abstract: A method for manufacturing a component (1) of a sanitary fitting (2) is proposed, comprising at least the following steps: a. Providing a first metal (3) in powder form having a first melting point, b. Providing a second metal (4) in powder form having a second melting point, wherein the second melting point is lower than the first melting point, c. Mixing the metals, d. Layer-by-layer construction of the component (1) by partial melting of the metals with a laser (5), e. Carrying out a heat treatment, whereby the second metal (4) is at least partially removed, f. Performing a compaction of the component (1) built up with the first metal (3).

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- 1 -

**Method for removing loose residues,
especially in the manufacture of a housing of a sanitary fitting**

TECHNICAL FIELD

5 The present disclosure concerns a method for removing loose residues, in particular in the context of an additive manufacturing process.

BACKGROUND ART

10 It is known from the state of the art to manufacture sanitary fittings, such as wash basin fittings, bathtub fittings, concealed fittings or the like from brass. Casting processes are generally used for this purpose in order to be able to realize complex geometries, which may also include different functional elements of the fitting.

SUMMARY

15 In this connection, however, it could be observed that corresponding casting processes are limited with regard to the quality and accuracy of the geometries and, in particular, their contours that can be achieved with them. This is particularly relevant for particularly thin-walled fittings. In addition, not all freely formable geometries can be realized with appropriate casting processes.

20 On this basis, it is the task of the present disclosure to at least partially solve the problems described with respect to the prior art. In particular, a method for manufacturing a component of a sanitary fitting, a component for a sanitary fitting and a sanitary fitting should be specified, each of which at least contributes to increasing the freedom in designing the geometry of a sanitary fitting. In addition, it should also be possible to realize fittings with the thinnest possible walls.

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These objects are solved by the features of the independent claims. Further advantageous configurations of the solution proposed here are indicated in the dependent claims. It should be noted that the features individually listed in the dependent claims

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may be combined in any technologically meaningful way and define further features of the disclosure. In addition, the features indicated in the claims are specified and explained in more detail in the description, whereby further preferred embodiments of the disclosure being presented.

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A method for manufacturing a component of a sanitary fitting contributes to this, comprising at least the following steps:

- a. Providing a first metal in powder form having a first melting point,
- b. Providing a second metal in powder form having a second melting point, the second melting point being lower than the first melting point,
- 10 c. Mixing the metals,
- d. Layer-by-layer construction of the component by partial melting of the metals with a laser,
- e. Carrying out a heat treatment, whereby the second metal is at least partially re-
- 15 moved,
- f. Performing a compaction of the component built up with the first metal.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a flowchart that illustrates a sequence of the method described here; and

20 Fig. 2 is an illustration of a possible application of the method described here.

DESCRIPTION OF EMBODIMENTS

As shown Fig. 1, the specified order of steps a., b., c., d., e. and f. is exemplary and may be used, for example, in a regular operating procedure. In particular, steps a. to f. shall be carried out at least once in the specified order. Furthermore, steps a. to f. In particular, steps a. to d. may also be carried out at least partially in parallel or even simultaneously.

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The method may be used, for example, to manufacture a brass component of a sanitary fitting. In particular, the method is used for the (bimetallic) laser sintering of a (brass) housing or (brass) housing part of a sanitary fitting. This method allows, for example, common brass alloys to be used and processed particularly advantageously in additive manufacturing processes.

In step a., a first metal in powder form having a first melting point is provided. The first metal to be provided in powder form may be a metallic material and possibly also a metal alloy. Preferably the first metal to be provided in powder form is a brass powder or a copper powder.

In step b., a second metal in powder form having a second melting point is provided, the second melting point being lower than the first melting point. In other words, this means that the second melting point is below the first melting point. The second metal to be provided in powder form may be a metallic material and possibly also a metal alloy. Preferably the second metal to be provided in powder form is a zinc powder.

In step c., the metals are mixed. Mixing may take place, for example, before and/or during the provision of the two metals. Alternatively or cumulatively, mixing may also take place during and/or after the provision of the two metals. The mixing of metals in a powder bed or to a powder bed is particularly preferred. In step c. a powder mixture of two metals with significantly different melting points is usually produced. Furthermore, the two metals may have limited or complete solubility in the liquid state.

In step d., the component is built up layer by layer by partial melting of the metals with a laser. The layer-by-layer construction may also be described in such a way that several layers are formed one after the other on top of each other or layer by layer. A layer essentially describes a horizontal cross-section through the component.

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In partial melting, the powder located within a layer is heated locally, at predetermined points at which material solidification is to occur, for as long and/or as intensively as necessary so that the metal powder grains there (temporary) liquefy and thus bond each other permanently (or until reheating). Partial melting may be carried out advantageously in the form of 3D printing (in a powder bed) and/or in the form of a three-dimensional, additive manufacturing process (in a powder bed and/or with laser melting).

Preferably, laser sintering is performed in step d. In step d. a so-called selective laser sintering (short: SLS) is particularly preferred. Selective Laser Sintering (SLS) is an additive manufacturing process to produce spatial structures by sintering with a laser from a powdery raw material.

In step e., a heat treatment is carried out, whereby the second metal is at least partially removed or separated from the first metal. In particular, the component is heated to a temperature above the melting point (or exactly to the melting point) of the second metal and below the melting point of the first metal. This allows the second metal to liquefy while the structure formed with the first metal remains in the solid state. This may also be described as a melting out of the second metal. However, (alternatively) a (at least partial) retention of this second metal in the component may be tolerated or is even desired.

In step f., a compression of the component built up with (at least) the first metal is carried out. This may also be described in such a way that the component, which is now or after step e. (mainly) is built up with the first metal, is compressed. In this context, compaction may be carried out thermally, for example, especially by means of sintering. It is advantageous to compress the component into its final shape.

Hot isostatic pressing (HIP) of the component is preferred. Hot isostatic pressing is a process in which the internal porosity of workpieces made of metal or other materials is

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reduced. With HIP, powdery metal materials may be compressed to a solid body without the detour of a melting process.

Preferably, the laser power(s) and/or the melting temperature(s) are selected and/or controlled so that zinc vaporization may be suppressed. In particular, the following may be set for a CuZn alloy:

- Laser power: $I < 30 \text{ J/mm}^3$
- Melting temperature: $460 \text{ }^\circ\text{C} - 906 \text{ }^\circ\text{C}$, preferably around $800 \text{ }^\circ\text{C}$

10 After an advantageous embodiment, it is suggested that a powder bed is formed in step c. This allows a particularly simple and controlled supply of the powders in an advantageous way. In this context, the method may also be described in particular as bimetal laser sintering in a metal printer with a powder bed.

15 Following another advantageous embodiment, it is proposed that no liquid binder is used during step d. This allows an essentially solvent-free production of the component in an advantageous way. This may also help to save material costs (for the solvent). In contrast to "normal" binder jetting processes, no plastic binder is used here in particular, which has to be brought out by solvents. Rather, the second metal may be used to provide a (pure) "metal binder", which may be reused after melting.

20

Following another advantageous embodiment, it is proposed that in step d. at least partial compounds are generated between several powder grains of the first metal. In this context, the laser parameters and/or the exposure strategies may be designed in such a way that (only) the powder spheres of the main material with the higher melting point (i.e. the powder grains of the first metal) partially connect with each other (in a targeted or controlled manner).

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After another advantageous embodiment, it is suggested that during step d. the second metal partially adheres itself to or around the first metal. The second material (i.e. the second metal) can, for example, be or remain (only) attached around the main material in undissolved form, acting as a heat conductor and/or supporting matrix, or it may form mixed crystals with the main material (the first metal). In this context, the second metal may act as a pure "metal binder", which may be melted out and reused after melting.

After another advantageous embodiment, it is proposed that in step e. only part of the second metal is removed. In this context, a (at least partial) retention of the second metal in the component may be tolerated and/or intentional. For example, a brass powder or copper powder (the first metal powder) may be processed with zinc powder (the second metal powder). In this context, brass may form in the intermediate areas, or brass areas may be enriched with zinc. If (pure) zinc is retained in the interstitial spaces, it may make sense to melt out (only) this in step e.

Following another advantageous embodiment, it is proposed that the first metal should be a copper-based material and the second metal a zinc-based material. This may contribute in a particularly advantageous way to the additive production of a brass component for a sanitary fitting.

Another advantageous embodiment proposes that the first melting point of the first metal is at least 130°C [degrees Celsius] above the second melting point of the second metal. This allows the second metal to be easily removed thermally.

It is particularly preferred when the first melting point of the first metal is at least 250°C [degrees Celsius] or even at least 450°C above the second melting point of the second metal. This allows in a particularly advantageous way that the second metal may be removed again as easily as possible and, if necessary, also as completely as possible by thermal means.

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A temperature difference of at least 450°C is particularly advantageous in this context if the first metal used is a copper-based material and the second metal is a zinc-based material. This is because copper usually has a melting point of 1085°C and zinc a melting point of 419.5°C.

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According to another aspect, a component for a sanitary fitting is also specified, whereby the component is manufactured using a method described here. The component may be a housing or a housing part of a sanitary fitting, for example.

10 According to another aspect, a sanitary fitting comprising a component manufactured using a method described here is also specified. In this context, the sanitary fitting may also have a component described here. The sanitary fitting may be, for example, a washbasin fitting, bathtub fitting, concealed fitting or the like.

15 The details, features and advantageous embodiments discussed in connection with the method may also occur in the component and/or sanitary fitting presented here and vice versa. In this respect, full reference is made to the explanations there concerning the further characterization of the features.

20 The solution presented here as well as its technical environment will be explained in more detail in the following using the figures. It should be pointed out that the disclosure is not to be restricted by the examples shown. In particular, unless explicitly stated otherwise, it is also possible to extract partial aspects of the facts explained in or in connection with the figures and combine them with other components and/or findings from other figures and/or the present description. It shows exemplary and schematic:

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Fig. 2 shows an exemplary and schematic illustration of a possible application of the method described here.

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For the production of a component 1 of a sanitary fitting 2, a first metal 3 in powder form having a first melting point and a second metal 4 in powder form having a second melting point, the second melting point being lower than the first melting point, are mixed together to form a powder bed 6 as an example.

5

Subsequently, component 1 is built up layer by layer by partial melting of the metals with a laser 5, which allows at least partial bonding between several powder grains of the first metal 3.

10 For example, no liquid binder is used. Instead, the second metal 4 serves as a "metal binder". In this context, the second metal 4 can, for example, act as a heat conductor and/or supporting matrix for the first metal 3. For this purpose, the second metal 4 may (at least partially) adhere itself firmly to or around the first metal 3 during the melting of the first metal 3.

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Then a heat treatment is carried out, during which the second metal 4 is at least partially removed or melted out. It may be that the second metal 4 is only partially removed.

20 Then a (thermal) compression of the component 1 built up with the first metal 3 is carried out. For thermal compaction, for example, a sintering process may be used.

For example, the first metal 3 is a copper-based material and the second metal 4 is a zinc-based material. Here the first melting point of the first metal 3 is at least 130° above the second melting point of the second metal 4.

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Thus, a method for manufacturing a component of a sanitary fitting, a component for a sanitary fitting and a sanitary fitting are specified here, which at least partially solve the problems described with reference to the state of the art. In particular, a method for manufacturing a component of a sanitary fitting, a component for a sanitary fitting and a
30 sanitary fitting are specified, each of which at least contributes to increasing the free-

- 9 -

dom in designing the geometry of a sanitary fitting. In addition, it may also be used to produce fittings with the thinnest possible walls.

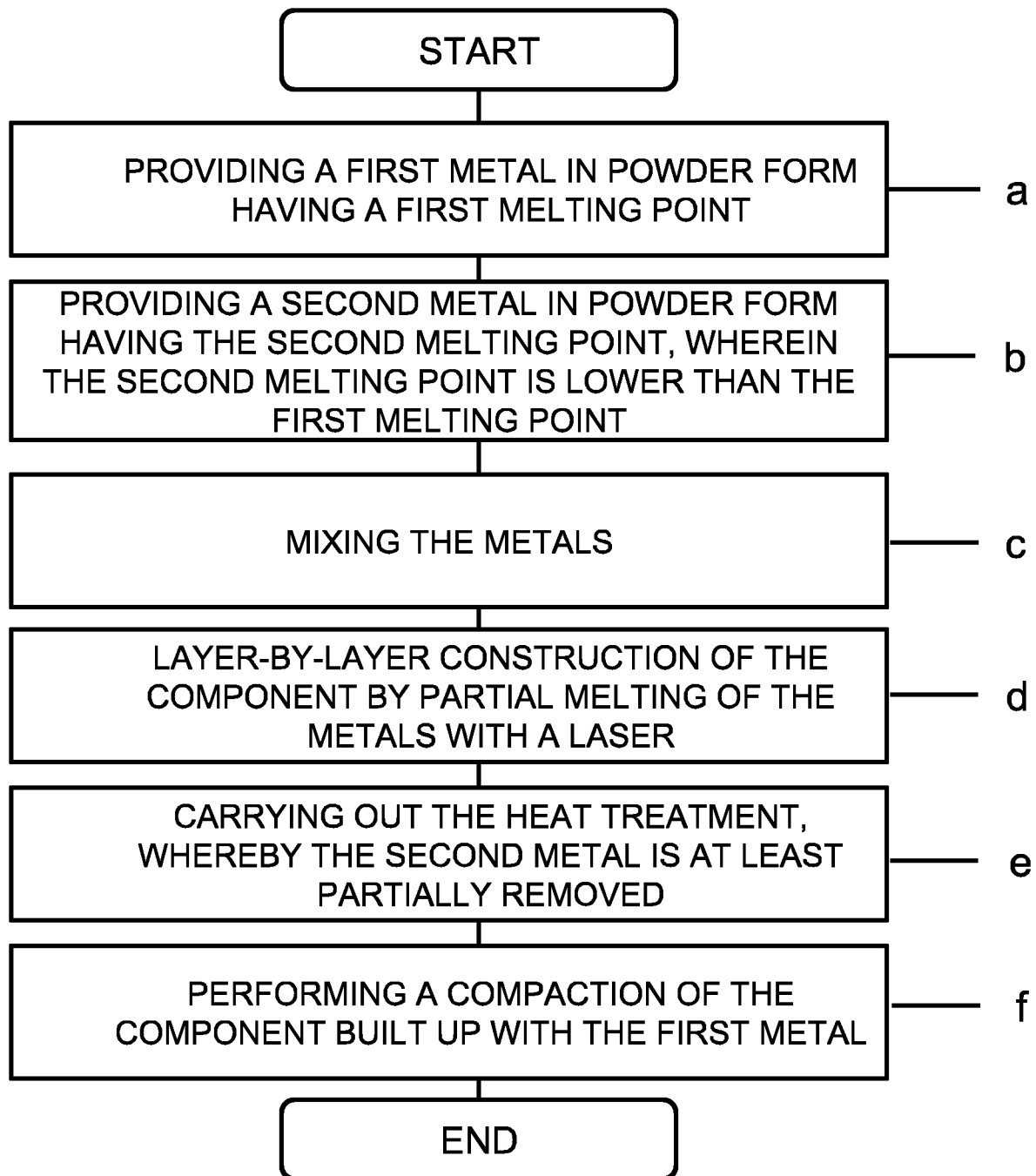
- 10 -

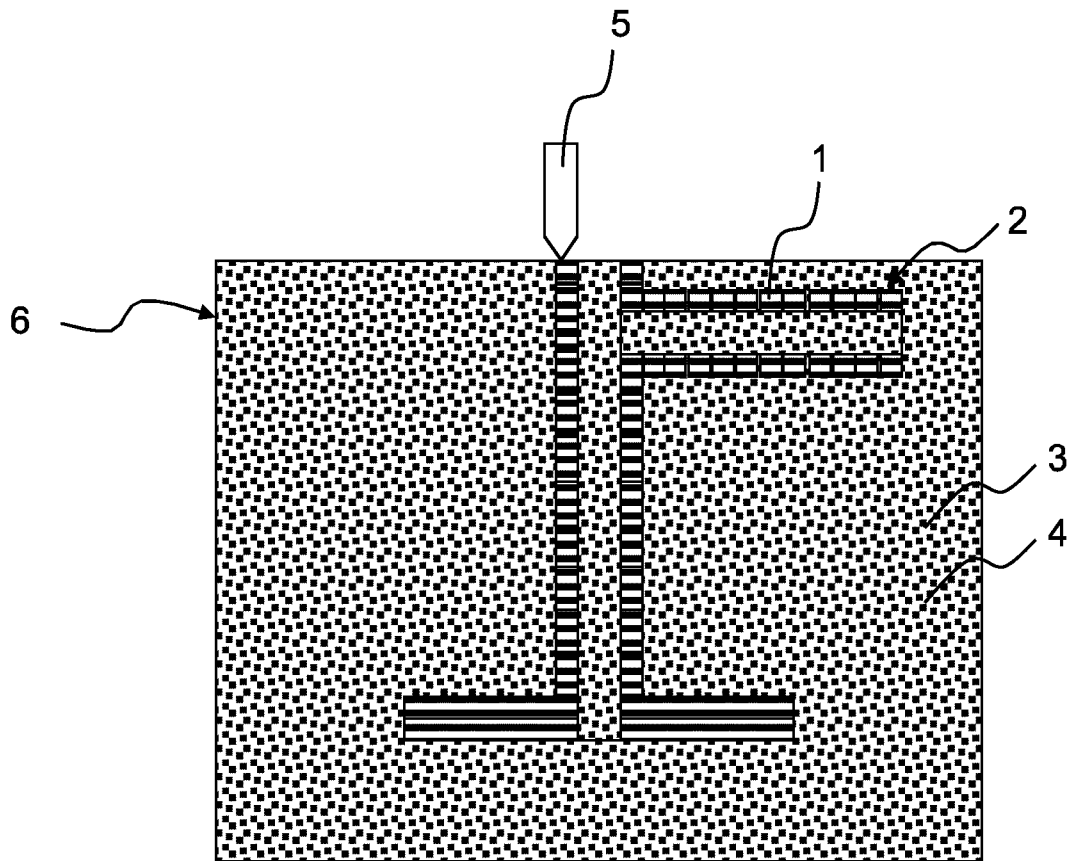
What is claimed is:

1. A method for manufacturing a component (1) of a sanitary fitting (2), comprising:
 - a. Providing a first metal (3) in powder form having a first melting point;
 - b. Providing a second metal (4) in powder form having a second melting point wherein the second melting point is lower than the first melting point;
 - c. Mixing the metals;
 - d. Layer-by-layer construction of the component (1) by partial melting of the metals with a laser (5);
 - e. Carrying out a heat treatment, whereby the second metal (4) is at least partially removed; and
 - f. Performing a compaction of the component (1) built up with the first metal (3).
2. The method according to Claim 1, wherein a powder bed (6) is formed in step c..
3. The method according to any one of the preceding claims in which no liquid binder is used during step d..
4. The method according to any one of the preceding claims, in which in step d. compounds are at least partially produced between several powder grains of the first metal (3).
5. The method according to any one of the preceding claims, in which during step d. the second metal (4) adheres partially to or around the first metal (3).
6. The method according to any one of the preceding claims, wherein in step e. only partial removal of the second metal (4) is performed.

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7. The method according to any one of the preceding claims, in which a copper-based material is used as the first metal (3) and a zinc-based material as the second metal (4).
- 5 8. The method according to any one of the preceding claims, in which the first melting point of the first metal (3) is at least 130°C above the second melting point of the second metal (4).
9. Component (1) for a sanitary fitting (2), wherein the component (1) is manufactured by the method according to any one of the preceding claims.
- 10 10. Sanitary fitting (2) comprising a component (1) produced by the method according to any one of claims 1 to 8.

**Fig. 1**

**Fig. 2**

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2020/058550

A. CLASSIFICATION OF SUBJECT MATTER		
INV. B22F1/00	B22F3/105	B33Y10/00
B33Y80/00	C22C1/04	E03C1/00
B22F3/24		
According to International Patent Classification (IPC) or to both national classification and IPC		
B. FIELDS SEARCHED		
Minimum documentation searched (classification system followed by classification symbols) B22F E03C B33Y C22C		
Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched		
Electronic data base consulted during the international search (name of data base and, where practicable, search terms used) EPO-Internal, WPI Data		
C. DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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Y	paragraphs [0001] - [0003], [0006] - [0008] figure 1	1-8

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☒ Further documents are listed in the continuation of Box C. ☒ See patent family annex.		
* Special categories of cited documents : "A" document defining the general state of the art which is not considered to be of particular relevance "E" earlier application or patent but published on or after the international filing date "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified) "O" document referring to an oral disclosure, use, exhibition or other means "P" document published prior to the international filing date but later than the priority date claimed "T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention "X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art "&" document member of the same patent family		
Date of the actual completion of the international search 8 May 2020		Date of mailing of the international search report 19/05/2020
Name and mailing address of the ISA/ European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016		Authorized officer Forestier, Gilles

INTERNATIONAL SEARCH REPORT

International application No
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