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(54) **SINTERING SYSTEM AND METHOD FOR AUTOMATED TEMPERATURE SENSOR CONNECTION**

(57) A sintering system, comprising a sintering device having a vacuum chamber, an upper electrode and a lower electrode, both the upper electrode and the lower electrode being arranged within the vacuum chamber, at least one workpiece holder for holding at least one sintering part, the workpiece holder being equipped with at least one temperature sensor, wherein the workpiece holder is configured for automatic loading into the vacuum chamber and automatic unloading out of the vacuum chamber, and a temperature sensor connector unit having a first connector and a second connector, the first connector being attached to the sintering device and wired to a temperature control unit of the sintering device, the second connector being attached to the workpiece holder and wired to the at least one temperature sensor, wherein the second connector is configured for automatic connection with the first connector during automatically loading the workpiece holder into the vacuum chamber and/or wherein the second connector is configured for

automatic disconnection from the first connector during automatically unloading the workpiece holder from the vacuum chamber.

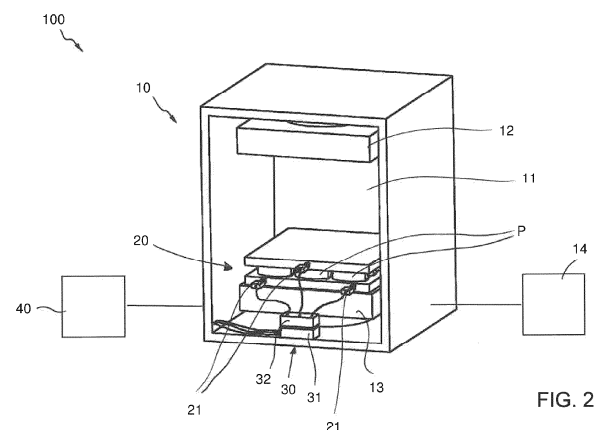


FIG. 2

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Description

TECHNICAL FIELD AND PRIOR ART

[0001] The invention relates to a sintering system.

[0002] Moreover, the invention relates to a method for automated temperature sensor connection during a sintering process using a sintering system.

[0003] A sintering system of this kind is known from WO 2017/177995 A1 and is intended for field-assisted sintering. This so-called field-assisted sintering is also known under the abbreviations FAST (Field Assisted Sintering Technology) and SPS (Spark Plasma Sintering). The known sintering system has an electrically conductive matrix in the form of a ring mold, into which the sintering material to be sintered is introduced, and two forming punches that can be inserted axially in opposite directions into the ring mold. In addition, a resistance heating device with a pulsed DC source and two electrodes is provided. The electrodes are supported in a pressure-transmitting and electrically conductive manner on the rear sides of the forming punches. To apply pressure to the sintering material, an actuating device acts on the rear sides of the electrodes and moves them together with the forming punches along an actuating axis towards each other. At the same time, a pulsed DC current is fed through the electrodes into the forming punches and from there into the matrix to heat the matrix. The electrical resistance of the matrix causes it to heat up, thereby effecting the heat input into the sintering material required for sintering.

[0004] Other mold types are also known, whereas the mold comprises of open stacks of workpieces between graphite plates. Another types of mold comprises of several graphite plates that are held together by a clamping device. This clamping device is often a frame or a ring, often with a clamping mechanism that can press the clamping plates together.

[0005] Additionally, to the pulsed DC-current, other forms of energy supply to the mold are also known. This can be non-pulsed DC-current, AC-current or modulated AC-current current with a higher frequency.

[0006] It is well-known that a temperature measurement is required for a controlled sintering process. A precisely monitored temperature is especially important for advanced materials, which are increasingly being sintered on these sintering systems. These materials respond very quickly to excessive temperature gradients, which can lead to cracks and defects in the sintering part. Additionally, the conductivity of the sintered material can change during the process, causing an increase in temperature due to excessive current flow. For this reason, the temperature measurement should be carried out as close as possible to the sintering parts. The temperature of the sintering parts is measured with a temperature sensor. Either a thermocouple or a pyrometer is used for temperature measurement. Thermocouples can measure temperatures on surfaces or in a drilled hole,

whereas the diameter of the hole must correspondent with the diameter of the thermocouple. This means that the thermocouple must be brought into contact with the workpiece that should be measured.

[0007] An automatic feeding system for inserting a thermocouple into a corresponding bore in the workpiece holder is known from the prior art. However, only one thermocouple can be automatically inserted into the workpiece holder from one direction, with this thermocouple always being part of the actual sintering device. The use of more than one thermocouple is also state of the art, with these thermocouples being inserted into the workpiece holder exclusively by hand in different holes in the workpiece holder.

SUMMARY OF THE INVENTION

[0008] It is an object of the invention to provide a sintering system of the type mentioned at the beginning that offers advantages compared to the prior art.

[0009] This object is solved by providing a sintering system with the features of claim 1 and a method for automated temperature sensor connection during a sintering process with the features of claim 6. Preferred embodiments are defined in the dependent claims.

[0010] According to a first aspect, a sintering system is provided, in particular for field assisted sintering. The sintering system comprises a sintering device having a vacuum chamber, an upper electrode and a lower electrode, both the upper electrode and the lower electrode being arranged within the vacuum chamber. The sintering system also comprises at least one workpiece holder for holding at least one sintering part. In one embodiment, the workpiece is designed in the form of one or more plates, which is/are preferably configured to hold several sintering parts. Several workpiece holders are preferably arranged one above the other, with the sintering parts arranged between the workpiece holders. The workpiece holder is equipped with at least one temperature sensor. The workpiece holder is configured for automatic loading into the vacuum chamber and automatic unloading out of the vacuum chamber. The temperature sensor is preferably a thermocouple. The workpiece holder can be equipped with the at least one temperature sensor manually or automatically, for example by an industrial robot. The at least one temperature sensor can be placed in a recess in the workpiece holder, in particular in a drilled hole. If the sintering system has several temperature sensors, these are preferably arranged on more than one side of the workpiece holder, even more preferably arranged evenly along the circumference of the workpiece holder. The sintering system also comprises a temperature sensor connector unit having a first connector and a second connector. The first connector is attached to the sintering device and wired to a temperature control unit of the sintering device. The first connector is preferably fixed inside the vacuum chamber. The second connector is attached to the workpiece holder and wired

to the least one temperature sensor. Moreover, the second connector is configured for automatic connection with the first connector during automatically loading the workpiece holder into the vacuum chamber. In addition or as an alternative, the second connector is configured for automatic disconnection from the first connector during automatically unloading the workpiece holder from the vacuum chamber.

[0011] The sintering system according to the invention allows both one and several temperature sensors to be connected automatically to the temperature control unit of the sintering device and/or to be disconnected automatically from the temperature control unit of the sintering device. The sintering system according to the invention enables automation, which, compared to the above-mentioned state of the art, reduces errors, saves costs and optimizes the production process. The sintering system according to the invention further enables precise monitoring of the process temperature, in particular the temperature of the workpiece, during the sintering process.

[0012] In one embodiment, the second connector is automatically connected with the first connector by automatically loading the workpiece holder into the vacuum chamber. In other words, the automatic connection of the second connector to the first connector is caused, realized and/or achieved (solely) by the loading movement of the workpiece holder into the vacuum chamber. The loading movement of the workpiece holder can be a horizontal movement to place the workpiece holder into the vacuum chamber, a vertical movement that places the workpiece holder on the lower electrode of the sintering device, and/or a vertical movement that places the workpiece holder on a device to hold the workpiece holder above the lower electrode of the sintering device. In addition or as an alternative, the second connector is automatically disconnected from the first connector by automatically unloading the workpiece holder from the vacuum chamber. In other words, the automatic disconnection of the second connector from the first connector is caused, realized and/or achieved (solely) by the unloading movement of the workpiece holder out of the vacuum chamber. These correspond to the aforementioned loading movements in the opposite direction.

[0013] In one embodiment, the sintering system comprises an automatic handling device. The automatic handling device is configured for automatic loading and/or automatic unloading of the vacuum chamber with the at least one workpiece holder. The automatic handling device can be an industrial robot, a manipulator or the like. In one embodiment, the automatic handling is configured for equipping the workpiece holder with at least one temperature sensor. In one embodiment, the automatic handling device is configured for connecting the second connector to the first connector and/or for disconnecting the second connector from the first connector.

[0014] In one embodiment, the first connector and the

second connector each have a housing. The housing is made of a temperature-resistant material, in particular ceramic, graphite or carbon fiber composite. This provides the temperature sensor connector unit with better protection against the excessive temperature gradients during the sintering process.

[0015] In one embodiment, the temperature sensor connector unit is protected by a cover that shields the temperature sensor connector unit from radiation of the workpiece holder or the two electrodes. In addition or as an alternative, the temperature sensor connector unit is protected by an water-cooling device. In addition or as a further alternative, the temperature sensor connector unit is protected by an cooling device that uses a gas flow made from protective gas. This also provides the temperature sensor connector unit with additional protection against the excessive temperature gradients during the sintering process.

[0016] According to a second aspect, a method for automated temperature sensor connection during a sintering process using a sintering system is provided, the sintering system comprises a sintering device having a vacuum chamber, an upper electrode and a lower electrode, both the upper electrode and the lower electrode being arranged within the vacuum chamber, and having at least one temperature control unit wired to a first connector. The sintering system also comprises at least one workpiece holder for holding at least one sintering part, the workpiece holder being equipped with at least one temperature sensor wired to a second connector. The method according to the invention comprises the step: automatically loading the least one workpiece holder into the vacuum chamber of the sintering device. The automatic loading of the vacuum chamber with the at least one workpiece carrier can be carried out by means of an automatic handling device, such as an industrial robot. The method further comprises the step: automatically connecting the second connector of the workpiece holder with the first connector of the sintering device, thereby automatically connecting the least one temperature sensor of the workpiece holder with the temperature control unit of the sintering device. Preferably, several temperature sensors are connected to the temperature control unit at the same time via the second connector.

[0017] The advantages of the sintering system according to the invention mentioned above apply mutatis mutandis to the method for automated temperature sensor connection according to the invention.

[0018] In one embodiment, the method comprises the step: automatically unloading the least one workpiece holder from the vacuum chamber of the sintering device. The automatic unloading of the at least one workpiece carrier from the vacuum chamber can be carried out by means of an automatic handling device, such as an industrial robot. The method comprises also the step: automatically disconnecting the second connector of the workpiece holder from the first connector of the sintering device, thereby disconnecting the least one temperature

sensor of the workpiece holder from the temperature control unit of the sintering device. Preferably, several temperature sensors are disconnected from the temperature control unit at the same time via the second connector.

[0019] In one embodiment, the automatic connection of the second connector of the workpiece holder with the first connector of the sintering device is realized by means of automatically loading the workpiece holder into the vacuum chamber or by means of an actuator or a gripper or an industrial robot. In other words, the second connector of the workpiece holder and the first connector of the sintering device are automatically connected by the loading movement itself. The loading movement of the workpiece holder can be a horizontal movement to place the workpiece holder into the vacuum chamber, a vertical movement that places the workpiece holder on the lower electrode of the sintering device, and/or a vertical movement that places the workpiece holder on a device provided to hold the workpiece holder above the lower electrode of the sintering device.

[0020] In one embodiment, the automatic disconnection of the second connector of the workpiece holder from the first connector of the sintering device is realized by means of automatically unloading the workpiece holder from the vacuum chamber or by means of an actuator or a gripper or an industrial robot. Thus, the second connector of the workpiece holder and the first connector of the sintering device can be automatically disconnected by the unloading movement itself. The unloading movement of the workpiece holder can be a horizontal movement to unload the workpiece holder from the vacuum chamber, a vertical movement to lift the workpiece holder from the lower electrode of the sintering device, and/or a vertical movement to lift the workpiece holder from a device provided for holding the workpiece holder above the lower electrode of the sintering device.

[0021] In one embodiment, when loading the workpiece holder into the vacuum chamber, the workpiece holder is automatically positioned by means of a centering device. The centering device can be in the form of a seat for the workpiece holder, which centers the workpiece holder automatically when the workpiece holder is placed on it. This enables a constant and repeatable process temperature. This also helps to further automate the sintering process.

[0022] In one embodiment, the least one temperature sensor is used to regulate the process temperature of the sintering process in a way, that only one temperature sensor is used to regulate the process and at least one further temperature sensor is used to monitor and document the process. Alternatively, more than one temperature sensor is used to regulate the process in a way that the lowest temperature is used to regulate the process. This means that the sensor used for control is the one of the several sensors that measures the lowest temperature. As an alternative, more than one temperature sensor is used to regulate the process in a way that the lowest

temperature is used to regulate the process and the at least one further temperature sensor is used to minimize the temperature tolerance within a given temperature range. As a further alternative, more than one temperature sensor is used to regulate the process in a way that the highest temperature is used to regulate the process. As a further alternative, more than one temperature sensor is used to regulate the process in a way that the highest temperature is used to regulate the process and the at least one further temperature sensor is used to minimize the temperature tolerance within a given temperature range. As a further alternative, more than one temperature sensor is used to regulate the process in a way that the average temperature is used to regulate the process and the at least one further temperature sensor is used to minimize the temperature tolerance within a given temperature range. It is possible to combine several of these alternatives. The aforementioned options for using at least one temperature sensor to control the process temperature of the sintering process can also be independent of the automatic loading of the least one workpiece holder into the vacuum chamber of the sintering device and the automatic connection of the second connector of the workpiece holder with the first connector of the sintering device.

BRIEF DESCRIPTION OF THE DRAWINGS

[0023] In the following, preferred exemplary embodiments of the invention will be described in detail with reference to the drawings. Throughout the drawings, the same elements will be denoted by the same reference numerals. The drawings schematically show:

- fig. 1 a schematically simplified view of an embodiment of a sintering system according to the invention, wherein a first connector and a second connector of the temperature sensor connector unit are disconnected,
- fig. 2 a perspective view of a further embodiment of a sintering system according to the invention, wherein the first connector and the second connector are connected, and
- fig. 3 a perspective view of a further embodiment of a sintering system according to the invention, wherein the sintering system comprises several workpiece holders and the first connector and the second connector are connected.

DETAILED DESCRIPTION OF EXEMPLARY EMBODIMENTS OF THE INVENTION

[0024] According to fig. 1, a sintering system 100 is provided. The sintering system 100 is configured for field assisted sintering, i.e. a so-called FAST (field assisted sintering technology) sintering system 100.

[0025] The sintering system 100 comprises a sintering device 10, at least one workpiece holder 20 and a tem-

perature sensor connector unit 30.

[0026] The sintering device 10 comprises a vacuum chamber 11, an upper electrode 12 and a lower electrode 13. Both the upper electrode 12 and the lower electrode 13 are arranged within the vacuum chamber 11. The sintering device 10 has a function known to the person skilled in the art. Hence, further features of the sintering device 10 need not be discussed in more detail.

[0027] The least one workpiece holder 20 is configured for holding at least one sintering part P. In the embodiment shown in Fig. 2, the sintering system 100 has one workpiece holder 20. In the embodiment shown in Fig. 3, the sintering system 100 has several workpiece holders 20, arranged one above the other. In the examples shown, each workpiece holder 20 is loaded with several sintering parts P.

[0028] In the embodiments shown, the workpiece holder 20 is designed in the form of two plates (see fig. 2), which are configured to hold several sintering parts P arranged next to each other between said two plates.

[0029] The workpiece holder 20 is equipped with at least one temperature sensor 21.

[0030] In the embodiment shown, the workpiece holder 20 comprises several temperature sensors 21.

[0031] For being equipped with said temperature sensors 21, the workpiece holder 20 comprises drilled holes in which the temperature sensors 21 are inserted. The number of temperature sensors 21 can vary depending on the application. In the embodiment shown in Fig. 2, the workpiece holder 20 is equipped with three temperature sensors 21. In the embodiment shown in Fig. 3, each workpiece holder 20 is equipped with one temperature sensor 21.

[0032] In the embodiments shown, the at least one temperature sensor 21 is a thermocouple.

[0033] In alternative embodiments not shown in the drawings, the temperature sensors are arranged on several sides of the workpiece holder, in particular along the entire circumference.

[0034] The workpiece holder 20 is configured for automatic loading into the vacuum chamber 11 and for automatic unloading out of the vacuum chamber 11.

[0035] The temperature sensor connector unit 30 comprises a first connector 31 and a second connector 32.

[0036] The first connector 31 is attached to the sintering device 10 and wired to a temperature control unit 14 of the sintering device 10. In preferred embodiments, the first connector 31 is fixedly attached inside the vacuum chamber 11.

[0037] The second connector 32 is attached to the workpiece holder 20 and wired to the least one temperature sensor 21. Furthermore, the second connector 32 is configured for automatic connection with the first connector 31 during automatically loading the workpiece holder 20 into the vacuum chamber 11.

[0038] In the embodiments shown, each of the temperature sensors 21 is connected to the second connector 32 by means of a cable. During the sintering process,

the sintering setup may shrink, which can be compensated by the loose guidance of the cables.

[0039] In the embodiments shown, the second connector 32 is additionally configured for automatic disconnection from the first connector 31 during automatically unloading the workpiece holder 20 from the vacuum chamber 11.

[0040] In preferred embodiments, the second connector 32 is automatically connected with the first connector 31 by automatically loading the workpiece holder 20 into the vacuum chamber 11. This means that when the workpiece holder 20 is inserted into the vacuum chamber 11, the second connector 32 is automatically connected to the first connector 31. Additionally or alternatively, the second connector 32 is automatically disconnected from the first connector 31 by automatically unloading the workpiece holder 20 from the vacuum chamber 11. This means that when the workpiece holder 20 is unloaded into the vacuum chamber 11, the second connector 32 is automatically connected to the first connector 31 by the unloading movement.

[0041] In the embodiments shown, the sintering system 100 further comprises an automatic handling device 40. The automatic handling device 40 is configured for automatic loading and unloading of the vacuum chamber 11 with the at least one workpiece holder 20. In preferred embodiments, the automatic handling device 40 is an industrial robot.

[0042] In preferred embodiments, the automatic handling device 40 is configured for automatic equipping the workpiece holder 20 with at least one temperature sensor 21.

[0043] In one embodiment, the automatic handling device 40 is also configured for connecting the second connector 32 to the first connector 31 and for disconnecting the second connector 32 from the first connector 31.

[0044] In the embodiments shown (see Figs. 2 and 3), the first connector 31 and the second connector 32 each have a housing. The housing is made of a temperature-resistant material, in particular ceramic, graphite or carbon fiber composite.

[0045] In embodiments not shown, the temperature sensor connector unit 30 is protected by a passive cover that shields the temperature sensor connector unit 30 from radiation of the workpiece holder 20 or the two electrodes 12, 13. Additionally or alternatively, the temperature sensor connector unit 30 is protected by an water-cooling device and/or an cooling device that uses a gas flow made from protective gas.

[0046] The sintering system 100 is set up for a method for automated temperature sensor connection during a sintering process.

[0047] One step of the method involves automatically loading the least one workpiece holder 20 into the vacuum chamber 11 of the sintering device 10, the workpiece holder 20 being manually or automatically equipped with at least one temperature sensor 21 previously to being loaded into the vacuum chamber 11.

[0048] The next step is to automatically connect the second connector 32 of the workpiece holder 20 with the first connector 31 of the sintering device 10, thereby connecting the least one temperature sensor 21 of the workpiece holder 20 with the temperature control unit 14 of the sintering device 10.

[0049] In preferred embodiments, the method further comprises automatically unloading the least one workpiece holder 20 from the vacuum chamber 11 of the sintering device 10. The method also includes automatically disconnecting the second connector 32 of the workpiece holder 20 from the first connector 31 of the sintering device 10, thereby disconnecting the least one temperature sensor 21 of the workpiece holder 20 from the temperature control unit 14 of the sintering device 10.

[0050] In preferred embodiments, the automatic connection of the second connector 32 of the workpiece holder 20 with the first connector 31 of the sintering device 10 is realized either by means of automatically loading the workpiece holder 20 into the vacuum chamber 11 or by means of an actuator or a gripper or an industrial robot. Hence, the second connector 32 of the workpiece holder 20 and the first connector 31 of the sintering device 10 can be automatically connected by the loading movement itself or be a separate movement, i.e. by means of said actuator or gripper.

[0051] The loading movement of the workpiece holder 20 can be a horizontal movement to place the workpiece holder 20 into the vacuum chamber 11, a vertical movement that places the workpiece holder 20 on the lower electrode 13 of the sintering device 10, and/or a vertical movement that places the workpiece holder 20 on a device to hold the workpiece holder 20 above the lower electrode 13 of the sintering device 10.

[0052] This applies equally to the automatic disconnection of the second connector 32 of the workpiece holder 20 from the first connector 31 of the sintering device 10. Said automatic disconnection is realized either by means of automatically unloading the workpiece holder 20 from the vacuum chamber 11 or by means of an actuator or a gripper or an industrial robot.

[0053] In preferred embodiments, when loading the workpiece holder 20 into the vacuum chamber 11, loading the workpiece holder 20 is automatically positioned by means of a centering device. The centering device is not shown in the figures.

[0054] In the embodiments shown, the least one temperature sensor 21 is used to regulate the process temperature of the sintering process in various ways. One option is that only one temperature sensor 21 is used to regulate the process and at least one further temperature sensor 21 is used to monitor and document the process. Another option is that more than one temperature sensor 21 is used to regulate the process in a way that the lowest temperature is used to regulate the process. Another option is that more than one temperature sensor 21 is used to regulate the process in a way that the lowest temperature is used to regulate the process and the at

least one further temperature sensor 21 is used to minimize the temperature tolerance within a given temperature range. Another option is that more than one temperature sensor 21 is used to regulate the process in a way that the highest temperature is used to regulate the process. Another option is that more than one temperature sensor 21 is used to regulate the process in a way that the highest temperature is used to regulate the process and the at least one further temperature sensor 21 is used to minimize the temperature tolerance within a given temperature range. Another option is that more than one temperature sensor 21 is used to regulate the process in a way that the average temperature is used to regulate the process and the at least one further temperature sensor 21 is used to minimize the temperature tolerance within a given temperature range.

Claims

1. A sintering system (100), comprising

a sintering device (10) having a vacuum chamber (11), an upper electrode (12) and a lower electrode (13), both the upper electrode (12) and the lower electrode (13) being arranged within the vacuum chamber (11),
at least one workpiece holder (20) for holding at least one sintering part (P), the workpiece holder (20) being equipped with at least one temperature sensor (21), wherein the workpiece holder (20) is configured for automatic loading into the vacuum chamber (11) and automatic unloading out of the vacuum chamber (11), and
a temperature sensor connector unit (30) having a first connector (31) and a second connector (32), the first connector (31) being attached to the sintering device (10) and wired to a temperature control unit (14) of the sintering device (10), the second connector (32) being attached to the workpiece holder (20) and wired to the least one temperature sensor (21),
wherein the second connector (32) is configured for automatic connection with the first connector (31) during automatically loading the workpiece holder (20) into the vacuum chamber (11) and/or wherein the second connector (32) is configured for automatic disconnection from the first connector (31) during automatically unloading the workpiece holder (20) from the vacuum chamber (11).

2. The sintering system (100) according to claim 1,

wherein the second connector (32) is automatically connected with the first connector (31) by automatically loading the workpiece holder (20) into the vacuum chamber (11) and/or

- wherein the second connector (32) is automatically disconnected from the first connector (31) by automatically unloading the workpiece holder (20) from the vacuum chamber (11).
3. The sintering system (100) according to claim 1 or 2, further comprising
an automatic handling device (40) configured for automatic loading and/or automatic unloading of the vacuum chamber (11) with the at least one workpiece holder (20).
 4. The sintering system (100) according to any of the preceding claims, wherein the first connector (31) and the second connector (32) each have a housing, the housing being made of a temperature-resistant material, in particular ceramic, graphite or carbon fiber composite.
 5. The sintering system (100) according to any of the preceding claims, wherein the temperature sensor connector unit (30) is protected by
 - a cover that shields the temperature sensor connector unit (30) from radiation of the workpiece holder (20) or the two electrodes (12; 13); and/or
 - a water-cooling device; and/or
 - a cooling device that uses a gas flow made from protective gas.
 6. A method for automated temperature sensor connection during a sintering process using a sintering system (100), the sintering system (100) comprising
 - a sintering device (10) having a vacuum chamber (11), an upper electrode (12) and a lower electrode (13), both the upper electrode (12) and the lower electrode (13) being arranged within the vacuum chamber (11), and having at least one temperature control unit (14) wired to a first connector (31),
 - and at least one workpiece holder (20) for holding at least one sintering part (P), the workpiece holder (20) being equipped with at least one temperature sensor (21) wired to a second connector (32),
 - the method comprising the steps:
 - automatically loading the least one workpiece holder (20) into the vacuum chamber (11) of the sintering device (10);
 - automatically connecting the second connector (32) of the workpiece holder (20) with the first connector (31) of the sintering device (10), thereby automatically connecting the least one temperature sensor (21) of the workpiece holder (20) with the temperature control unit (14) of the sintering device (10).
 7. The method according to claim 7, further comprising
 - automatically unloading the least one workpiece holder (20) from the vacuum chamber (11) of the sintering device (10);
 - automatically disconnecting the second connector (32) of the workpiece holder (20) from the first connector (31) of the sintering device (10), thereby automatically disconnecting the least one temperature sensor (21) of the workpiece holder (20) from the temperature control unit (14) of the sintering device (10).
 8. The method according to claim 6 or 7, wherein the automatic connection of the second connector (32) of the workpiece holder (20) with the first connector (31) of the sintering device (10) is realized by means of automatically loading the workpiece holder (20) into the vacuum chamber (11) or by means of an actuator or a gripper.
 9. The method according to claim 7, wherein the automatic disconnection of the second connector (32) of the workpiece holder (20) from the first connector (31) of the sintering device (10) is realized by means of automatically unloading the workpiece holder (20) from the vacuum chamber (11) or by means of an actuator or a gripper.
 10. The method according to any of the claims 6 to 9, wherein when loading the workpiece holder (20) into the vacuum chamber (11), the workpiece holder (20) is automatically positioned by means of a centering device.
 11. The method according to any of the claims 6 to 10, wherein the least one temperature sensor (21) is used to regulate the process temperature of the sintering process in a way, that:
 - only one temperature sensor (21) is used to regulate the process and at least one further temperature sensor (21) is used to monitor and/or document the process;
 - more than one temperature sensor (21) is used to regulate the process in a way that the lowest temperature is used to regulate the process; and/or
 - more than one temperature sensor (21) is used to regulate the process in a way that the lowest temperature is used to regulate the process and the at least one further temperature sensor (21) is used to minimize the temperature tolerance within a given temperature range; and/or
 - more than one temperature sensor (21) is used to regulate the process in a way that the highest

temperature is used to regulate the process;
and/or
more than one temperature sensor (21) is used
to regulate the process in a way that the highest
temperature is used to regulate the process and
the at least one further temperature sensor (21)
is used to minimize the temperature tolerance
within a given temperature range; and/or
more than one temperature sensor (21) is used
to regulate the process in a way that the average
temperature is used to regulate the process and
the at least one further temperature sensor (21)
is used to minimize the temperature tolerance
within a given temperature range.

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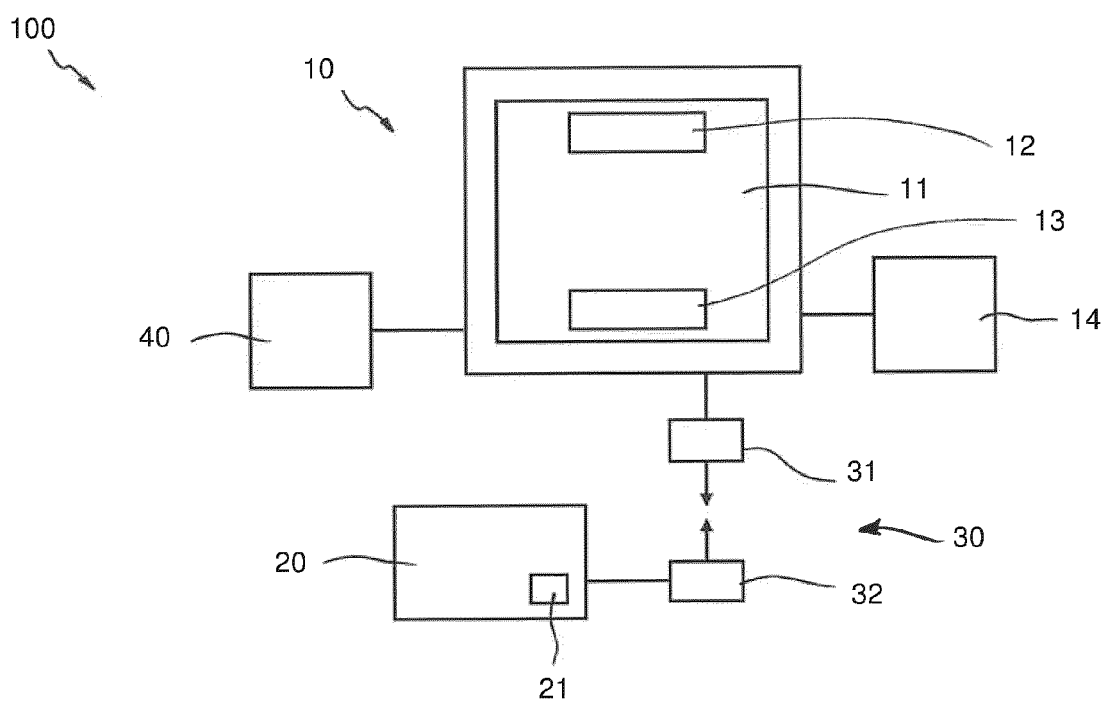


FIG. 1

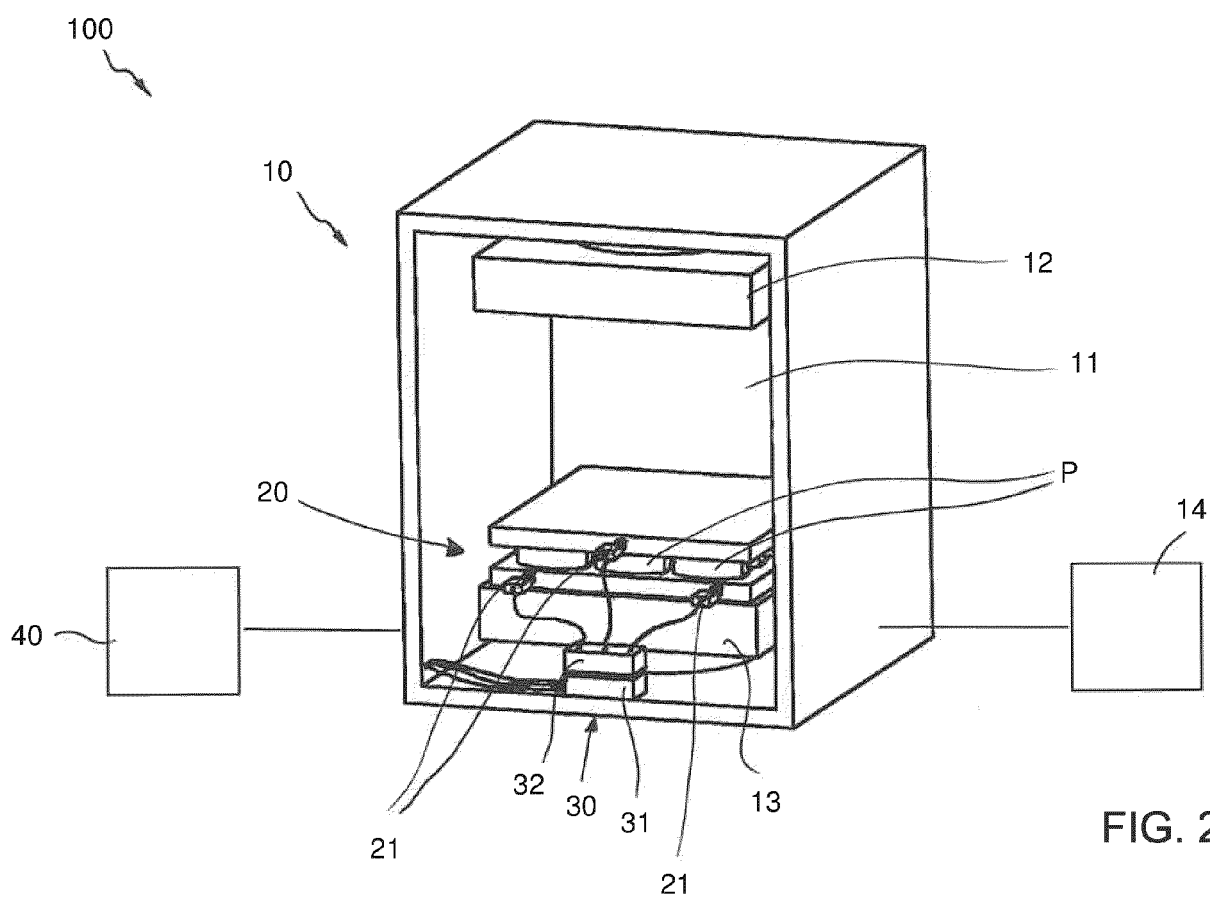
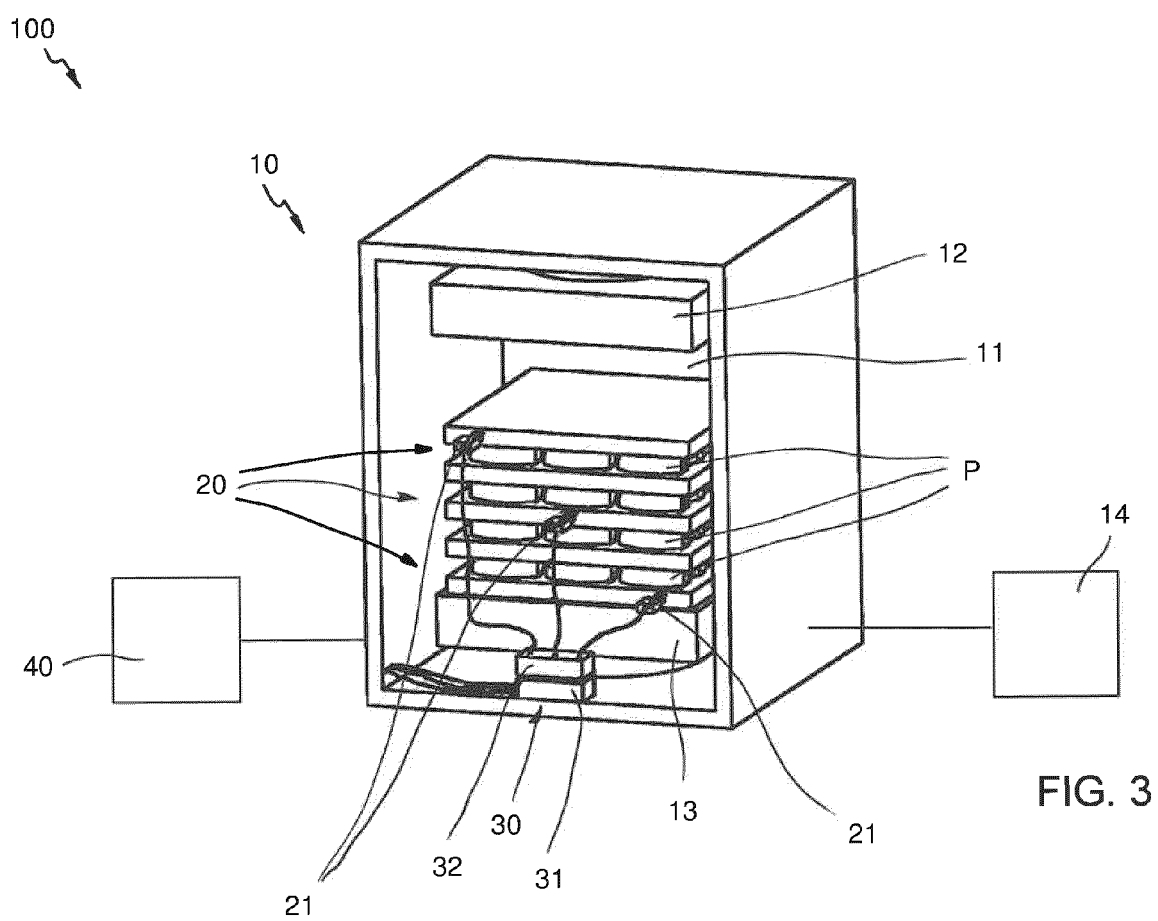


FIG. 2





EUROPEAN SEARCH REPORT

Application Number

EP 25 15 0111

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
A	DE 198 24 497 A1 (DEKEMA DENTAL KERAMIKOEFEN GMB [DE]) 9 December 1999 (1999-12-09) * claims 1,9; figure 1 * -----	1-11	INV. F27B5/04 B22F3/00 F27B5/18 F27D19/00 F27D21/00 B22F3/105 ADD. F27B5/12 F27B5/13 F27B5/14
			TECHNICAL FIELDS SEARCHED (IPC)
			F27B B22F C04B F27D
The present search report has been drawn up for all claims			
Place of search		Date of completion of the search	Examiner
The Hague		24 June 2025	Momeni, Mohammad
CATEGORY OF CITED DOCUMENTS			
X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document			
T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

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ANNEX TO THE EUROPEAN SEARCH REPORT
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5 This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
The members are as contained in the European Patent Office EDP file on
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24-06-2025

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For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

REFERENCES CITED IN THE DESCRIPTION

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