Office de la Propriété Intellectuelle du Canada
Un organisme d'Industrie Canada

Canadian Intellectual Property Office
An agency of Industry Canada

CA 2295896 C 2005/05/24

(11)(21) 2 295 896

(12) BREVET CANADIEN
CANADIAN PATENT

(13) C

(22) Date de dépôt/Filing Date: 2000/01/14

(41) Mise à la disp. pub./Open to Public Insp.: 2000/07/19

(45) Date de délivrance/Issue Date: 2005/05/24

(30) Priorité/Priority: 1999/01/19 (199 01 643.7) DE

(51) Cl.Int.[7]/Int.Cl.[7] B22F 3/105, A61C 13/00

(72) Inventeurs/Inventors:
DOLABDJIAN, HAIG, DE;
STRIETZEL, ROLAND, DE

(73) Propriétaire/Owner:
BEGO BREMER GOLDSCHLAGEREI WILH. HERBST GMBH & CO.KG, DE

(74) Agent: OYEN WIGGS GREEN & MUTALA LLP

(54) Titre : METHODE POUR FABRIQUER DES DENTS ARTIFICIELLES ET DE PROTHESES DENTAIRES AUXILIAIRES

(54) Title: METHOD FOR PRODUCING TOOTH REPLACEMENTS AND AUXILIARY DENTAL PARTS

(57) Abrégé/Abstract:

Application of the laser sintering process, in which shaped pieces made of a sintering powder are built up in layers by exposing each layer successively to the energy of a laser beam that leads to local sintering, whereby the laser beam is guided over the respective powder layer by means of a computer-controlled system using data that represent the configuration of the shaped body in this layer, for the production of tooth replacement elements (crowns, bridges, inlays and the like) and/or dental parts, whereby the powder comprises a biocompatible material of varying grain size between 0 and 50 μm.

ABSTRACT

Application of the laser sintering process, in which shaped pieces made of a sintering powder are built up in layers by exposing each layer successively to the energy of a laser beam that leads to local sintering, whereby the laser beam is guided over the respective powder layer by means of a computer-controlled system using data that represent the configuration of the shaped body in this layer, for the production of tooth replacement elements (crowns, bridges, inlays and the like) and/or dental parts, whereby the powder comprises a biocompatible material of varying grain size between 0 and 50 μm.

BEGO Bremer Goldschlägerei Wilh. Herbst GmbH & Co., Wilhelm-Herbst-Straße 1, 28359 Bremen, Germany

---

Method for producing tooth replacements and auxiliary dental parts

---

Tooth replacements in the form of crowns, bridges, inlays and the like frequently comprise complex molded bodies which must usually take account in each specific case of the spatial configuration of intact tooth parts (tooth stumps), entire teeth or parts of the jaw that have been lost, on the one hand, and the spatial situation in relation to adjacent and/or antagonistic teeth, on the other hand. In the prior art, such tooth replacement elements are produced in complex processes. The most widespread method is to produce the shaped bodies required – usually made of precious-metal or base-metal alloys, as well as pure metals – in a multi-step impression and casting process. However, computer-controlled milling of such shaped bodies out of the solid material, which inevitably leads to considerable waste that has to be reprocessed at great effort and expense, has also become known.

The objective of the invention is to provide another, more advantageous way of producing such shaped bodies (and auxiliary dental parts required in implantology).

The invention uses a method that has become known in another field as "rapid prototyping" for producing complex tools or components. According to said method, shaped bodies made of a sintering powder are built up in layers by exposing each layer successively to the energy of a laser beam that leads to local sintering, whereby the laser beam is guided over the respective powder layer by means of a computer-controlled system using data that represent the configuration of the shaped piece in this layer. As a result of supplying such energy, the powder elements affected in each case are superficially melted and form a fixed bond with each other. Due to the precise focusing of the laser beam, the energy supply can be configured exactly – at high density – and controlled in accordance with the stored spatial data of the shaped body required.

Furthermore, the invention provides for a powder consisting of a biocompatible material of varying grain size between 0 and 50 μm. In contrast to current application of the laser sintering method for technical purposes, the invention thus ensures that the shaped body designed for dental purposes is compatible with human tissue (see Hoffmann-Axthelm, Lexikon der Zahnmedizin [Encyclopedia of Dental Medicine], 6th/11th edition, p. 97, and Reuling, Biokompatibilität dentaler Legierungen [Biocompatibility of Dental Alloys]). The grain size distribution ensures extremely dense sintering with the advantage of a high compressive load capacity of the shaped body and minimal creation of cavities, which would be susceptible to bacteria cultures forming; in addition, it defines the size and fitting accuracy of the restoration.

However, it is also possible to carry out precise local compacting of the powdery initial material in another way, whether by supplying energy in a different manner or, – in the case of plastics as the initial material – by controlling locally confined polymerization. In general, however, optically focusable electromagnetic radiation is preferable to other means of energy transfer, such as corpuscular radiation carried out in a vacuum.

Due to its certain degree of roughness, the sintering surface of the shaped body produced in accordance with the invention is particularly well-suited for the frequently desired veneering process using ceramic or other materials, as is the case with crowns or bridges. Furthermore, because it is easy to influence the file on which the control process is based, it is possible to make corrections to the configuration of the shaped body that may appear desirable (with respect to the traced result) for a wide variety of reasons.

The powder preferably comprises an alloy with essentially equal proportions of the alloy components in each grain of powder. This provides a major advantage compared to the conventional production of shaped dental bodies from melted alloys, because there is no risk of segregation of the alloy components in the melt and/or in the shaped body after casting. In addition, the production of semi-finished products that are made of certain alloys and are particularly advantageous for dental purposes necessitates complicated and costly processes, such as suction casting and the like, whereas pulverization of such alloys is significantly less complex. However, whereas a melt produced from such a powder (for subsequent production of shaped cast bodies) is exposed for its part to the risk of segregation and thus non-homogeneity, a shaped body that is sintered according to the invention maintains its uniform distribution of alloy components.

A metal powder with the following composition has proved effective for use with the method according to the invention, whereby the method is not confined to said composition:

Ni (Nickel)	61.4
Cr (Chromium)	22.9
Mo (Molybdenum)	8.8
Nb (Niobium)	3.9
Fe (Iron)	2.5
Mn (Manganese)	0.4
Ti (Titanium)	0.1
Total	100

CLAIMS:

1. Method for producing tooth replacement elements or auxiliary dental parts, wherein the method comprises a laser sintering process, in which shaped bodies made of a sintering powder are built up in layers by exposing each layer successively to the energy of a laser beam that leads to local sintering, whereby the laser beam is guided over the respective powder layer by means of a computer-controlled system using data that represent the configuration of the shaped piece in this layer, whereby the powder comprises a biocompatible material of varying grain sizes between 0 and 50 μm.

2. Method according to claim 1, characterized by the fact that the powder comprises an alloy with essentially equal proportions of the alloy components in each grain of powder.

3. Shaped body for use as a tooth replacement or as dental auxiliary parts, wherein the shaped body is built of a powder being laser sintered and comprising a biocompatible material of varying grain sizes between 0 and 50 μm and by application of a method according to claim 1 or 2.