

(19) World Intellectual Property Organization
International Bureau



(43) International Publication Date
26 June 2008 (26.06.2008)

PCT

(10) International Publication Number
WO 2008/076038 A1

(51) International Patent Classification:
B29C 67/04 (2006.01) *B22F 7/00* (2006.01)
B22F 3/105 (2006.01)

(21) International Application Number:
PCT/SE2007/001110

(22) International Filing Date:
17 December 2007 (17.12.2007)

(25) Filing Language: Swedish

(26) Publication Language: English

(30) Priority Data:
0602713-0 18 December 2006 (18.12.2006) SE

(71) Applicant and

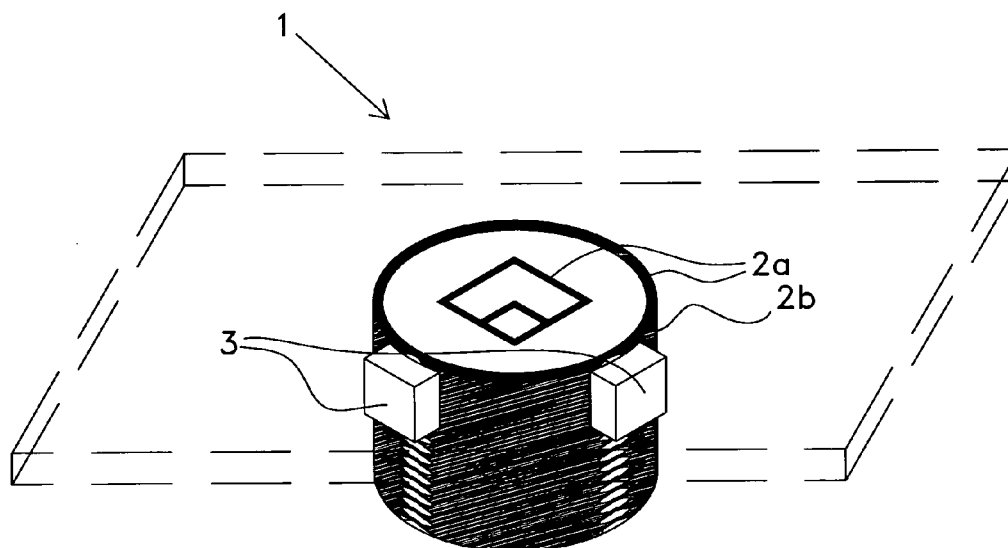
(72) Inventor: **SÖDER, Gunnar** [SE/SE]; Egilsvagen 3,
S-168 56 Bromma (SE).

(81) Designated States (*unless otherwise indicated, for every kind of national protection available*): AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BH, BR, BW, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RS, RU, SC, SD, SE, SG, SK, SL, SM, SV, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) Designated States (*unless otherwise indicated, for every kind of regional protection available*): ARIPO (BW, GH, GM, KE, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IS, IT, LT, LU, LV, MC, MT, NL, PL, PT, RO, SE, SI, SK, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Published:
— with international search report

(54) Title: A DEVICE AND METHOD FOR PRODUCING A THREE-DIMENSIONAL OBJECT WITH A 3-D PRINTER WHERE THE FEEDING MECHANISM FEEDS THE OBJECT IN REVERSE OF THE BUILDING DIRECTION



(57) Abstract: The invention relates to a 3-d printer and a method for production of three dimensional objects, The 3-d printer deposits and fuses layers of continuous sheets of substance of a selected shape on top of each other such that a continuous body is built. The 3-d printer further has a feeding device arranged to grasp part of the continuous body and feed this downwards during production, such that new layers may be added from above without the upper end of the body moving upwards, but instead as the body grows it is fed out downwards such that objects with unlimited heights or lengths may be produced. The 3-d printer may during production of a desired object further produce a holder part that is arranged to be received in the feeding device.

WO 2008/076038 A1

A DEVICE AND METHOD FOR PRODUCING A THREE-DIMENSIONAL OBJECT WITH A 3-D PRINTER WHERE THE FEEDING MECHANISM FEEDS THE OBJECT IN REVERSE OF THE BUILDING DIRECTION

The present invention relates to a 3-d printer and a method for producing three dimensional objects according to the introductory portions of the independent claims.

Background of the invention

3-d printers are today well known and are available in many versions. Typically, initially a thin layer of plastic or metal powder is deposited in the bottom of a trough. A laser fuses the plastic or metal powder over selected portions of the layer. In a next step a further thin layer is deposited on top of the previous, partially sintered layer and the laser fuses selected portions of the second layer, while in the same process fusing the new layer with the layer below. By repeating the process sintered substance of a chosen form grows upwards in the powder and when the process is finished one only has to remove residual unfused powder.

The maximum size of a 3-d object that may be produced by such a process is defined by the size of the trough. This obviously sets the maximum height of the 3-d object that may be produced by such a process, which means impractically high troughs must be used if high objects are to be made.

An object of the invention is therefore to provide a 3-d printer that allows production of higher objects than what is possible with prior art 3-d printers.

These and other objects are attained by a 3-d printer according to the characterising portions of the independent claims.

Summary of the invention

The invention relates to a 3-d printer that deposits and fuses layers of continuous sheets of substance of a selected shape on top of each other such that a continuous body is built. The 3-d printer has, as opposed to prior art 3-d printers, a feeding device arranged to grasp part of the continuous body (2a, 2b) and feed this downwards during production, such that new layers may be added from above without the upper end of the body moving upwards, but instead as the body grows it is fed out downwards. This has the important advantage over prior art 3-d printers that

objects with unlimited height or lengths may be produced

An advantageous way of producing bodies with the 3-d printer is to during production of a desired object further let it produce a holder part that is arranged to be received in the feeding device.

At start-up of the process the 3-d printer may start in ordinary fashion by producing a body in a trough that the feeding device may grasp or the process may start from a starting body being available in advance.

The invention further relates to a method for production of three dimensional objects that utilizes such a feeding device.

Brief description of the drawings

Fig. 1 shows an embodiment of the invention

Description of a preferred embodiment

With a 3-d printer according to the invention, the process is started by a thin layer of powder deposited on a bottom plate and portions of the layer being sintered. A new layer is deposited on top of the old one, portions of this are sintered and in that process it is fused with the old layer. The process is repeated on the bottom plate until a selected height is achieved.

In the process, the desired portion of the object is sintered and concurrently a holder part is suitably sintered that throughout the sintering process is attached to the desired object. The holder part is further arranged such that a feeding device (3) may grip onto the holder part a feed the desired object downwards.

In fig. 1 the 3-d printing process has reached this state where the holder part (2b) is fully formed and is received in the feeding device (3). The desired object (2a) is can now be found within the holder part (2b) and the bottom plate that was used at the start of the process has been removed. When a further layer is to be added, the holder part with the desired object is shifted one layer thickness downwards, and the process is repeated. With a 3-d printer according to the invention the height of the objects that may be produced is in principle unlimited.

In the selected embodiment, the holder part runs through an opening in a flat table (1), such that after lowering of the holder part, an evenly thick layer of powder may be deposited over a surface that covers the whole cylinder with holder part and the desired object. In this way any selected shape may be achieved within the limits set by the size of the cylinder.

Obviously, the feeding device may directly grasp the desired object and in such case no holder part is needed, but this puts higher demands on the design of the feeding device and the table (1). The process does not always have to start with a part suitable for reception into a feeding device being produced on a bottom plate which is then removed, alternatively such a part may be available presintered or cast and the process may then start directly from the step illustrated in fig. 1. Even if it generally is less practical, the printer may obviously add layers sidewise and eject the body to the side or in any direction. By 3-d printer is in this document not only meant a device for production of three dimensional objects from powder by sintering, but obviously the production method according to the invention may be applied on other methods for preparation of three dimensional objects from powders, gels, etc.

Claims

- 1 A 3-d printer comprising a device that deposits and fuses layers of continuous sheets of substance of a selected shape on top of each other such that a continuous body (2a, 2b) is built in a building direction, **characterised in** that said 3-d printer further comprises a feeding device (3) arranged to grasp part of the continuous body (2a, 2b) and feed this in a direction opposite to the building direction.
- 2 A 3-d printer according to claim 1, **characterised in** that said feeding device (3) is arranged to feed the continuous body (2a, 2b) essentially one sheet thickness before a new sheet of substance is fused with those previously fused.
- 3 A 3-d printer according to claim 1 or 2, **characterised in** that said 3-d printer is arranged to at least deposit and fuse layers of continuous sheets of substance of a selected shape such that a holder part (2b) is formed, where said holder part is arranged to be received in the feeding device (3).
- 4 A 3-d printer according to any one of the preceding claims, **characterised in** that said 3-d printer deposits layers of powder that are fused into continuous sheets.
- 5 A method for production of a three dimensional object comprising a first step where a layer in the form of a sheet of selected shape is added in a building direction and fused with a layer situated under it, **characterised in** that in a second step the sheets fused so far are fed essentially one sheet thickness in a direction opposite to the building direction.
- 6 A method for production of a three dimensional object according to claim 4, **characterised in** that before the first and second steps in the process, in a first preceding step a number of layers in the form of sheets of selected shapes are deposited on each other in a building direction from a bottom plate, and each sheet is fused with one laying below it, such that a body (2a, 2b) is formed, and in a second preceding step a feeding device (3) grasp the body, and in a third preceding step the bottom plate is removed.
- 7 A method for production of a three dimensional object according to claim 4, **characterised in** that before the first and second steps in the process, in a preceding step a body (2a, 2b) is

placed in a feeding device (3).

1/1

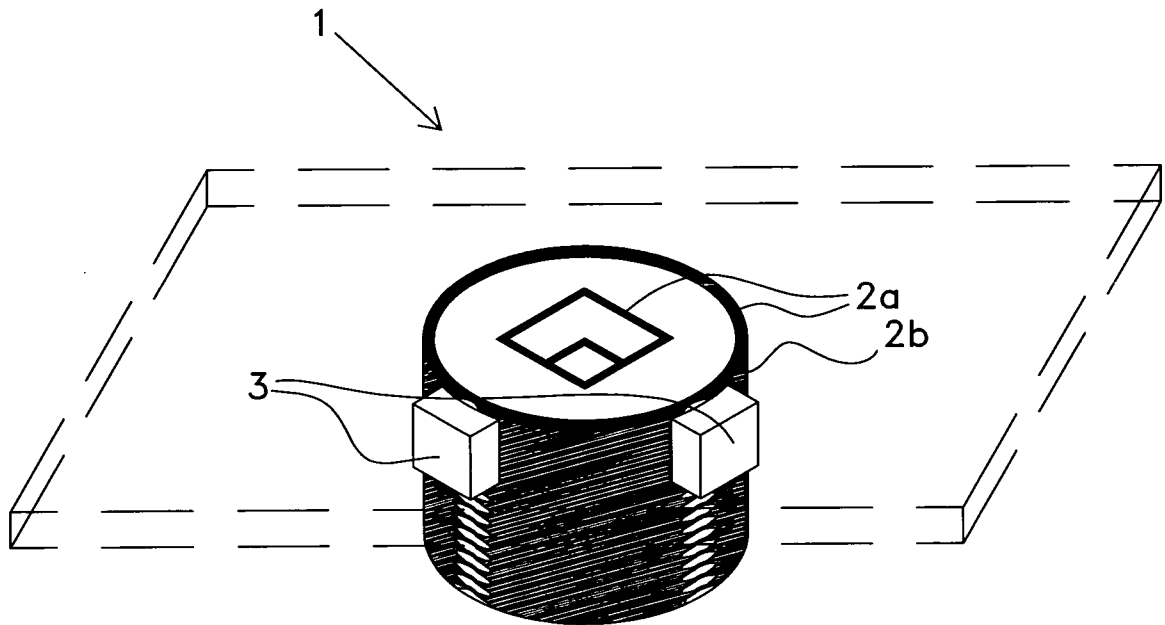


Fig. 1

INTERNATIONAL SEARCH REPORT

International application No.
PCT/SE2007/001110

A. CLASSIFICATION OF SUBJECT MATTER

IPC: see extra sheet

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)

IPC: B29C, B22F

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPO-INTERNAL, WPI DATA, PAJ

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	EP 1666234 A1 (FUJI PHOTO FILM CO. LTD.), 7 June 2006 (07.06.2006), figure 1, abstract --	1-7
A	US 20020026982 A1 (J.F. BREDT ET AL), 7 March 2002 (07.03.2002), figures 2-3, abstract --	1-7
A	US 20020105114 A1 (N. KUBO ET AL), 8 August 2002 (08.08.2002), figure 1, abstract --	1-7
A	DE 19813742 C1 (EOS GMBH ELECTRO OPTICAL SYSTEMS), 15 July 1999 (15.07.1999), figure 1, abstract --	1-7

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

25 February 2008

Date of mailing of the international search report

26-02-2008

Name and mailing address of the ISA/
Swedish Patent Office
Box 5055, S-102 42 STOCKHOLM
Facsimile No. +46 8 666 02 86

Authorized officer

Fredrik Strand / MRo
Telephone No. +46 8 782 25 00

International patent classification (IPC)**B29C 67/04** (2006.01)**B22F 3/105** (2006.01)**B22F 7/00** (2006.01)**Download your patent documents at www.prv.se**

The cited patent documents can be downloaded at www.prv.se by following the links:

- In English/Searches and advisory services/Cited documents (service in English) or
- e-tjänster/anförda dokument (service in Swedish).

Use the application number as username.

The password is **NKEUVMPNFH**.

Paper copies can be ordered at a cost of 50 SEK per copy from PRV InterPat (telephone number 08-782 28 85).

Cited literature, if any, will be enclosed in paper form.

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.

26/01/2008

PCT/SE2007/001110

EP	1666234	A1	07/06/2006	JP	2005074665	A	24/03/2005
				US	20060290032	A	28/12/2006
				WO	2005021247	A	10/03/2005
				JP	2005088392	A	07/04/2005
				JP	3735844	B	18/01/2006
				JP	2005208096	A	04/08/2005
				JP	2005254521	A	22/09/2005

US	20020026982	A1	07/03/2002	CA	2338617	A	11/05/2000
				DE	69916305	D,T	24/03/2005
				DE	69928973	D,T	07/09/2006
				EP	1124688	A,B	22/08/2001
				EP	1403031	A,B	31/03/2004
				EP	1623816	A	08/02/2006
				HK	1037914	A	30/09/2004
				JP	2002528375	T	03/09/2002
				US	6610429	B	26/08/2003
				US	20040138336	A	15/07/2004
				WO	0026026	A	11/05/2000
				AT	211056	T	15/01/2002
				DE	29724176	U	13/04/2000
				DE	69709374	D,T	20/06/2002
				EP	0925169	A,B	30/06/1999
				HK	1019866	A	04/10/2002
				JP	3607300	B	05/01/2005
				JP	2000505737	T	16/05/2000
				US	5902441	A	11/05/1999
				US	6236460	B	22/05/2001
				US	6416850	B	09/07/2002
				WO	9809798	A	12/03/1998

US	20020105114	A1	08/08/2002	JP	2002307562	A	23/10/2002
				US	6896839	B	24/05/2005
				JP	2002292750	A	09/10/2002

DE	19813742	C1	15/07/1999	DE	59901586	D	00/00/0000
				EP	0945202	A,B	29/09/1999
				JP	3138815	B	26/02/2001
				JP	11342542	A	14/12/1999
				US	6136257	A	24/10/2000