

DESCRIPTION

TITLE OF INVENTION: PRINT HEAD FOR A SYSTEM FOR THREE-DIMENSIONAL PRINTING OF MATERIAL

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[0001] The present invention relates to the field of 3D printing and in particular to the 3D-printing of building materials.

PRIOR ART

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[0002] 3D printing of building materials such as concrete or mortar has been used to design construction elements or even buildings. This 3D printing involves a vat of material. A pump is used to feed said material from the vat to a print head. This print head comprises an opening-closing means used to enable or block printing. This opening-closing means is used when creating an object/building. In fact, it is sometimes necessary to interrupt the printing process during construction to form openings or to produce complex parts with discontinuities.

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[0003] The disadvantage of existing systems is that the process of stopping and restarting printing results in poor print quality. This poor quality is due to the fact that, on restart, the pressure in the printing system is not instantly restored to its operating value. As a result, the bead of material deposited during this time is not qualitative, and its dimensions are not as desired, that is, the bead of material is thinner. The result is a structure that may have more fragile areas.

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[0004] There is therefore a need to find a solution to this problem of material deposit quality.

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SUMMARY OF THE INVENTION

[0005] The present invention seeks to solve the problems of the prior art by providing a printing system that maintains a constant output stream during
5 pauses in said printing.

[0006] In this respect, the invention relates to a print head for a system for three-dimensional printing of material, said head comprising a main body provided with an opening and an outlet through which the material to be printed
10 passes, said head further comprising means for closing the outlet opening, characterized in that the closing means comprise a rotor associated with a motor element, a stator, and a tubular membrane attached at one end to the rotor and at the other end to the stator.

15 [0007] According to one example, the rotor and stator are circular and concentric.

[0008] According to one example, the main body is a conduit acting as a stator.

20 [0009] According to one example, the main body is a conduit, the rotor being arranged to surround said main body.

[0010] According to one example, the membrane has a cylindrical or conical shape, or comprises two cylindrical portions of different diameters connected
25 by a conical portion.

[0011] According to one example, the rotor or stator are mounted so as to be translatable, the translational mobility being controlled by damping means.

30 [0012] According to one example, the damping means comprise at least one spring, preferably multiple springs, even more preferentially an evenly distributed series of springs.

[0013] According to one example, the membrane is attached to the rotor and/or stator by a clamping ring.

5 [0014] According to one example, the clamping ring has a rounded profile.

[0015] According to one example, the clamping ring comprises ring-holding means comprising at least one hole and one stud arranged, respectively, on the clamping ring and on the inner conduit or vice versa.

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[0016] The invention further relates to a three-dimensional printing device comprising a material reservoir connected to a print head via a hose, said print head being carried by a structure enabling said print head to move along at least three axes, namely length, width and height, said printing device being
15 controlled by a computing unit, characterized in that said print head is the print head according to the invention.

DESCRIPTION OF DRAWINGS

20 [0017] Other particular features and advantages will become clear from the following description thereof, given by way of indication and in an entirely non-limiting manner, with reference to the appended drawings, in which:

[0018] - [Fig. 1] shows a view of a printing system according to the invention;

[0019] - [Fig. 2] shows a diagram of the printing system according to the
25 invention;

[0020] - [Fig. 3] shows a print head of the printing system according to the invention;

[0021] - [Figs. 4] and 5 show means for closing the print head according to the invention;

30 [0022] - [Fig. 6] shows different versions of a print head membrane of the printing system according to the invention;

[0023] - [Figs.7] to 9 show configurations of the printing system according to the invention;

[0024] - [Fig. 10] shows a variant of the print head with dampers according to the invention;

- 5 [0025] - Figures 11 and 12 show a variant of a clamping ring of a print head according to the invention.

DETAILED DESCRIPTION

- 10 [0026] In [Fig. 1], a system 1 for three-dimensional printing of materials is shown. The printing system 1 is used to produce a construction object such as a brick or breeze block, or to produce a building directly. The printing system comprises a print head 10 through which the material is deposited. The print head 10 is mounted on a structure 2 enabling said print head 10 to move along
15 at least three axes, namely length, width and height, to carry out said printing. This structure 2 may take the form of an articulated arm or gantry. The print head 10 and structure 2 are connected to a control unit.

- [0027] The print head 10, shown in [Fig. 2], is connected to a reservoir 20 via
20 a conduit known as the main conduit 40. The reservoir 20 is a reservoir in which the printing mixture is stored. The reservoir 20 is also referred to as a mixer when it is fitted with means for mixing the mixture, such as an endless screw or rotating paddles.

- 25 [0028] The printing system 1 further comprises a pump 50 for feeding the mixture from the reservoir to the print head. All this is controlled by a control unit 60.

- [0029] The print head 10, shown in [Fig. 3], comprises a main body 12 provided
30 with an inlet 13 at which the main conduit is connected and an outlet 14 through which the material is ejected for printing. The print head further comprises closing means 30 arranged at the outlet to allow material to be printed or not.

- [0030] According to the invention, the closing means 30 comprise a rotor 32 and a stator 34 as shown in [Fig. 4]. The closing means 30 further comprise a membrane 36. This membrane 36 is attached to both the stator 34 and the rotor 32. The rotor 32 and stator are arranged to be one inside the other, that is concentric, and thus form an inner and outer element. Preferably, the rotor and stator are circular. The rotor 32 and/or stator 34 may be at least hexagonal in shape, for example octagonal or dodecagonal.
- 10 [0031] Rotating the rotor relative to the stator moves the membrane 36 and rotates it in turn. This rotation of the membrane 36 causes it to overlap on itself, resulting in the appearance of pleats 360, enabling the membrane to simulate an iris, as seen in [Fig. 5].
- 15 [0032] The membrane 36 is a tubular membrane. This membrane 36 has a cylindrical or conical or other shape such as, for example, a shape comprising two portions of different diameters joined together by a conical portion as shown in [Fig. 6].
- 20 [0033] This membrane 36 is cleverly attached to the rotor and stator. For this purpose, the membrane 36 is assumed to comprise an outer face and an inner face. The tubular stator 34 and rotor 32 also comprise inner and outer faces. The membrane 36 is then attached to the rotor 32 and stator 34 so that the outer face of the membrane 36 is in contact with the inner face of the rotor/stator element arranged as the inner element. The membrane 36 is then attached to the rotor 32 and stator 34 so that the outer face of the membrane 36 is in contact with the outer face of the rotor/stator element arranged as the outer element. To achieve this, the membrane 36 is turned inside out. To achieve this, the membrane 36 is first attached to the inner element acting as the rotor 32 or stator 34, then turned inside out and folded back on itself for attachment to the outer element. The membrane 36 is secured by various fasteners, as shown in [Fig. 7].
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[0034] An example of a fastener is a clamping ring. This clamping ring may be screwed directly onto the rotor or stator, or may comprise two portions that screw together. Another example consists of screwing the membrane to the
5 rotor and stator.

[0035] The membrane 36 is fastened in such a way that it is taut once in place.

[0036] In a first embodiment shown in [Fig. 8], the main body 12 is in the form
10 of a conduit, that is a tubular part. This main body 12 is the stator 34. The print head then comprises a rotor 32. This rotor 32 takes the form of a tubular part which surrounds the stator 34. The rotor 32 is rotated by a motor. This motor 38 is controlled by the control unit. In this first embodiment, the material is thus expelled by said stator 34.

15 [0037] In a second embodiment shown in [Fig. 9], the main body 12 is in the form of a conduit, that is a tubular part. The rotor 32 is a conduit that surrounds the main body, the two conduits being circular to enable the rotor to be rotated. The stator 34 is a fixed conduit, attached to the main body 12 for example. In
20 this second embodiment, the material is thus expelled through the main conduit 12.

[0038] Of course, the main body 12 is not necessarily in the shape of a conduit. This conduit shape can be limited to the portion where the outlet opening is
25 formed. The main body 12 may thus be in the shape of a square or rectangle or triangle, from which a circular conduit forming the outlet extends.

[0039] The motor 38 used to rotate the rotor 32 is preferably a stepper motor. A motor of this type enables fine, step-by-step rotation, so that the membrane
30 can thus be opened or closed precisely.

[0040] The advantage of the system according to the invention is that it allows a stop-start phase without loss of pressure.

[0041] In one variant, one of the conduits is mounted on a damper as shown in [Fig. 10]. Indeed, when the membrane 36 is deformed, traction is exerted on said outer conduit. The rotor 32 or stator 34 are mounted on a damper so that traction is not confined to the membrane. Preferably, the damper-mounted conduit is the outer conduit. In this case, the assembly consists of an outer conduit attached to a fixed point by a series of damping elements such as springs. In this way, when the rotor 32 is rotated, the membrane 36 closes and expands. This extension of the membrane 36 causes tension. The presence of the springs compensates for this tension, since instead of having the tension localized on the membrane 36, this tension is compensated for by the springs, which allow the spring-mounted conduit to move. When the rotor rotates in the opposite direction, the springs allow the membrane to relax, returning the spring-mounted conduit to its original position.

[0042] In one variant, the membrane 36 is attached to the inner conduit by a clamping ring 39. This clamping ring 39 has a rounded shape as shown in [Fig. 11]. This rounded shape helps protect the membrane. In fact, as the membrane 36 stretches, it presses and rubs against the edge face of the inner conduit. As the membrane 36 rotates, this pressing can damage the membrane. The rounded clamping ring reduces friction on the membrane.

[0043] The clamping ring 39 is optionally associated with ring-holding means. This is because when the membrane 36 of the closing means 30 is closed, residual pressure may be present in the print head 10 or in the main conduit 40. This residual pressure tends to exert stress on the clamping ring 39, which can lead to axial translation of said clamping ring 39. This causes the clamping ring to disengage from the membrane 36. To avoid this, the ring-holding means are designed to limit this axial translation. In a first example, the ring-holding means comprise at least one hole 39b, which either does or does not go all

the way through, and a stud 39a arranged on the clamping ring 39 and on the inner conduit (which may be the stator 34) as seen in [Fig. 12]. The stud and hole are arranged so that said stud fits into the hole, even with the membrane interposed between said stud and hole. This stud-hole assembly creates a stop
5 which limits the translation of the clamping ring. It is understood that the stud is arranged on the clamping ring and the hole on the inner conduit, or vice versa. In a second example, the inner conduit may comprise at least one bead which limits the translation of the clamping ring.

10 [0044] Of course, the present invention is not limited to the shown example but is subject to different variants and modifications which will become apparent to a person skilled in the art.

CLAIMS

- [Claim 1] A print head (10) for a system (1) for three-dimensional printing of material, said head comprising a main body (12) provided with an inlet opening (13) and with an outlet opening (14), through which openings the material to be printed passes, said head further comprising means (30) for closing the outlet opening, characterized in that the closing means comprise a rotor (32) associated with a motor element (38), a stator (34), and a tubular membrane (36) fixed by one end to the rotor and by the other end to the stator.
- 10 [Claim 2] The print head according to the preceding claim, wherein the rotor (32) and stator (34) are circular and concentric.
- [Claim 3] The print head according to one of claims 1 or 2, wherein the main body is a conduit acting as a stator.
- 15 [Claim 4] The print head according to one of claims 1 or 2, wherein the main body is a conduit, the rotor being arranged to surround said main body.
- 20 [Claim 5] The print head according to one of the preceding claims, wherein the membrane (36) has a cylindrical or conical shape or comprises two cylindrical portions of different diameters connected by a conical portion.
- [Claim 6] The print head according to one of the preceding claims, wherein the rotor or stator are mounted so as to be translatable, the translational mobility being controlled by damping means.
- 25 [Claim 7] The print head according to the preceding claim, wherein the damping means comprise at least one spring, preferably multiple springs, even more preferentially a series of evenly distributed springs.
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[Claim 8] The print head according to one of the preceding claims, wherein the membrane is secured to the rotor and/or stator by a clamping ring (39).

[Claim 9] The print head according to the preceding claim, wherein the
5 clamping ring has a rounded profile.

[Claim 10] The print head according to the preceding claim, wherein the clamping ring comprises ring-holding means comprising at least one hole (39b) and one stud (39a) arranged, respectively, on the clamping ring (39) and on
10 the inner conduit or vice versa.

[Claim 11] A three-dimensional printing device (1) comprising a material reservoir connected to a print head via a hose, said print head being carried by a structure enabling said print head to move along at least three axes,
15 namely length, width and height, said printing device being controlled by a computing unit, characterized in that said print head is the print head according to one of the preceding claims.