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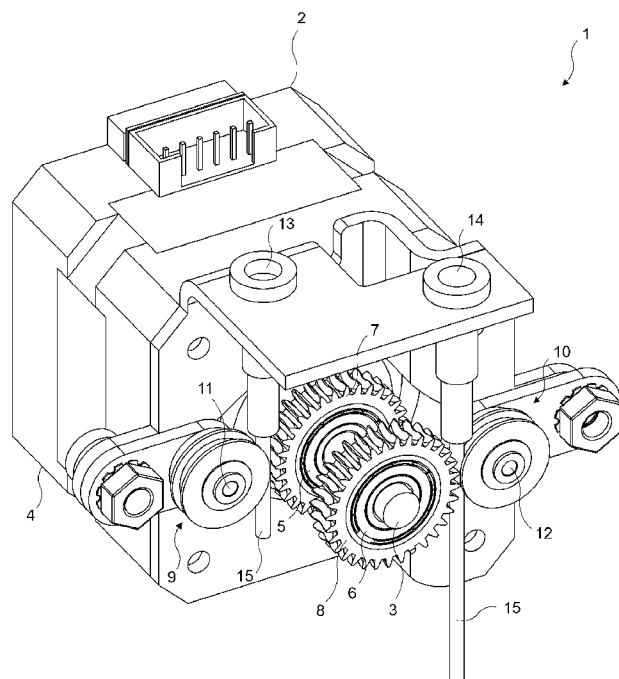
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(54) Title: A FEEDING MECHANISM USED IN 3D PRINTERS

Figure 1



(57) Abstract: The present invention relates to a three-dimen-
sional printer (1) comprising a motor (2); a motor shaft (3); and a
feeding mechanism (4) having two unidirectional ball bearings (5
and 6) which are mounted to said motor shaft (3) one behind the
other, two drive gears (7 and 8) which are coaxially mounted onto
the two ball bearings (5 and 6), and two guiding members (9 and
10) which extend parallel to the motor shaft (3) next to each drive
gear (7 and 8), wherein the filament (15) is inserted between the
drive gear (7 and 8) and the guiding member (9 and 10).

Description**A FEEDING MECHANISM USED IN 3D PRINTERS**

- [0001] The present invention relates to a three-dimensional printer which drives two filaments with one motor.
- [0002] One of the important problems in the feeding mechanisms in three-dimensional printers is the need for stepper motors as many as the number of filaments in order to drive more than one filament. In the state of the art, a separate stepper motor is used to drive each filament, which in turn much increases the dimensions and the weight of the feeding mechanism.
- [0003] In the state of the United States Patent No. US8827684, a three-dimensional printer is disclosed, comprising stepper motors as many as the number of filaments to drive a plurality of filaments, wherein common fixtures are used to minimize the dimensions thereof.
- [0004] Another state of the art embodiment is disclosed in United States Patent Application No. US2012189729. In the three-dimensional printer disclosed in this document, there are two stepper motors which are oppositely placed, a filament crushing gear and a ball bearing on the shaft of the motors. By oppositely placing the motors, the filament crushing gear of one motor drives the filament using the ball bearing of the other motor, thus two filaments can be driven with two stepper motors in a small space.
- [0005] In the state of the United States Patent Application No. US2208213419, a three-dimensional printer is disclosed, comprising a mechanism which is installed in the direction of rotation of the motor driving the solid material, which compresses the material while rotating in the pushing direction and releases the material while rotating in the opposite direction.
- [0006] Another state of the art embodiment is disclosed in United States Patent Application No. US2007228590. In this document, a three-dimensional printer is disclosed, comprising a mechanism which moves between the first and second positions so as to form two production lines and which drives the filament with the motion of the stepper motor after switching between the extruder positions.
- [0007] The aim of the present invention is the realization of a three-dimensional

printer which drives a plurality of filaments.

- [0008] The three-dimensional printer realized in order to attain the aim of the present invention, explicated in the first claim and the respective claims thereof, comprises a motor; a motor shaft; two unidirectional ball bearings which are mounted to said motor shaft; two drive gears which are coaxially mounted onto the two ball bearings; and two guiding members which extend parallel to the motor shaft next to each drive gear, wherein the filament is inserted between the drive gear and the guiding member. Thus, at least two filaments can be driven with a single motor by driving the filament related to the rotational direction of the motor. In fact, as by means of the present invention the number of motors is half of the number of filaments driven, the volume and mass of the feeding mechanism is reduced. The dimensions of the feeding mechanism create unused regions in the production volume, and since the volume of the feeding mechanism decreases, the efficient production volume increases. Moreover, as the mass of the feeding mechanism decreases, the moment of inertia also decreases, thus ensuring a more stable and precise production process.
- [0009] The distance between the drive gears and the guiding member can be adjusted. Thus, filaments with different diameters can be driven.
- [0010] In the preferred embodiment of the present invention, the three-dimensional printer comprises a first ball bearing; a first drive gear which is mounted onto the first ball bearing; a second ball bearing which is mounted to the same motor shaft coaxially with the first ball bearing; a second drive gear which is mounted onto the second ball bearing; and a first and a second guiding member which are positioned right and left so as to align with the first gear and the second gear, wherein the filaments coming from the first and second feeding paths remain therebetween so as to be driven.
- [0011] In the preferred embodiment of the present invention, the motor is a stepper motor.
- [0012] In an embodiment of the present invention, the motor shaft has a D-shaped cross-section.

- [0013] Since two filaments can be driven by means of the present invention, the support structure can be easily discarded in pieces produced by selecting production material and water-soluble support filament. Thus, the need for cleaning the support is eliminated, and the supports do not leave any traces on the main piece.
- [0014] By means of the present invention, the volume and mass of the mechanism driving a plurality of filaments is prevented from increasing, thus providing a mechanism with less volume and increasing the efficient production area. Moreover, since its low mass reduces the moment of inertia, it also reduces the reaction force which would act on the axis motors during the change of direction. Thus, a more stable and precise production is performed.
- [0015] A three-dimensional printer realized in order to attain the aim of the present invention is illustrated in the attached figure, where:
- [0016] Figure 1 – is the perspective view of the feeding mechanism of a three-dimensional printer.
- [0017] The elements illustrated in the figures are numbered as follows:
1. Three-dimensional printer
 2. Motor
 3. Motor shaft
 4. Feeding mechanism
 5. First ball bearing
 6. Second ball bearing
 7. First drive gear
 8. Second drive gear
 9. First guiding member
 10. Second guiding member
 11. First guide shaft
 12. Second guide shaft
 13. First feeding line
 14. Second feeding line
 15. Filament
- [0018] The three-dimensional printer (1) comprises a motor (2); a motor shaft (3);

and a feeding mechanism (4) having two unidirectional ball bearings (5 and 6) which are mounted to said motor shaft (3) one behind the other, two drive gears (7 and 8) which are coaxially mounted onto the two ball bearings (5 and 6), and two guiding members (9 and 10) which extend parallel to the motor shaft (3) next to each drive gear (7 and 8), wherein the filament (15) is inserted between the drive gear (7 and 8) and the guiding member (9 and 10). Thus, by using freewheel clutch principle of the unidirectional ball bearing (5 and 6), a pair of filaments (15) are driven with a single motor (2).

[0019] In the three-dimensional printer (1), the filament (15) enters between the drive gear (7 and 8) and the guiding member (9 and 10), and after this step, the filament (15) is squeezed between the driving gear (7 and 8) and the guiding member (9 and 10) with the effect of the rotation. The drive gear (7 and 8) leaves marks on the filament (15) which is squeezed so as to form pressing surfaces. Said pressing surfaces prevent the filament (15) from sliding. Moreover, since the distance between the gears (7 and 8) and the guiding members (9 and 10) can be adjusted, a filament (15) with desired thickness can be driven.

[0020] While rotating in one direction, the unidirectional ball bearing (5 and 6) functions as a ball bearing, but in the other direction, functions as a clutch. Thus, different filaments (15) can be driven in both directions by separating in the rotational direction of the motor (2). For example, the unidirectional ball bearing (6) in front, functioning as a clutch clockwise, drives the filament (15) downwards, which is squeezed between the drive gear (7 and 8) and the guiding member (9 and 10). Meanwhile, the ball bearing (5) at the rear does not move.

[0021] In the preferred embodiment of the three-dimensional printer (1) of the present invention, the ball bearings (5 and 6) are snap-fitted onto the motor shaft (3) one behind the other. In this embodiment, the three-dimensional printer (1) further comprises a motor shaft (3) with D-shaped profile. After being snap-fitted onto the drive gear (7 and 8), the unidirectional ball bearing (5 and 6) is mounted onto the motor shaft (3) with D-shaped profile.

- [0022] In the preferred embodiment of the present invention, the feeding mechanism (4) comprises a first ball bearing (5) which is snap-fitted onto the motor shaft (3) and a second ball bearing (6) snap-fitted in the front thereof; a first drive gear (7) which is coaxially mounted onto the first ball bearing (5); a second drive gear (8) which is coaxially mounted to the second ball bearing (6); a first guiding member (9) which is positioned as aligned with the first drive gear (7) so as to be spaced apart from the first drive gear (7) at a certain distance; and a second guiding member (10) which is positioned as aligned with the second drive gear (8) so as to be spaced apart from the first drive gear (8) at a certain distance. In the preferred embodiment of the present invention, the feeding mechanism (4) comprises a first guide shaft (11) which is positioned parallel to the motor shaft (3) and whereon the first guiding member (9) is mounted so as to rotate therearound, and a second guide shaft (12) which is positioned parallel to the motor shaft (3) and whereon the second guiding member (10) is mounted so as to rotate therearound (Figure 1).
- [0023] In the preferred embodiment of the present invention, the feeding mechanism (4) further increases a first feeding path (13) through which the filament (15) passes and moves towards the feeding mechanism (4) so as to enter between the first drive gear (7) and the first guiding member (9), and a second feeding path (14) which enables the filament (15) to enter between the second drive gear (8) and the second guiding member (10).
- [0024] In the three-dimensional printer (1), the feeding mechanism (4) operates as follows: The second ball bearing (6) functioning as a clutch clockwise drives downwards the filament (15), which is squeezed between the second drive gear (8) and the second guiding member (10), through the second feeding path (14). Meanwhile, the ball bearing (5) does not move. When the rotational direction of the motor (2) changes, the first ball bearing (5) functioning a clutch counterclockwise starts to rotate with the first drive gear (7) thereon. Meanwhile, the filament (15) between the first drive gear (7) and the first guiding member (9) is driven downwards through the first feeding path (13). During this process, the second ball bearing (6) does not move.

[0025] The present invention drives two filaments (15) with a single motor (2) unlike patents disclosing similar embodiments. Generally, in embodiments where a plurality of filaments (15) are driven, one motor (2) is used for each filament (15) being driven. By means of the present invention, the feeding mechanism (4) uses only one motor (2) for the intake of both filaments (15), and thus the volume and mass of the feeding mechanism (4) are decreased. This decrease in volume increases the effective production volume. Since the decrease in mass decreases the inertia force, the reaction forces acting on the axis motors (2) during the change of direction of the feeding mechanism (4) are reduced, ensuring a more stable and precise production process.

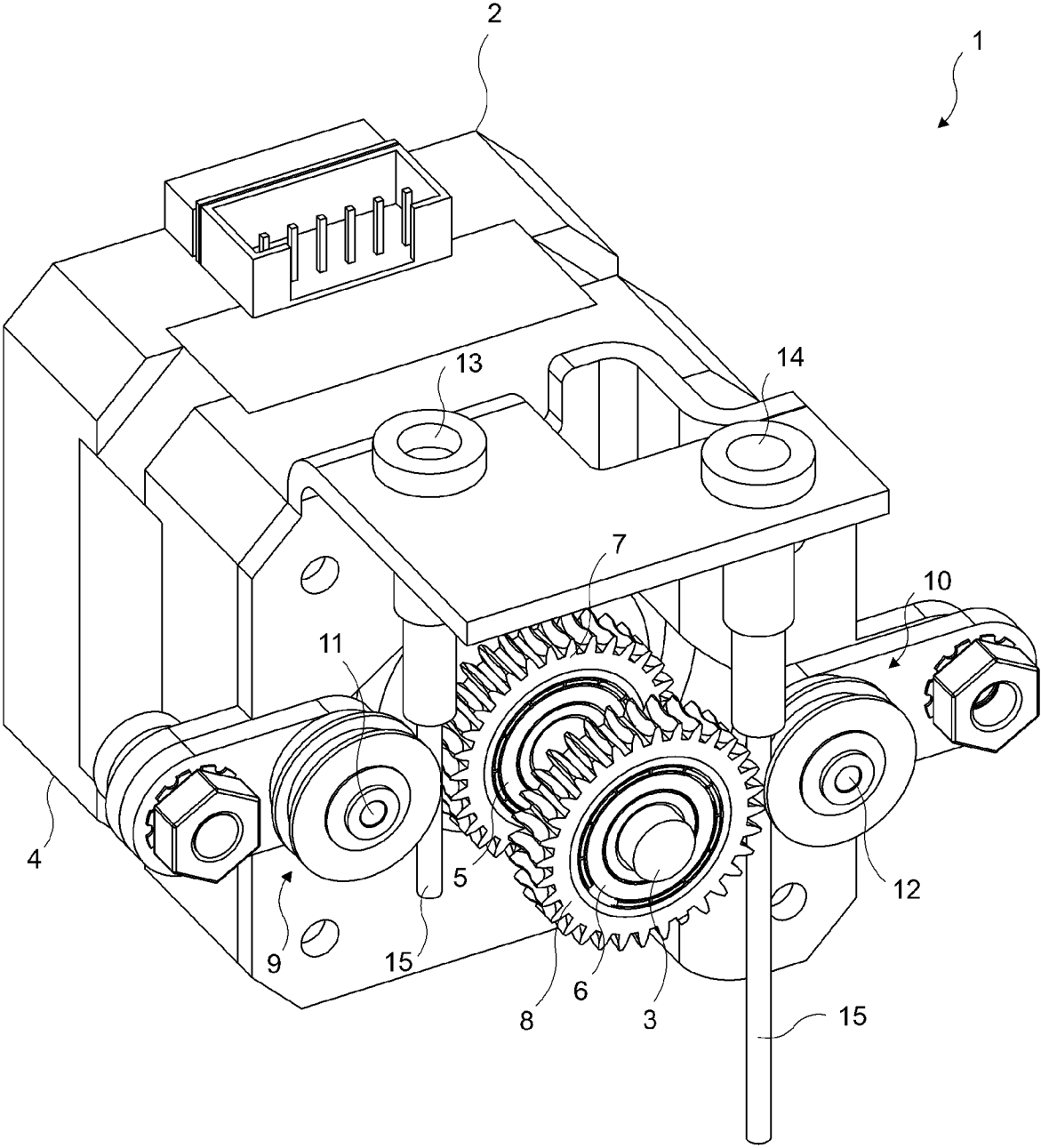
Claims

1. A three-dimensional printer (1) **comprising** a motor (2) and a motor shaft (3); **characterized by** a feeding mechanism (4) having two unidirectional ball bearings (5 and 6) which are mounted to said motor shaft (3) one behind the other, two drive gears (7 and 8) which are coaxially mounted onto the two ball bearings (5 and 6), and two guiding members (9 and 10) which extend parallel to the motor shaft (3) next to each drive gear (7 and 8), wherein the filament (15) is inserted between the drive gear (7 and 8) and the guiding member (9 and 10).
2. A three-dimensional printer (1) as in Claim 1, **characterized by** the feeding mechanism (4) comprising the two unidirectional ball bearings (5 and 6) which function as a ball bearing while rotating in one direction and as a clutch while rotating in the other direction.
3. A three-dimensional printer (1) as in Claim 1 or 2, **characterized by** the feeding mechanism (4) comprising the two ball bearings (5 and 6) which are snap-fitted onto the motor shaft (3) one behind the other.
4. A three-dimensional printer (1) as in Claim 1, **characterized by** a motor shaft (3) with a D-shaped profile.
5. A three-dimensional printer (1) as in Claim 1, **characterized by** the feeding mechanism (4) comprising a first ball bearing (5) which is snap-fitted onto the motor shaft (3) and a second ball bearing (6) snap-fitted in the front thereof; a first drive gear (7) which is coaxially mounted onto the first ball bearing (5); a second drive gear (8) which is coaxially mounted to the second ball bearing (6); a first guiding member (9) which is positioned as aligned with the first drive gear (7) so as to be spaced apart from the first drive gear (7) at a certain distance; and a second guiding member (10) which is positioned as aligned with the second drive gear (8) so as to be spaced apart from the first drive gear (8) at a certain distance.
6. A three-dimensional printer (1) as in Claim 5, **characterized by** the feeding mechanism (4) comprising a first guide shaft (11) which is positioned parallel to the motor shaft (3) and whereon the first guiding member (9) is mounted so as to rotate therearound, and a second guide shaft (12) which is positioned parallel to the motor shaft (3) and whereon the second guiding member (10) is

mounted so as to rotate therearound.

7. A three-dimensional printer (1) as in Claim 5 and 6, **characterized by** the feeding mechanism (4) comprising a first feeding path (13) through which the filament (15) passes and moves towards the feeding mechanism (4) so as to enter between the first drive gear (7) and the first guiding member (9), and a second feeding path (14) which enables the filament (15) to enter between the second drive gear (8) and the second guiding member (10).

Figure 1



INTERNATIONAL SEARCH REPORT

International application No
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A. CLASSIFICATION OF SUBJECT MATTER
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ADD.

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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.
A	CN 108 582 781 A (GUANGZHOU ELECTRONIC TECH CO LTD CHINESE ACADEMY OF SCIENCES) 28 September 2018 (2018-09-28) As shown in FIG. 2 to FIG. 4, the feeding assembly 2 includes a driving motor 201, a driving pinion 202, two passive large gear assemblies 203 mounted symmetrically, two wire pressing wheel assemblies 204, and two elastic clamping devices. 205 and two inlet tubes 206. The driving motor 201 is mounted on the back surface of the substrate 1, and its rotating shaft extends toward the front surface of the substrate 1, and the driving pinion 202 is fixedly mounted on the rotating shaft of the driving motor 201. Two passive large gear assemblies 203 are symmetrically disposed on both sides of the driving pinion 202, respectively meshing with the -/--	1-7



Further documents are listed in the continuation of Box C.



See patent family annex.

* Special categories of cited documents :

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Date of the actual completion of the international search

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Date of mailing of the international search report

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Name and mailing address of the ISA/

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INTERNATIONAL SEARCH REPORT

International application No

PCT/EP2020/054713

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
	driving pinion 202, and the axes of the three are on the same horizontal plane. The passive bull gear assembly 203 includes a rolling bearing 2031, a passive bull gear 2032 that meshes with the driving pinion 202, a one-way bearing 2033, a feed wheel shaft 2034, and a snap spring 2035. The one-way bearing 2033 is nested into the central hole of the passive large gear 2032, and the two cannot rotate relative to each other; the feeding wheel shaft 2034 is tightly passed through the inner hole of the one-way bearing 2033 to the stepped position of the axle, and then the circlip spring 2035 is fitted to define The position of the one-way bearing 2033 in the axial direction of the feed wheel shaft 2034; the rolling bearing 2031 is tightly fitted into the end of the feed wheel shaft 2034, and is fitted and fixed with the hole on the substrate 1, so that the passive large gear assembly 203 can be firmly positioned. The one-way bearing 2033 of the two passive bull gear assemblies 203 is mounted in the opposite direction such that when the drive pinion 202 rotates in one direction, one feed wheel shaft 2034 rotates, the other feed wheel shaft 2034 does not rotate, and when the drive pinion 202 rotates around the other When turning in one direction, the situation is just the opposite.; figures ----- A US 2015/328837 A1 (VENTOLINA CORDERO CLYDE [SG] ET AL) 19 November 2015 (2015-11-19) paragraphs [0023] - [0026]; figures ----- A US 2012/189729 A1 (PAX CHARLES E [US]) 26 July 2012 (2012-07-26) cited in the application paragraph [0029]; figures -----	1-7 1-7

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

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Patent document cited in search report		Publication date	Patent family member(s)	Publication date
CN 108582781	A	28-09-2018	NONE	

US 2015328837	A1	19-11-2015	CN 105082534 A	25-11-2015
			TW 201544299 A	01-12-2015
			US 2015328837 A1	19-11-2015

US 2012189729	A1	26-07-2012	NONE	
