[19] Patents Registry [11] 1185219 A
The Hong Kong Special Administrative Region
香港特別行政區
專利註冊處

[12]

SHORT-TERM PATENT SPECIFICATION
短期專利說明書

[21] Application No. 申請編號
13111802.0
[22] Date of filing 提交日期
21.10.2013

[51] Int.Cl.[8] B41J B29C

[30] Priority 優先權
05.12.2012 US 61/733,689
14.03.2013 US 13/831,050
[45] Publication Date of granted patent 批予專利的發表日期
07.02.2014

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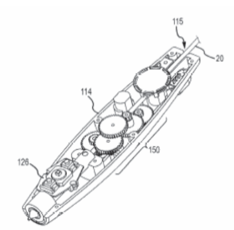
[54] HAND-HELD THREE-DIMENSIONAL DRAWING DEVICE 手持式三維繪圖裝置

[57] A three-dimensional (3D) drawing device having a housing configured for manipulation by a user's hand and to accept a feed stock that is, in certain embodiments, a strand of thermoplastic. The drawing device has a nozzle assembly with an exit nozzle and a motor connected to a gear train that engages the strand of thermoplastic feed stock such that rotation of the motor causes the feed stock to be extruded out of the exit nozzle to form a three-dimensional object.
一種三維 (3D) 繪圖裝置，具有一個殼體，其被配置為使用者用手操縱和接受原料，在某些實施例中其原料是一縷熱塑性 。繪圖裝置有一個含有出口噴嘴的噴嘴元件和一個電機連接與一個齒輪裝置，其齒輪裝置用於接合一縷熱塑性原料，以電機的轉動在出口噴嘴擠出原料以形成三維物體 。



This print reflects an amendment of specification under section 120 of the Patents Ordinance.
本文件顯示，說明書已根據專利條例第 120 條修訂 。

Docket No.: 092749-0011

HAND-HELD THREE-DIMENSIONAL DRAWING DEVICE

Cross-Reference to Related Applications

[0001] The present application claims benefit of and priority to U.S. Provisional Patent Application Serial No. 61/733,689 filed on December 5, 2012, the entirety of which is hereby incorporated herein by reference.

BACKGROUND

Field

[0002] The present disclosure relates to extrusion devices and, in particular, a hand-held implement configured to extrude a material so as to construct three-dimensional (3D) objects.

Description of the Related Art

[0003] Three-dimensional printers are known which may be used to produce 3D items of all types. Certain printers operate by deposition of sequential layers of plastic while others function by sequential agglomeration or solidification of layers of a precursor material. These printers tend to be large and expensive and require the design to be provided as a computer file, for example as generated by a Computer-Aided Design (CAD) program.

[0004] U.S. Patent 3,665,158 to Froedge discloses a conventional handheld extrusion device. A chamber is filled with a granulated solid plastic material and then sealed with a cap. The contents of the chamber are heated to melt the plastic and create pressure within the chamber. A passage leads from the chamber to a rotatable nozzle that blocks flow in a first position and allows flow in a second position. A trigger is attached to the nozzle such that pulling the trigger moves the nozzle to the second position, thereby allowing the molten plastic to be expelled from the nozzle due to the pressure within the chamber. Releasing the trigger allows the nozzle to return to the first position, thereby stopping the flow of plastic. There is no provision to replenish the raw material without shutting off the device nor any mechanism to mechanically feed material to the nozzle at a constant rate. In addition, Froedge's system does not provide a means of cooling the extruded material.

SUMMARY

[0005] It is desirable to provide a reliable, easily refillable hand-held device to form 2D and 3D items without the need for computerized design files. The present disclosure describes a hand-held device that allows a user to "draw" a 3D structure with a feed stock that can be replenished while in continuous use.

[0006] In certain embodiments, a 3D drawing device is disclosed that includes a housing configured for manipulation by a user's hand and to accept a feed stock, a nozzle assembly at least partially disposed within the housing and having an exit nozzle, a motor disposed within the housing, and a gear train disposed within the housing and coupled between the motor and the feed stock and configured such that rotation of the motor causes the feed stock to be extruded out of the exit nozzle to form a three-dimensional object.

[0007] In certain embodiments, a 3D drawing device is disclosed that includes a housing configured for manipulation by a user's hand and to accept a feed stock. The housing has an internal volume and at least one cooling port in fluid communication with the internal volume. The 3D drawing device also includes a nozzle assembly at least partially disposed within the housing proximate to the at least one cooling port and having an exit nozzle, a fan disposed within the housing and configured to draw air into the internal volume and then force the air out of the at least one cooling port, a motor disposed within the housing, and an actuator coupled to the housing. Actuation of the actuator causes the feed stock to be extruded out of the exit nozzle to form a three-dimensional object.

BRIEF DESCRIPTION OF THE DRAWINGS

[0008] The accompanying drawings, which are included to provide further understanding and are incorporated in and constitute a part of this specification, illustrate disclosed embodiments and together with the description serve to explain the principles of the disclosed embodiments. In the drawings:

[0009] FIG. 1 is a perspective view of an exemplary 3D drawing device according to certain aspects of the present disclosure.

[0010] FIG. 2 is a cut-way view of the device of FIG. 1 with a portion of the housing removed according to certain aspects of the present disclosure.

[0011] FIGS. 3A-3B are cross-sectional and cutaway views of the device of FIG. 1 according to certain aspects of the present disclosure.

[0012] FIGS. 4A-4B are plan and perspective views of the feed mechanism according to certain aspects of the present disclosure.

[0013] FIGS. 5A-5B are perspective and cutaway views of another embodiment of a 3D drawing device according to certain aspects of the present disclosure.

DETAILED DESCRIPTION

[0014] The present disclosure describes a hand-held device that allows a user to "draw" a 2D or 3D structure and to easily refill or replace the feed stock.

[0015] The detailed description set forth below is intended as a description of various configurations of the subject technology and is not intended to represent the only configurations in which the subject technology may be practiced. The appended drawings are incorporated herein and constitute a part of the detailed description. The detailed description includes specific details for the purpose of providing a thorough understanding of the subject technology. However, it will be apparent to those skilled in the art that the subject technology may be practiced without these specific details. In some instances, well-known structures and components are shown in block diagram form in order to avoid obscuring the concepts of the subject technology. Like components are labeled with identical element numbers for ease of understanding.

[0016] As used within this disclosure, the phrase "feed stock" means any material provided in any form suitable for processing within the 3D drawing device so as to provide the desired output stream. Feed stock may be a thermoplastic such as acrylonitrile butadiene styrene (ABS), polyvinyl chloride (PVC) or a polylactic acid (PLA), a thermoset material such as an epoxy, a metal such as tin or lead or a mixture of metals. Feed stock may be a single material or a mixture of materials, such as a rod having particles of a first material dispersed within a matrix of a second material.

[0017] FIG. 1 is a perspective view of an exemplary 3D drawing device 100 according to certain aspects of the present disclosure. The device 100 includes a housing 110 in which a control assembly 120, a nozzle assembly 130, a fan assembly 140 are provided. The housing 110 may be sized and configured to fit in a user's hand and suitably shaped to allow for manipulation like a pen or pencil. An actuator, for example buttons 122 and 124 in this embodiment, may be positioned to allow the user to actuate either the actuator while holding the device 100. In this embodiment, the user may actuate one or both of buttons 122, 124 while manipulating the 3D drawing device 100. In this embodiment, the device 100 is configured to accept a feed stock 20 in the form of a strand that may be 3 mm in diameter. In certain embodiments, the feed stock 20 may be provided as a cut length, for example 30 cm in length, or as a continuous strand drawn from a spool (not shown in FIG. 1). includes an input portal 18, or other input element, such as a hopper, for example, through which a raw material 19 is provided to the implement 10. The feed stock 20 may be a thermoplastic material, for example a PVC, an ABS, or a PLA, however, other embodiments may accept other types of material, such as a thermoset plastic or a metal or combination of materials.

[0018] In an example of use of one embodiment of the device 100, the user selects a particular type and color of a thermoplastic feed stock 20 and introduces the feed stock 20 into the entrance port 115 (see FIG. 2) and connects a power cord (not shown in FIG. 1) to a power source, such as a wall outlet. In certain embodiments, the 3D drawing device 100 may include a portable power source (not shown in FIGS. 1-2), for example a lithium polymer battery, to power the device 100. After a warm-up period, the user may press button 122 while drawing a line on a surface with the device 100, for example tracing a pattern on a printed sheet, in a manner similar to drawing a line with a pencil. A column 22 of the feed stock 20 is extruded from the nozzle assembly while the button 122 is depressed. In certain embodiments, the column 22 may be 0.3 mm in diameter. If the user moves the device along the surface at approximately the same speed as the rate of extrusion of the column 22, the user will create a solid, three-dimensional “line” on the surface. In certain embodiments, the feed stock 20 exists the nozzle assembly 130 in essentially a solid form such that the extruded column retains its shape. In certain embodiments, freshly extruded feed stock 20 will bond to previously extruded columns 22 such that a structure may be formed by drawing a line across to onto a previously drawn column 22.

[0019] In certain embodiments, button 122 may cause the feed stock 20 to be extruded at a first rate, for example 2.6 mm/sec, while the second button 124 may cause the feed stock 20 to be extruded at a second rate, for example 5.0 mm/sec. In certain embodiments, the first rate may be in the range of 0.1-10.0 mm/sec and the second rate may be in the range of 2-50 mm/sec. In certain embodiments, the first and second rates are chosen to provide a speed appropriate for the intended user, for example a device 100 intended for use by a young child may have slower rates than a device 100 intended for an adult artist. In certain embodiments, the 3D drawing device 100 may include a variable speed control mechanism (not shown in FIG. 1-2) to allow the user to adjust one or more of the rates of extrusion. In certain embodiments, the variable speed control mechanism may include a dial. In certain embodiments, releasing either of the buttons 122, 124 may cause the internal mechanism to draw the feed stock 20 backward a certain amount, thereby breaking off the extruded column 22. In this manner, the user can "write" with the 3D drawing device 100 in much the same manner as they would with a pen except they can do so in three dimensions since the extruded material is three-dimensional. The user can create free-form lines, shapes or other objects, as desired. A user may additionally use stencils or other guides in order to create desired objects such as sculpture, jewelry, artistic pieces, etc. In addition, or in the alternative, the 3D drawing device 100 may be used to repair or enhance existing objects and structures. In certain embodiments, pressing both buttons 122, 124 at the same time may cause another action, such as expelling the unused portion of the feed stock 20 from the entrance port 115 such that the user may switch to a different color or type of feed stock 20.

[0020] FIG. 2 is a cut-way view of the device 100 of FIG. 1 with a portion of the housing 110 removed according to certain aspects of the present disclosure. It can be seen that a circuit assembly 126 is positioned under the switches 122, 124 and a feed mechanism 150 is disposed on the lower housing 114, with the feed stock 20 entering through the entrance port 115 and passing over and between elements of the feed mechanism 150, which is discussed in greater detail with respect to FIGS. 4A-4B. In certain embodiments, the circuit assembly 126 may include a processor while, in certain embodiments, the circuit assembly 126 may include analog circuit elements such as mechanical switches, resistors, capacitors, and other electrical elements (not visible in FIG. 2) as known to those of skill in the art. In certain embodiments, the circuit assembly 126 may include a power conditioning circuit (not shown) that converts power from the power source to a different form, such as a direct current (DC) voltage. In certain embodiments, the circuit assembly 126 may include a portable power source (not shown in FIG. 2). In certain embodiments, the circuit assembly 126 may be connected to an external power source through a power cord (not shown in FIGS. 1-2). In certain embodiments, the 3D drawing device 100 also includes an external control interface 127 that is connected to the circuit assembly 126 and configured to accept actuation commands from a remote system, such as a computer numerical control (CNC) machine. In certain embodiments, the housing 110 may be adapted for mounting on a tool interface of a CNC machine such that the machine can manipulate the 3D drawing device 100 to create 3D objects. For example, the external control interface 127 may include three electrical pins, wherein a pin 1 is a common such as a ground, a pin 2 that is coupled to the button 122 such that provision of a DC voltage across pin 1 and pin 2 is equivalent to pressing button 122, and a pin 3 that is coupled to the button 124 such that provision of a DC voltage across pin 1 and pin 3 is equivalent to pressing button 124. In certain embodiments, the external control interface 127 may be configured to accept signals through a radio frequency (RF) or optical wireless system. In certain embodiments, the external control interface 127 may be configured to accept signals through a fiber-optic cable.

[0021] FIGS. 3A-3B are cross-sectional and cutaway views of the device 100 of FIG. 1 according to certain aspects of the present disclosure. FIG. 3A is a side view of the entire 3D drawing device 100, showing how the upper housing 112 and lower housing 114 together form an internal volume 116 in which is located the feed mechanism 150. At the right end, it can be seen that the nozzle assembly 130 includes an extruder 132 and a guide tube 134, which are discussed in greater detail with respect to FIG. 3B. the fan assembly 140 includes a fan cover 142, which is stationary and attached to the upper housing 112, an impeller 14 located underneath the cover 142 and configured to draw air into the internal volume 116 through ports (not visible in FIG. 3A) in the cover 142. A motor 146 is mounted, in this example, to the lower housing 114 and drives the impeller 144 at a constant speed. The air that is drawn into the internal volume may, in certain embodiments, flow out through either cooling ports 118 in the upper and lower housings 112, 114. The cooling ports 118 are discussed in greater detail with respect to FIG. 3B. It can be seen in FIG. 3A that, in this embodiment, the feed stock 20 follows a straight path though the device 100.

[0022] FIG. 3B is a close-up, cutaway view of the nozzle assembly 130. The extruder 132 has a first chamber 135 formed as a cylindrical bore of approximately the same diameter as the feed stock 20 and an extrusion passage 133 of a smaller diameter, terminating in an exit nozzle 133A. In certain embodiments, the first chamber 135 may have a first diameter of 3 mm while the extrusion passage 133 has a diameter of 0.3 mm. In certain embodiments, the extruder 132 is formed of a thermally conductive material, for example a metal or a ceramic, with a heating element, for example a nichrome wire, (not visible in FIG. 3B) wound around the exterior circumference. When the device 100 is connected to a power source, the heating element raises the temperature of the extruder 132 to a temperature that may be above the melting point of the feed stock 20. In certain embodiments, the nozzle assembly 130 includes a temperature sensor that is connected to the circuit assembly 126 which may include a temperature control circuit to regulate the power to the heater element so as to maintain the temperature of the extruder 132 within a desired range of a setpoint. As systems and methods for temperature regulation are known to those of skill in the art, the details are not provided herein. In certain embodiments, an indicator (not shown), for example an LED, may be provided to indicate that the extruder 132 has reached a temperature sufficient to melt the feed stock 20.

[0023] In certain embodiments, for example with a feed stock comprising a plastic, the temperature of the extruder 132 may be in the range of 20-500 °C. In certain embodiments, for example with a feed stock comprising a metal, the temperature of the extruder 132 may be in the range of 1000-2000 °C. In certain embodiments, for example with a feed stock comprising a metal such as lead, tin, or mixtures thereof, the temperature of the extruder 132 may be in the range of 100-400 °C. In certain embodiments, for example with a feed stock comprising a metal such as copper, gold, silver or mixtures thereof, the temperature of the extruder 132 may be in the range of 1000-1200 °C. In certain embodiments, for example with a feed stock comprising a metal such as platinum, the temperature of the extruder 132 may be in the range of 1600-2000 °C. In certain embodiments, the 3D drawing device 100 may include a variable temperature controller (not shown) that is connected to the circuit assembly 126 to allow a user to select a setpoint temperature for the extruder 132. In certain embodiments, the variable temperature controller may allow the use to select a type of material, for example "thermoplastic," and the circuit assembly 126 will adjust the setpoint temperature of the extruder 132. In certain embodiments, the variable temperature controller may include a dial.

[0024] A guide tube 134 is aligned with the first chamber 135 of the extruder 132 such that feed stock passing through the guide tube 134 enters the first chamber 135. In certain embodiments, the guide tube 134 may be formed of a low-friction material, such as polytetrafluoroethylene (PTFE), so allow the feed stock 20 to slide easily while also minimizing the gap between the guide tube 134 and feed stock 20. The extruder 132 and guide tube 134 are held in alignment by a mounting tube 138. In certain embodiments, the mounting tube 138 is formed of a metal having a relatively low thermal conductivity, compared to other metals. In certain embodiments, the mounting tube 138 may be a stainless steel. In certain embodiments, an insulating film (not visible in FIG. 3B), for example a polyimide tape, may be applied over the heating element and under the mounting tube 138.

[0025] In certain embodiments, an insulator 131 may be provided over the mounting tube 138 so as to reduce the amount of heat transferred from the extruder 132 to the upper and lower housings 112, 114. In certain embodiments, one or both of the upper and lower housings 112, 114 may have cooling ports 118 formed therethrough such that air can flow from the interior volume 116 to the ambient atmosphere. In certain embodiments, the passages formed in the top and bottom housings 112, 114 that lead to the cooling ports 118 may be angled such that the air that emerges from the cooling ports 118 is directed inward toward the tip 137. Thus, as the air exits the cooling ports 118, the air passes by the tip 137 of the extruder 132, cooling both the tip 137 and the feed stock 20 that just been extruded from the extrusion passage 133. Both of these cooling effects serve to reduce the temperature of the feed stock 20 as it exits the extrusion passage 133 such that the feed stock 20 may be essentially solid as it exits the extrusion passage 133. In certain embodiments, the freshly extruded feed stock 20 may be pliable and formable into various shapes. In certain embodiments, the surface of the freshly extruded feed stock 20 may be receptive to attachment, *e.g.* sticky, such that the extruded material will bond to other previously extruded feed stock 20.

[0026] In certain embodiments, there may be a gap between the insulator 131 and the mounting tube 138. In certain embodiments, this gap may provide a thermal break so as to further thermally isolate the upper and lower housings 112, 114 from the extruder 132.

[0027] As the feed stock 20 is driven toward the extrusion passage 133 by the feed mechanism 150 (not shown in FIG. 3B), the portion of the feed stock 20 that is within the extruder 132 will be heated by the extruder 132 such that the feed stock 20 within the first chamber 135 softens or melts. As the solid feed stock 20 is forced forward, the softened or molten feed stock 20 will be forced out through the extrusion passage 133 and emerge from the tip 137, where the cooling air that is flowing out of the cooling ports 118 flows over the freshly extruded feed stock 20, thereby cooling and solidifying the feed stock 20. In certain embodiments, a portion of the extruder 132 that extends outward beyond a front plane 102 may be cooled to a temperature below the temperature of the main portion of the extruder 132 by the air flowing out of the cooling ports 118. In certain embodiments, the temperature of the tip 137 may be below the melting point of the feed stock 20.

[0028] FIGS. 4A-4B are plan and perspective views of the feed mechanism 150 according to certain aspects of the present disclosure. FIG. 4A shows a series of gear pairs 153, 154, 155, 156, and 157 that are driven by the motor 152 through a spur gear (not visible in FIG. 4A) that is attached to the rotor of the motor 152. Each gear pair has a large gear and a small gear that are fixedly attached to each other and rotate about a common axis. The small gear of the motor 152 drives the large gear 153A, which causes the small gear 153B to drive the large gear 154A. In certain embodiments, the large gears 153A, 154A, 155A, 156A, and 157A each may have 40 teeth while the small gears 153B, 154B, 155B and 156B (not visible in FIG. 4A), and 157B may have 12 teeth, providing a 40:12 step-down ratio between each gear pair. In certain embodiments, the step-down from the motor 152 to the small gear 157B may be 5*(40:12) or approximately 17:1, *i.e.* seventeen complete rotations of the motor 152 causes only one complete rotation of the small gear 157B. In certain embodiments, the gear pairs 153, 154, 155, 156, and 157 may have a different number of teeth on the large and/or small gears. In certain embodiments, the gear pairs 153, 154, 155, 156, and 157 may not have the same number of teeth on each corresponding large or small gear.

[0029] In use, the use of a motor 152 to drive a step-down gear train 150 to control the advancement of the feed stock 20 provides an improved level of control over the rate of extrusion of the feed stock 20. For example, a conventional glue gun has a direct linkage between a trigger and the glue stick, such that pressure on the trigger on the trigger is directly transferred to the rod. The rate of advancement of the glue stick, and therefore the rate of extrusion, is dependent upon the viscosity of the melted glue and therefore caries over a die range. This often results in excessive glue being dispensed. In addition, since releasing the trigger does not retract the glue stick, there is frequently a "tail" of glue drawn out of the glue gun as the nozzle is moved away from the dispensing location. In contrast, the disclosed 3D drawing device 100 provides a constant rate of extrusion, for example 3 mm/sec, due to the controlled motion provided by the motor 152 and gear train 150. In addition, the circuit assembly 126 causes the motor 152 to briefly run in reverse when the button 122 is released, thereby retracting the feed stock 20 slightly and drawing the melted feed stock 20 that is within the extrusion passage 133 back into the extruder 132, thereby cleanly severing the extruded column 22 from the tip 137.

[0030] FIG. 4B shows how the teeth of the final small gear 157B engage the feed stock 20. In this embodiment, the feed stock 20 passes by a post 119 of the lower housing 114, then by the small gear 157B, and then into the guide tube 134. In certain embodiments, the gear 157B is positioned such that the teeth press against the feed stock 20, which is restrained from lateral motion away from the teeth of gear 157B by the post 119 and the guide tube 134, such that rotation of the gear 157B applies an axial force, *i.e.* directed along the length, to the feed stock 20. Rotation of the gear set 150 in a first direction will cause the feed stock 20 to move linearly forward, *i.e.* toward the tip 137. As this portion of feed stock 20 is not affected by the heating within the extruder 132, rotation of the gear set 150 in a reverse direction will cause the feed stock 20 to move linearly backward, *i.e.* away from the tip 137.

[0031] It can be seen from FIGS. 4A and 4B that rotation of the motor 152, which is controlled by pressing one of the buttons 122, 124, causes the feed stock 20 to move forward or backward. The step-down from the motor 152 to the small gear 157B provides a smooth rate of motion of the feed stock, as the motor 152 may turn at a speed within a normal range of smooth operation while the step-down converts this to a low rate of linear motion of the feed stock 20.

[0032] FIGS. 5A-5B are perspective and cutaway views of another embodiment 200 of a 3D drawing device according to certain aspects of the present disclosure. FIG. 5A shows a 3D drawing device 200 configured to accept a feed stock in the form of pellets 25 that are held in a hopper 250 attached to the body 210. A power cord 270 is attached to the body 210. FIG. 5B is a cut-away view showing a feed screw 260 that transfers the pellets 25 from the hopper 250 to the nozzle assembly 230 that melts the pellets 25 and, under pressure provided by the feed screw 260, extrudes the melted feed stock 25 in a manner similar to the nozzle assembly 130 of embodiment 100, previously discussed. Other features of the embodiment 100, such as the cooling ports 118, may also be provided in embodiment 200. In certain embodiments, the pellets may be transferred from the hopper 250 to the nozzle assembly 130 by other mechanisms, for example a reciprocating cylinder (not shown in FIGS. 5A-5B) as will be known to those of skill in the art. In certain embodiments, the feed stock may be provided as a liquid, for example an epoxy with beads of catalyst suspended in a liquid polymer, that is held in the hopper 250. In certain embodiments, passage of the liquid feed stock through an extrusion passage, similar to extrusion passage 133 of embodiment 100, may modify the liquid feed stock such that it hardens quickly after extrusion from the 3D drawing device 200.

[0033] The disclosed examples of a 3D drawing device illustrate the principles of its construction and use. The provision of a flow of cooling air at the tip to quickly solidify the extruded feed stock allows the user to work in three dimensions, rather than being forced to rely on a support surface to hold the still-fluid extruded material in place while it hardens. The use of a mechanical gear train to advance the feed stock, instead of a pressurized supply or a direct connection between a trigger and a feed rod, allows precise control of the rate of extrusion, thereby increasing the uniformity of the extruded column of material and allowing precise placement without excess material.

[0034] This application includes description that is provided to enable a person of ordinary skill in the art to practice the various aspects described herein. While the foregoing has described what are considered to be the best mode and/or other examples, it is understood that various modifications to these aspects will be readily apparent to those skilled in the art, and the generic principles defined herein may be applied to other aspects. It is understood that the specific order or hierarchy of steps or blocks in the processes disclosed is an illustration of exemplary approaches. Based upon design preferences, it is understood that the specific order or hierarchy of steps or blocks in the processes may be rearranged. The accompanying method claims present elements of the various steps in a sample order, and are not meant to be limited to the specific order or hierarchy presented. Thus, the claims are not intended to be limited to the aspects shown herein, but is to be accorded the full scope consistent with the language claims.

[0035] Headings and subheadings, if any, are used for convenience only and do not limit the invention.

[0036] Reference to an element in the singular is not intended to mean "one and only one" unless specifically so stated, but rather "one or more." Use of the articles "a" and "an" is to be interpreted as equivalent to the phrase "at least one." Unless specifically stated otherwise, the terms "a set" and "some" refer to one or more.

[0037] Terms such as "top," "bottom," "upper," "lower," "left," "right," "front," "rear" and the like as used in this disclosure should be understood as referring to an arbitrary frame of reference, rather than to the ordinary gravitational frame of reference. Thus, a top surface, a bottom surface, a front surface, and a rear surface may extend upwardly, downwardly, diagonally, or horizontally in a gravitational frame of reference.

[0038] Although the relationships among various components are described herein and/or are illustrated as being orthogonal or perpendicular, those components can be arranged in other configurations in some embodiments. For example, the angles formed between the referenced components can be greater or less than 90 degrees in some embodiments.

[0039] Although various components are illustrated as being flat and/or straight, those components can have other configurations, such as curved or tapered for example, in some embodiments.

[0040] Pronouns in the masculine (*e.g.*, his) include the feminine and neuter gender (*e.g.*, her and its) and vice versa. All structural and functional equivalents to the elements of the various aspects described throughout this disclosure that are known or later come to be known to those of ordinary skill in the art are expressly incorporated herein by reference and are intended to be encompassed by the claims. Moreover, nothing disclosed herein is intended to be dedicated to the public regardless of whether such disclosure is explicitly recited in the claims. No claim element is to be construed under the provisions of 35 U.S.C. §112, sixth paragraph, unless the element is expressly recited using the phrase "means for" or, in the case of a method claim, the element is recited using the phrase "operation for."

[0041] A phrase such as an "aspect" does not imply that such aspect is essential to the subject technology or that such aspect applies to all configurations of the subject technology. A disclosure relating to an aspect may apply to all configurations, or one or more configurations. A phrase such as an aspect may refer to one or more aspects and vice versa. A phrase such as an "embodiment" does not imply that such embodiment is essential to the subject technology or that such embodiment applies to all configurations of the subject technology. A disclosure relating to an embodiment may apply to all embodiments, or one or more embodiments. A phrase such as an embodiment may refer to one or more embodiments and vice versa.

[0042] The word "exemplary" is used herein to mean "serving as an example or illustration." Any aspect or design described herein as "exemplary" is not necessarily to be construed as preferred or advantageous over other aspects or designs.

[0043] All structural and functional equivalents to the elements of the various aspects described throughout this disclosure that are known or later come to be known to those of ordinary skill in the art are expressly incorporated herein by reference and are intended to be encompassed by the claims. Moreover, nothing disclosed herein is intended to be dedicated to the public regardless of whether such disclosure is explicitly recited in the claims. No claim element is to be construed under the provisions of 35 U.S.C. §112, sixth paragraph, unless the element is expressly recited using the phrase "means for" or, in the case of a method claim, the element is recited using the phrase "step for." Furthermore, to the extent that the term "include," "have," or the like is used in the description or the claims, such term is intended to be inclusive in a manner similar to the term "comprise" as "comprise" is interpreted when employed as a transitional word in a claim.

[0044] Although embodiments of the present disclosure have been described and illustrated in detail, it is to be clearly understood that the same is by way of illustration and example only and is not to be taken by way of limitation, the scope of the present invention being limited only by the terms of the appended claims.

CLAIMS

What is claimed is:

1. A three-dimensional (3D) drawing device comprising:

a housing configured to accept a feed stock;

a nozzle assembly at least partially disposed within the housing and having an exit nozzle;

a motor disposed within the housing; and

a gear train disposed within the housing and coupled between the motor and the feed stock and configured such that rotation of the motor causes the feed stock to be extruded out of the exit nozzle to form a three-dimensional object.

2. The 3D drawing device of claim 1, further comprising a heating element positioned adjacent to the exit nozzle and configured to melt the feed stock prior to extrusion through the exit nozzle.

3. The 3D drawing device of claim 1, further comprising a fan configured to provide a flow cooling air at exit nozzle.

4. The 3D drawing device of claim 3, wherein:

the housing comprises an internal volume and at least one cooling port proximate to the exit nozzle, the cooling port in fluid communication with the internal volume; and

the fan is disposed within the housing and configured to draw air into the internal volume.

5. The 3D drawing device of claim 4, wherein the at least one cooling port is configured to direct a flow of cooling air from the internal volume onto the extruded feed stock at the exit nozzle.

6. The 3D drawing device of claim 1, further comprising an actuator configured to selectably cause the motor to rotate in at least a first direction that causes the feed stock to be extruded out of the exit nozzle.

7. The 3D drawing device of claim 6, wherein the actuator is configured to selectably cause the motor to rotate in a second direction that is opposite the first direction.

8. The 3D drawing device of claim 7, wherein the actuator comprises at least one button.

9. The 3D drawing device of claim 8, wherein the actuator comprises:

a first button that causes the motor to rotate in the first direction at a first speed such that the feed stock is extruded out of the exit nozzle at a first rate; and

a second button that that causes the motor to rotate in the first direction at a second speed such that the feed stock is extruded out of the exit nozzle at a second rate that is greater than the first rate,

wherein simultaneous actuation of the first and second buttons causes the motor to rotate in the second direction.

10. The 3D drawing device of claim 1, wherein:

the feed stock is provided in the in the form of a strand; and

the gear train comprises a final gear having teeth that engage the strand of feed stock such that rotation of the final gear causes the strand of feed stock to linearly move.

11. A three-dimensional (3D) drawing device comprising:

a housing configured to accept a feed stock, the housing having an internal volume and at least one cooling port in fluid communication with the internal volume;

a nozzle assembly at least partially disposed within the housing proximate to the at least one cooling port and having an exit nozzle;

a fan disposed within the housing and configured to draw air into the internal volume and then force the air out of the at least one cooling port;

a motor disposed within the housing; and

an actuator coupled to the housing, wherein actuation of the actuator causes the feed stock to be extruded out of the exit nozzle to form a three-dimensional object.

12. The 3D drawing device of claim 11, further comprising a heating element positioned adjacent to the exit nozzle and configured to melt the feed stock prior to extrusion through the exit nozzle.

13. The 3D drawing device of claim 11, wherein the at least one cooling port is configured to direct a flow of cooling air from the internal volume onto the extruded feed stock at the exit nozzle.

14. The 3D drawing device of claim 11, further comprising:

a motor disposed within the housing and coupled to the actuator such that actuation of the actuator causes the motor to rotate in at least a first direction; and

a gear train disposed within the housing and coupled between the motor and the feed stock and configured such that rotation of the motor in the first direction causes the feed stock to be extruded out of the exit nozzle.

15. The 3D drawing device of claim 14, wherein the actuator is configured to selectably cause the motor to rotate in a second direction that is opposite the first direction.

16. The 3D drawing device of claim 15, wherein the actuator comprises at least one button.

17. The 3D drawing device of claim 16, wherein the actuator comprises:

a first button that causes the motor to rotate in the first direction at a first speed such that the feed stock is extruded out of the exit nozzle at a first rate; and

a second button that that causes the motor to rotate in the first direction at a second speed such that the feed stock is extruded out of the exit nozzle at a second rate that is greater than the first rate,

wherein simultaneous actuation of the first and second buttons causes the motor to rotate in the second direction.

18. The 3D drawing device of claim 14, wherein:

the feed stock is provided in the form of a strand; and

the gear train comprises a final gear having teeth that engage the strand of feed stock such that rotation of the final gear causes the strand of feed stock to linearly move.

19. The 3D drawing device of claim 1, wherein the housing is configured to be held in a user's hand.

20. The 3D drawing device of claim 11, wherein the housing is configured to be held in a user's hand.

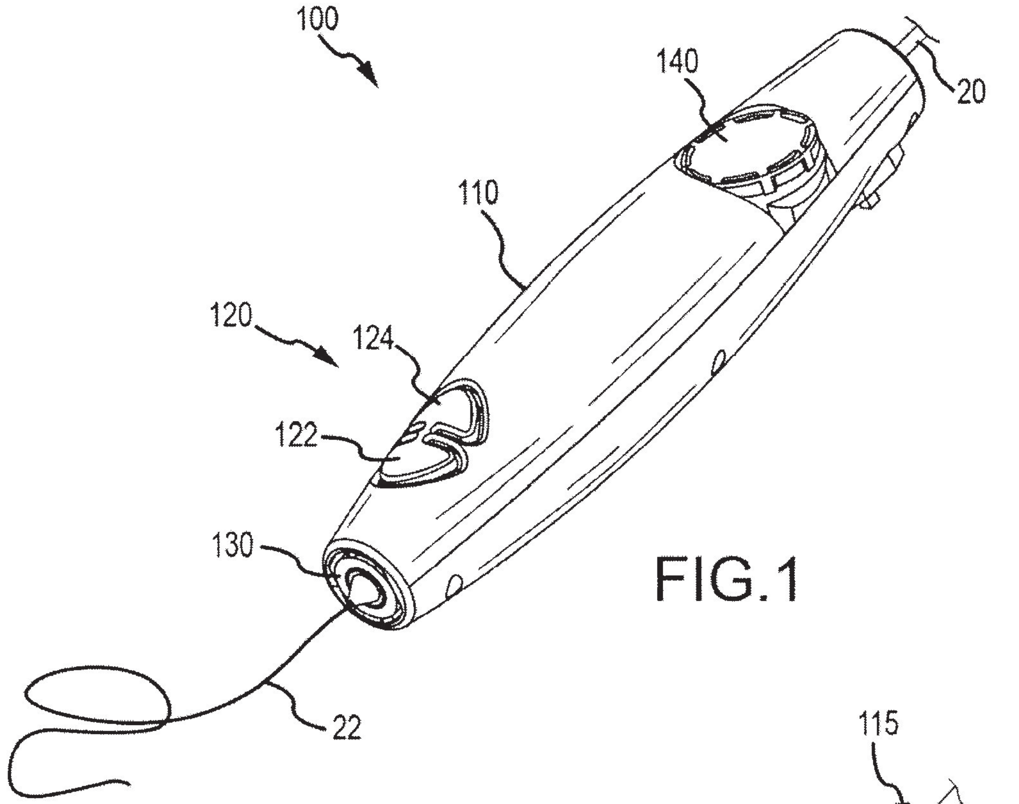


FIG.1

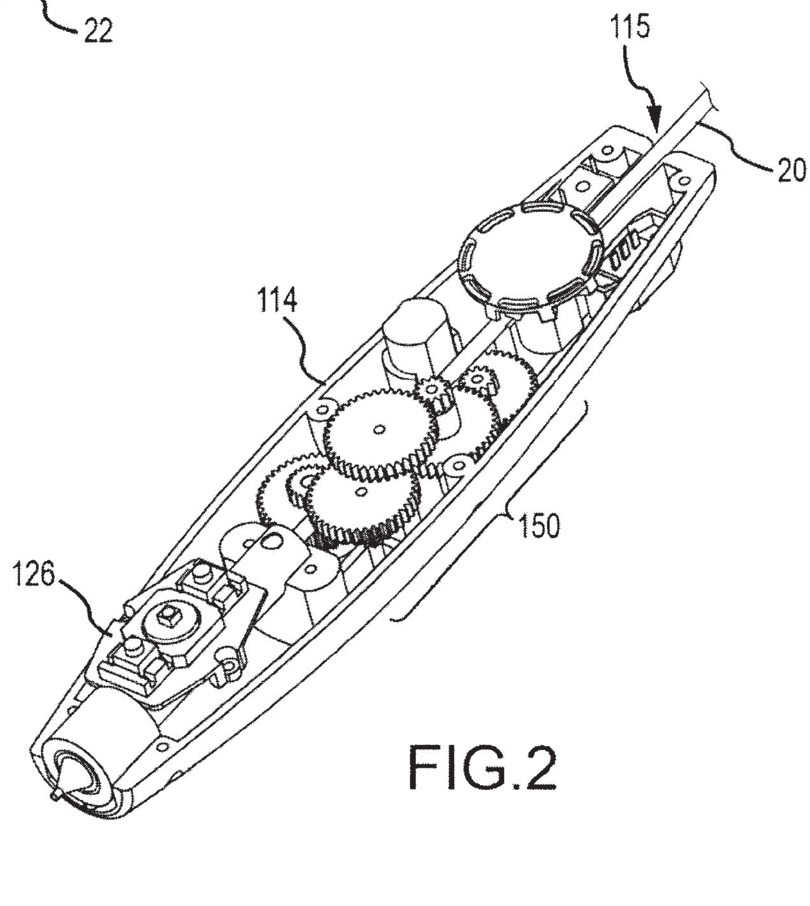
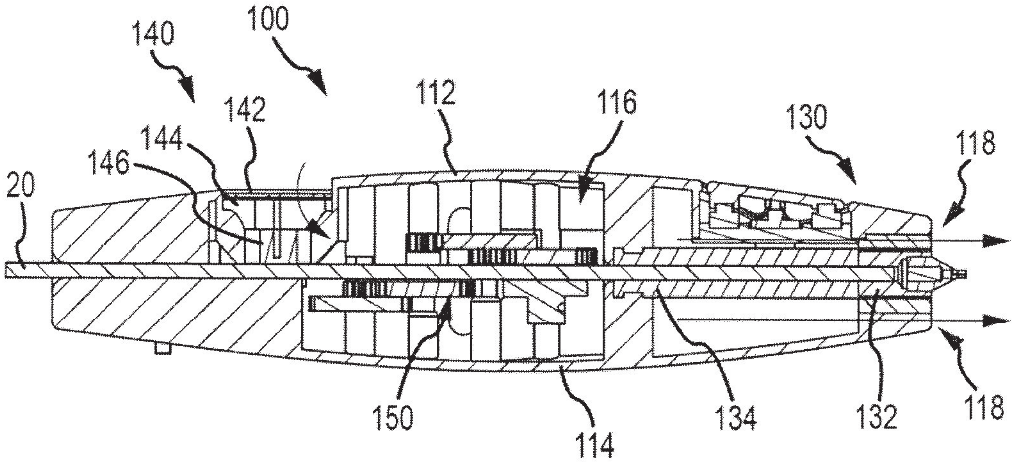


FIG.2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100
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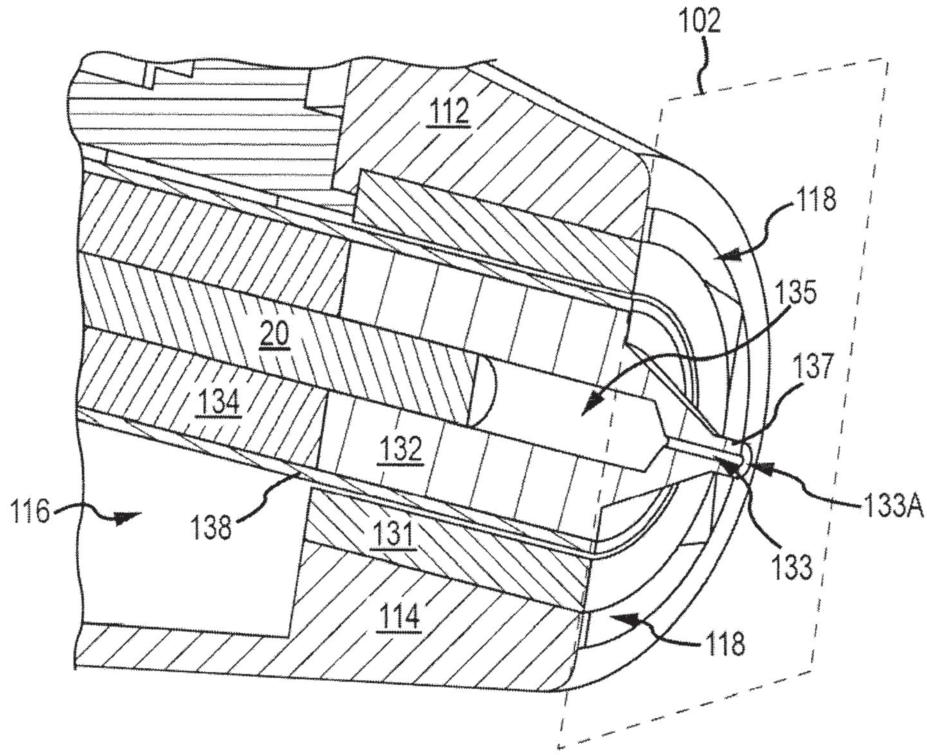
144
146
112
116
130
118
20
150
114
134
132
118

FIG.3A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112
118
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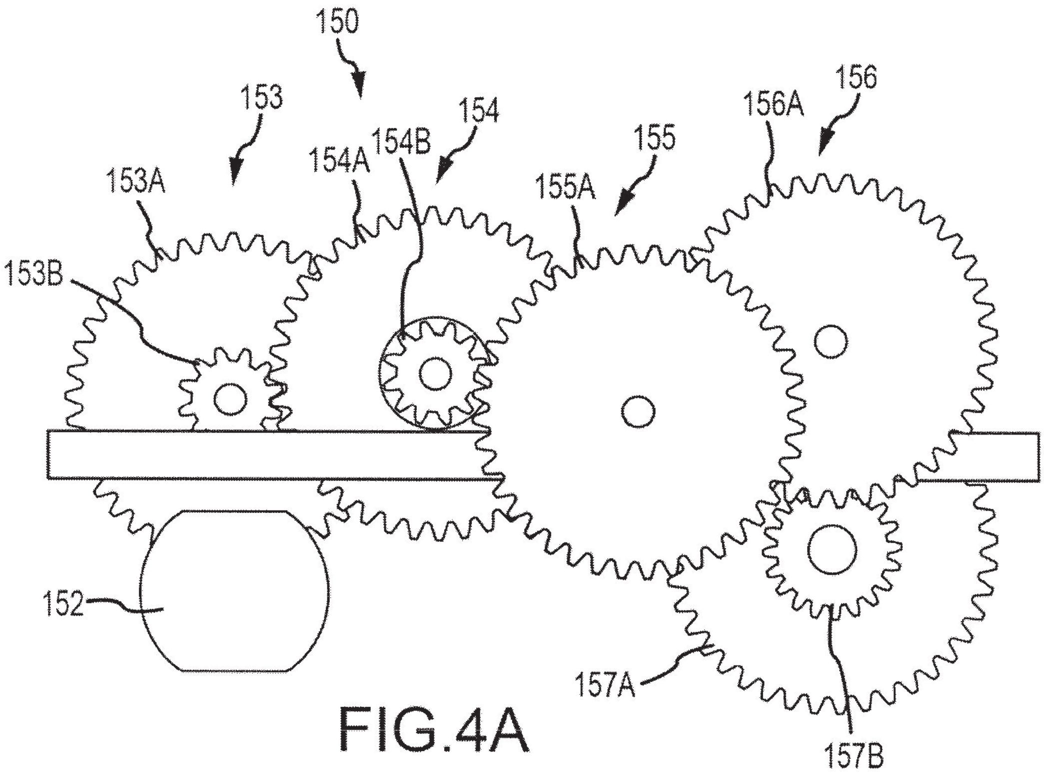
20
137
134
132
133A
116
138
131
133
114
118

FIG.3B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154B
154A
153A
155
155A
156A
156
153B
152
157A
157B

FIG.4A

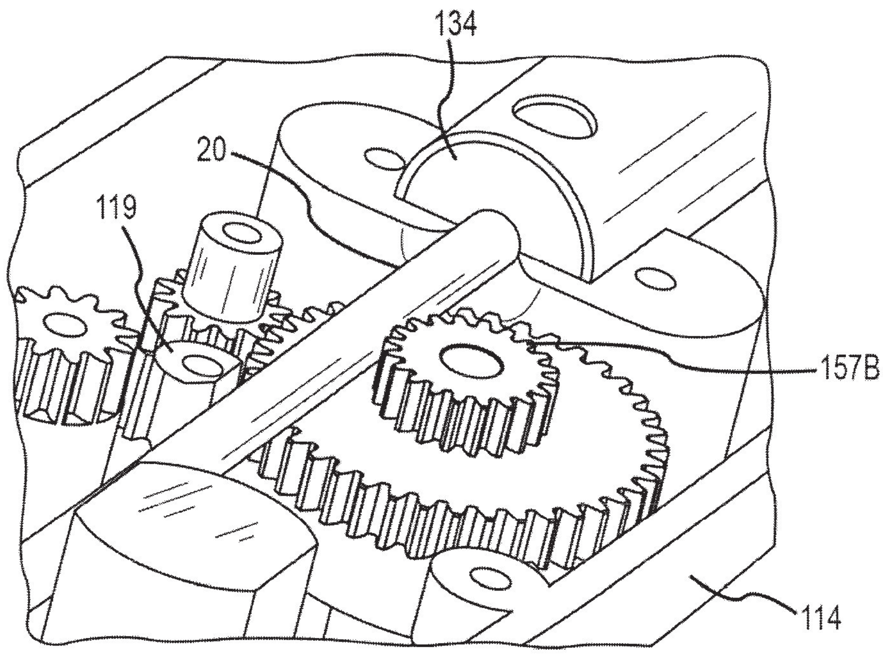
134
20
119
157B
114

FIG.4B

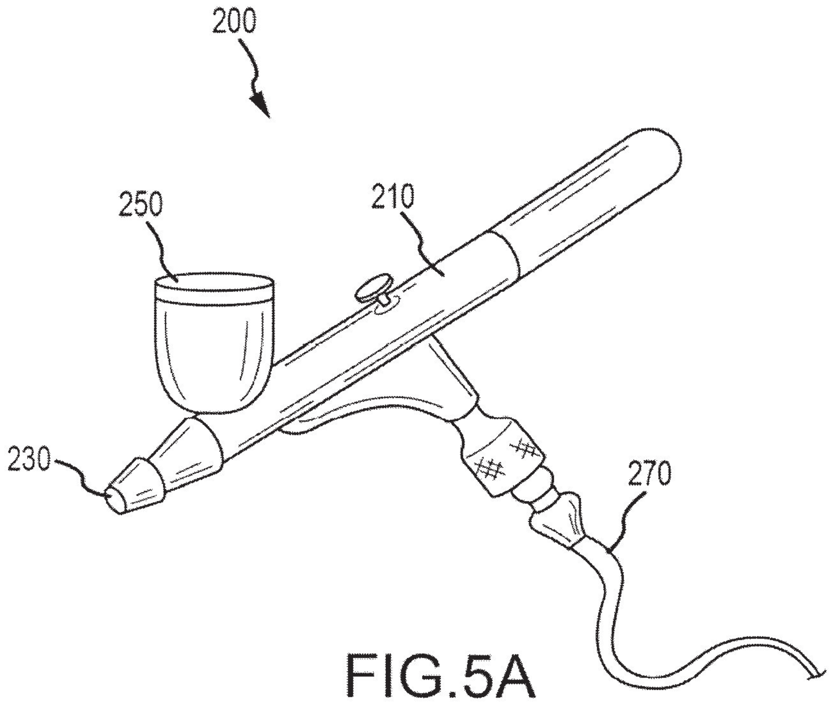

FIG.5A

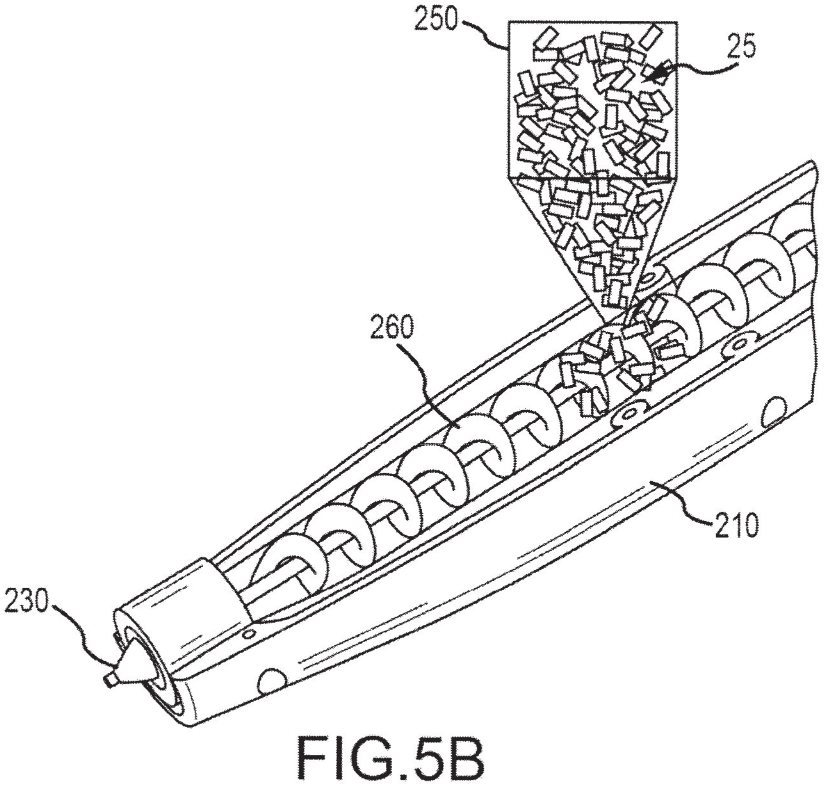

FIG.5B

HK 1185219 A

香港短期专利申请检索报告

SEARCH REPORT FOR HONGKONG SHORT-TERM PATENT APPLICATION

中华人民共和国国家知识产权局

STATE INTELLECTUAL PROPERTY OFFICE OF THE PEOPLE'S REPUBLIC OF CHINA

PSCC-QI-7.5-01-06-5

编号 HK1300384

香港短期专利申请

检 索 报 告

检索名称 Hand-held Three-Dimensional Drawing Device

委 托 方 北京罗杰律师事务所

委托日期 2013 年 11 月 8 日

中华人民共和国国家知识产权局

中华人民共和国国家知识产权局

检索依据的技术材料：见附件		
权利要求数目： 20	说明书页数： 15	附图页数： 4
审查员确定的 IPC 分类号： B41J 2/005(2006.01) I，B29C 67/00(2006.01) N		
审查员实际检索的 IPC 分类号： B41J，B29C，G01D，C23C		

检索使用的数据库：

检索用专利文献

☒ 国际专利文献数据库（INPADOC）

☒ 德温特世界专利索引数据 （DWPI）

☒ 中国专利文摘数据库（CNABS/CPRSABS)

☒ 世界专利文摘库（SIPOABS）

☐ 中国香港文摘数据库（HKABS）

☒ 中国台湾文摘库（TWABS）

☐ 化学物质登记数据库（REGISTRY）

☒ 专利全文数据库（CN/EP/US/WO/JP）

☐ 美国化学文摘（CA/CAPlus）

☐ 中国外观设计专利数据库

☐ 基因序列数据库（DGENE/USGENE/PCTGENE）

☐ 其它：________________

检索用非专利文献

☒ 中国知网系列数据库（CNKI）

☒ 万方数据知识服务平台

☐ 汤森路透 ISI Web of Knowledge 平台

☐ 国家图书馆非专利期刊

☐ 荷兰医学文摘库（EMBASE）

☒ 互联网

☐ 美国工程索引库（EI）

☐ 中国药物数据库

☐ 英国科学文摘库（INSPEC）

☐ 知识产权网（IP.COM）

检索使用的中文与外文关键词：

手持，便携，制图，绘图，画图，打印，印刷，喷嘴，喷口，电动机，电机，马达，齿轮，传动，加热，冷却，风扇，速率，方向，旋转，按钮，handheld, hand-held, portable, draw, drawing, print, printing, nozzle, muzzle, motor, gear, gearing, heating, cooling, fan, rate, direction, rotate, rotation, rotating, button

中华人民共和国国家知识产权局

相关专利文献					
类型	国别以及代码[11]给出的文献号	代码[43]或[45]给出的日期	IPC 分类号	相关的段落和/或图号	涉及的权利要求
X	US2012/0219699 A1	2012-08-30	C23C 16/52	说明书[0070]段，[0125]段至[0139]段，[0141]段	11-13，20
A	US2012/0219699 A1	2012-08-30	C23C 16/52	全文	1-10，14-19
A	CN101172428 A	2008-05-07	B41J 3/36	全文	1-20
A	CN202399493 U	2012-08-29	B29C 47/08	全文	1-20

相关非专利文献					
类型	书名、期刊或文摘名称（包括卷号或期刊号）	出版日期	作者姓名、出版者名称或文章标题	相关页数	涉及的权利要求

表格填写说明事项：

1. 关于说明书的页数，在有附图的情况下应当包括附图的页数，但不包括权利要求书和摘要的页数。
2. 审查员实际检索领域的 IPC 分类号应当填写到大组和／或小组所在的分类位置。
3. 对于期刊或其它定期出版物的名称，可以使用符合一般公认的国际惯例的缩写。
4. 相关文件的类型说明：

   X：一篇文件影响新颖性或创造性

   Y：与本报告中的另外的 Y 类文件组合而影响创造性

   A：背景技术文件

   E：在香港短期专利申请的申请日的当天或之后公布的在先申请或专利

   P：公布日先于香港短期专利申请的申请日但迟于所要求的优先权日的文件

中华人民共和国国家知识产权局

关于检索主题是否具有新颖性、创造性的简要说明：

本申请的检索和评述是基于要求 2012 年 12 月 5 日提交的美国临时专利申请 No. 61/733,689 的优先权的基础上进行的。

检索员通过检索，得到三篇相关文件：

对比文件 1：US2012/0219699 A1

对比文件 2：CN101172428 A

对比文件 3：CN202399493 U

对比文件 1 为最接近的现有技术。

对比文件 1 公开了一种手持的表面溅射装置，并具体公开了以下技术特征（见说明书[0070]段，[0125]段至[0139]段，[0141]段）：喷嘴，用于将溅射材料喷射在目标表面上；喷射控制机构，该喷射控制机构用于控制喷射方向、喷射速度、喷射散布、喷射散度、喷射形状和/或喷射材料比率，该喷射控制机构能例如由马达和/或阀调节；溅射材料供应部；该溅射装置能施加呈浮雕或三维物体形式的三维期望的溅射图案；溅射材料需要预加热以溶解，由此喷射和溅射材料供应需要被加热；用于溅射材料的固化单元使得能够通过在溅射材料施加之后立即固化溅射材料来将下一层材料快速施加到先前的一层材料上，虽然对比文件 1 没有明确公开容纳原料的壳体，但由于对比文件 1 是一种手持溅射装置，因此，其必然包括壳体以便手持。

对比文件 2 是现有技术。对比文件 2 公开了一种手持式打印装置，并具体公开了以下技术特征（见第 5 页第 8 行至第 9 行第 22 行）：壳体；打印机构，以移动的方式设置于该壳体中，并且经由打印透孔打印信息；驱动机构，设置于该壳体中，并且连接于该打印机构，用于驱动该打印机构移动，该驱动机构具有一马达和一传动皮带。

对比文件 3 是现有技术。对比文件 3 公开了一种新型的挤出机，并具体公开了以下技术特征（见说明书[0011]段至[0014]段）：挤出机包括亚克力支架(4)、步进电机(1)、驱动齿轮(3)、挤出头(2)，所述步进电机(1)固定在亚克力支架(4)上，所述驱动齿轮(3)连接装置在步进电机(1)一端，该驱动齿轮将 ABS 或 PLA 线材送到加热区，加热块融化 ABS 或 PLA 线材并在驱动齿轮的失去下，在前挤出头的小孔中挤出直径 0.1 至 0.3mm 的细丝。

上述对比文件都没有公开齿轮传动链，位于壳体内并且耦合在马达和原料之间，以便马达的旋转使原料从出口喷嘴喷出以形成三维物体，因此，权利要求 1 具有新颖性，符合中华人民共和国专利法第二十二条第二款的规定，相应地，直接或间接引用权利要求 1 的从属权利要求 2-10、19 也具有新颖性，符合中华人民共和国专利法第二十二条第二款的规定。

权利要求 1 所请求保护的技术方案与对比文件 1 所公开的技术方案相比，其区别技术特征在于：齿轮传动链，位于壳体内并且耦合在马达和原料之间，以便马达的旋转使原料从出口喷嘴喷出以形成三维物体，基于上述区别技术特征，权利要求 1 的技术方案实际要解决的技术问题是：通过大小齿轮的配合，控制原料的进给方向和挤出速率。对比文件 2 至 3 也没有给出将传动皮带或驱动齿轮与对比文件 1 的技术方案相结合以实现齿轮传动链，从而控制进给方向和挤出速率的技术启示，而且上述区别技术特征也不是本领域的公知常识，同时，权利要求 1 的技术方案不仅能实现手持，而且通过电机和齿

轮传动链的配合，能实现控制原料的进给方向和挤出速率的技术效果，因此，在对比文件 1 的基础上，结合对比文件 2 至 3 和公知常识的任何组合，均不能显而易见地得到权利要求 1 要求保护的技术方案，因此，权利要求 1 具有创造性，符合中华人民共和国专利法第二十二条第三款的规定，相应地，直接或间接引用权利要求 1 的从属权利要求 2-10、19 也具有创造性，符合中华人民共和国专利法第二十二条第三款的规定。

上述对比文件都没有公开风扇，位于壳体内并且用来使空气引入内部室并使空气进入冷却部，因此，权利要求 11 具有新颖性，符合中华人民共和国专利法第二十二条第二款的规定，相应地，直接或间接引用权利要求 11 的从属权利要求 12-18、20 也具有新颖性，符合中华人民共和国专利法第二十二条第二款的规定。

权利要求 11 所请求保护的技术方案与对比文件 1 所公开的技术方案相比，其区别技术特征在于：风扇，位于壳体内并且用来使空气引入内部室并使空气进入冷却部，基于上述区别技术特征，权利要求 11 的技术方案实际要解决的技术问题是：通过空气冷却原料，但对比文件 1 公开了固化单元，用于使通过在溅射材料施加之后立即固化溅射材料来将下一层材料快速施加到先前的一层材料上，而通过空气冷却原材料是非常公知的手段，将空气冷却原材料的手段应用于固化单元，从而对溅射材料进行固化存在着技术启示，因此，本领域的技术人员在对比文件 1 和公知常识的基础上得出该权利要求请求保护的技术方案是显而易见的，该权利要求所请求保护的技术方案不具备突出的实质性特点和显著的进步，因此该权利要求不具备创造性，不符合中华人民共和国专利法第二十二条第三款的规定。

权利要求 12 的附加技术特征已经在对比文件 1 中公开（见说明书[0070]段）：溅射材料需要预加热以溶解，由此喷射和溅射材料供应需要被加热，因此，权利要求 12 也不具备创造性，不符合中华人民共和国专利法第二十二条第三款的规定。

权利要求 13 的部分附加技术特征已经在对比文件 1 中公开（见说明书[0141]段）：用于溅射材料的固化单元使得能够通过在溅射材料施加之后立即固化溅射材料来将下一层材料快速施加到先前的一层材料上，而采用冷却空气来进行对原材料的固化是公知的技术手段，因此，权利要求 13 不具备创造性，不符合中华人民共和国专利法第二十二条第三款的规定。

权利要求 14 的附加技术特征：齿轮传动链，位于壳体内并且耦合在马达和原料之间，以便马达的旋转使原料从出口喷嘴喷出以形成三维物体在对比文件 1 至 3 中均没有公开，而且不是本领域的公知常识，因此，权利要求 14 具备创造性，符合中华人民共和国专利法第二十二条第三款的规定，相应地，直接或间接引用权利要求 14 的权利要求 15 至 18 也具备创造性，符合中华人民共和国专利法第二十二条第三款的规定。

权利要求 20 的附加技术特征已经在对比文件 1 中公开（见说明书[0125]段）：一种手持表面喷射设备，虽然对比文件 1 没有明确公开壳体，但由于对比文件 1 是一种手持溅射装置，因此，其必然包括壳体以便手持。因此，权利要求 20 不具备创造性，不符合中华人民共和国专利法第二十二条第三款的规定。

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检索结论：

权利要求 1-20 具有新颖性，符合中华人民共和国专利法第二十二条第二款的规定。

权利要求 1-10 和 14-19 具有创造性，符合中华人民共和国专利法第二十二条第三款的规定。

权利要求 11-13 和 20 不具有创造性，不符合中华人民共和国专利法第二十二条第三款的规定。

电学发明审查部计算机三 室	审查员签章：李琼	完成检索日期：2013 年 11 月 28 日

发文：

专利局 2013.12.13.00 发文