



(51) International Patent Classification:

A61B 5/15 (2006.01) A61B 5/155 (2006.01)
A61B 5/153 (2006.01) A61M 5/42 (2006.01)

(21) International Application Number:

PCT/US2019/060890

(22) International Filing Date:

12 November 2019 (12.11.2019)

(25) Filing Language:

English

(26) Publication Language:

English

(30) Priority Data:

62/760,465 13 November 2018 (13.11.2018) US

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(81) Designated States (unless otherwise indicated, for every
kind of national protection available): AE, AG, AL, AM,
AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY, BZ,
CA, CH, CL, CN, CO, CR, CU, CZ, DE, DJ, DK, DM, DO,
DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN,
HR, HU, ID, IL, IN, IR, IS, JO, JP, KE, KG, KH, KN, KP,

(54) Title: BLOOD COLLECTION SYSTEM AND AUTOMATIC BLOOD COLLECTION DEVICE

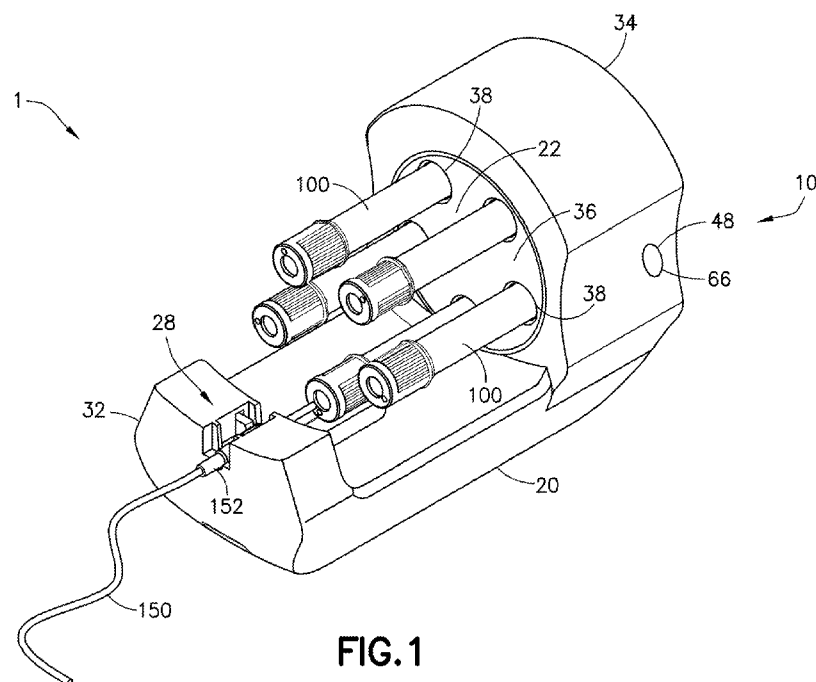


FIG. 1

(57) Abstract: A blood collection system including an automatic blood collection device and a blood collection constraint and detection device is disclosed. The automatic blood collection device provides a clamping subsystem, a translation subsystem, and a rotation subsystem that allows a device of the present disclosure to automatically collect a blood sample within a plurality of blood collection containers. The device of the present disclosure frees the hands of a nurse or medical practitioner after a patient's vein or artery is successfully pierced so that the nurse or medical practitioner can focus on taking care of a patient's needle side to manage blood collection.



KR, KW, KZ, LA, LC, LK, LR, LS, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SA, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, 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, LR, LS, MW, MZ, NA, RW, SD, SL, ST, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, KM, ML, MR, NE, SN, TD, TG).

Declarations under Rule 4.17:

- *as to applicant's entitlement to apply for and be granted a patent (Rule 4.17(ii))*
- *as to the applicant's entitlement to claim the priority of the earlier application (Rule 4.17(iii))*

Published:

- *with international search report (Art. 21(3))*
- *before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments (Rule 48.2(h))*

BLOOD COLLECTION SYSTEM AND AUTOMATIC BLOOD COLLECTION DEVICE

CROSS-REFERENCE TO RELATED APPLICATION

[0001] The present application claims priority to United States Provisional Application Serial No. 62/760,465, filed November 13, 2018, entitled “Blood Collection System and Automatic Blood Collection Device”, the disclosure of which is hereby incorporated by reference in its entirety.

BACKGROUND OF THE INVENTION

1. Field of the Disclosure

[0002] The present disclosure relates generally to blood collection systems. More particularly, the present disclosure relates to an automatic blood collection device and a blood collection constraint and detection device.

2. Description of the Related Art

[0003] Conventional blood collection sets require a nurse or medical practitioner to manually insert a draw tip into multiple blood tubes after a patient’s vein or artery is successfully pierced and the blood is ready to be collected. A nurse or medical practitioner needs one hand at the patient’s side to manage the blood collection and to take care of the needle to make sure it is in the right position and/or angle to ensure an optimal blood collection result. This makes it difficult to handle multiple blood tubes by only one hand which require a draw tip of the blood collection set to be forced through a rubber sealing of each individual blood tube to activate the vacuum of each blood tube to receive blood within the blood tube. This process can require a significant amount of time to collect a required blood sample within multiple blood tubes.

[0004] A nurse or medical practitioner may also need to manually fasten an elastic rubber bandage to a patient before inserting a needle into a patient’s vein or artery to begin a blood collection procedure. It can be difficult for a nurse or medical practitioner to identify a patient’s vein or artery before inserting the needle. During a blood collection procedure, it is difficult for a nurse or medical practitioner to efficiently and quickly perform these tasks simultaneously.

SUMMARY OF THE INVENTION

[0005] The present disclosure provides a blood collection system including an automatic blood collection device and a blood collection constraint and detection device. The automatic blood collection device provides a clamping subsystem, a translation subsystem, and a rotation subsystem that allows a device of the present disclosure to automatically collect a blood sample within a plurality of blood collection containers. The device of the present disclosure frees the hands of a nurse or medical practitioner after a patient's vein or artery is successfully pierced so that the nurse or medical practitioner can focus on taking care of a patient's needle side to manage blood collection.

[0006] In accordance with an embodiment of the present invention, an automatic blood collection device includes a housing having a first end, a second end, and a holder defining a receiving cavity; a clamping subsystem in communication with the receiving cavity, the clamping subsystem transitionable between a first position in which a collection container is receivable within the receiving cavity and a second position in which the clamping subsystem locks the collection container within the receiving cavity; a translation subsystem in communication with the holder, the translation subsystem transitionable between a first setting in which the translation subsystem moves the holder towards the first end and a second setting in which the translation subsystem moves the holder away from the first end; and a rotation subsystem in communication with the holder, the rotation subsystem transitionable between an off setting and an on setting in which the rotation subsystem rotates the holder relative to the housing.

[0007] In one configuration, the automatic blood collection device includes a second clamping subsystem in communication with a receiving portion, the second clamping subsystem transitionable between a first position in which a first portion of a blood collection set is receivable within the receiving portion and a second position in which the second clamping subsystem locks the first portion of the blood collection set within the receiving portion. In another configuration, the receiving portion is located at the first end. In yet another configuration, with the translation subsystem in the first setting, the translation subsystem moves the collection container, locked within the receiving cavity, towards the first end into engagement with the first portion of the blood collection set. In one configuration, with the collection container engaged with the first portion of the blood collection set, a blood sample is collected within the collection container. In another configuration, the automatic blood collection device includes a detection subsystem that monitors a level of the blood sample that is collected within the collection container. In yet another configuration, with the blood sample

collected within the collection container, and with the translation subsystem in the second setting, the translation subsystem moves the collection container away from the first end and disengages the collection container from the first portion of the blood collection set. In one configuration, the holder defines a second receiving cavity, and with the clamping subsystem in the first position, a second collection container is receivable within the second receiving cavity. In another configuration, with the clamping subsystem in the second position, the clamping subsystem locks the second collection container within the second receiving cavity. In yet another configuration, the clamping subsystem includes a lock portion and a cam portion, with the clamping subsystem in the first position, the cam portion is disengaged from the lock portion, and with the clamping subsystem in the second position, the cam portion engages the lock portion to contact and lock the collection container within the receiving cavity. In one configuration, the clamping subsystem includes a first motor that moves the cam portion into engagement with the lock portion. In another configuration, the automatic blood collection device includes a first switch, wherein actuation of the first switch activates the first motor thereby moving the cam portion into engagement with the lock portion. In yet another configuration, the translation subsystem includes a translation gear system and a translation component in communication with a portion of the holder, wherein with the translation subsystem in the first setting, the translation gear system rotates the translation component in a first direction to move the holder towards the first end, and with the translation subsystem in the second setting, the translation gear system rotates the translation component in a second direction to move the holder away from the first end. In one configuration, the translation subsystem includes a second motor in communication with the translation gear system. In another configuration, the automatic blood collection device includes a second switch, wherein actuation of the second switch activates the second motor thereby driving the translation gear system. In yet another configuration, the second direction is opposite the first direction. In one configuration, the rotation subsystem includes a rotation gear system having a clutch mechanism. In another configuration, the clutch mechanism includes a clutch tab on a portion of the rotation gear system and a clutch slot defined on a portion of the holder, wherein with the rotation subsystem in the off setting, the clutch tab is disengaged from the clutch slot, and with the rotation subsystem in the on setting, the clutch tab engages the clutch slot and the rotation gear system rotates the holder relative to the housing. In yet another configuration, the rotation subsystem includes a third motor in communication with the rotation gear system. In one configuration, the third motor is automatically activated to drive the rotation gear system.

[0008] In accordance with another embodiment of the present invention, a blood collection system includes an automatic blood collection device including a housing having a first end, a second end, and a holder defining a receiving cavity; a clamping subsystem in communication with the receiving cavity, the clamping subsystem transitionable between a first position in which a collection container is receivable within the receiving cavity and a second position in which the clamping subsystem locks the collection container within the receiving cavity; a translation subsystem in communication with the holder, the translation subsystem transitionable between a first setting in which the translation subsystem moves the holder towards the first end and a second setting in which the translation subsystem moves the holder away from the first end; and a rotation subsystem in communication with the holder, the rotation subsystem transitionable between an off setting and an on setting in which the rotation subsystem rotates the holder relative to the housing; and a blood collection constraint and detection device including a constraint subsystem having a housing defining an arm receiving cavity and a securement mechanism in communication with the arm receiving cavity, the securement mechanism transitionable between a first position in which an arm of a patient is receivable within the arm receiving cavity and a second position in which the securement mechanism secures the arm within the arm receiving cavity; and a detection subsystem in communication with the constraint subsystem, wherein with the arm within the arm receiving cavity and the securement mechanism in the second position, the detection subsystem identifies a blood circulation portion of the arm of the patient.

[0009] In one configuration, the securement mechanism automatically transitions from the first position to the second position when the arm is received within the arm receiving cavity. In another configuration, with the arm within the arm receiving cavity and the securement mechanism in the second position, the detection subsystem automatically identifies the blood circulation portion of the arm of the patient. In yet another configuration, with the securement mechanism in the second position, the securement mechanism secures the arm within the arm receiving cavity such that the blood circulation portion of the arm of the patient is exposed. In one configuration, the detection subsystem includes an infrared lighting mechanism. In another configuration, the blood circulation portion is a vein. In yet another configuration, the blood circulation portion is an artery.

BRIEF DESCRIPTION OF THE DRAWINGS

[0010] The above-mentioned and other features and advantages of this disclosure, and the manner of attaining them, will become more apparent and the disclosure itself will be better

understood by reference to the following descriptions of embodiments of the disclosure taken in conjunction with the accompanying drawings, wherein:

[0011] **FIG. 1** is a perspective view of an automatic blood collection device in accordance with an embodiment of the present invention.

[0012] **FIG. 2** is a partial exploded, perspective view of an automatic blood collection device in accordance with an embodiment of the present invention.

[0013] **FIG. 3** is a perspective view of an automatic blood collection device illustrating interior portions of the device in accordance with an embodiment of the present invention.

[0014] **FIG. 4** is a perspective view of a first clamping subsystem with a collection container received within a receiving cavity in accordance with an embodiment of the present invention.

[0015] **FIG. 5** is a cross-sectional view of a first clamping subsystem in accordance with an embodiment of the present invention.

[0016] **FIG. 6A** is a perspective view of a second clamping subsystem with a portion of a blood collection set received within a receiving portion in accordance with an embodiment of the present invention.

[0017] **FIG. 6B** is an elevation view of a second clamping subsystem with a portion of a blood collection set received within a receiving portion in accordance with an embodiment of the present invention.

[0018] **FIG. 7** is a perspective view of a translation subsystem and a rotation subsystem with collection containers received within receiving cavities in accordance with an embodiment of the present invention.

[0019] **FIG. 8** is a partial perspective view of a rotation subsystem with collection containers received within receiving cavities in accordance with an embodiment of the present invention.

[0020] **FIG. 9** is a partial perspective view of a rotation subsystem with collection containers received within receiving cavities in accordance with an embodiment of the present invention.

[0021] **FIG. 10** is a perspective view of a blood collection constraint and detection device in accordance with an embodiment of the present invention.

[0022] Corresponding reference characters indicate corresponding parts throughout the several views. The exemplifications set out herein illustrate exemplary embodiments of the disclosure, and such exemplifications are not to be construed as limiting the scope of the disclosure in any manner.

DETAILED DESCRIPTION

[0023] The following description is provided to enable those skilled in the art to make and use the described embodiments contemplated for carrying out the invention. Various modifications, equivalents, variations, and alternatives, however, will remain readily apparent to those skilled in the art. Any and all such modifications, variations, equivalents, and alternatives are intended to fall within the spirit and scope of the present invention.

[0024] For purposes of the description hereinafter, the terms “upper”, “lower”, “right”, “left”, “vertical”, “horizontal”, “top”, “bottom”, “lateral”, “longitudinal”, and derivatives thereof shall relate to the invention as it is oriented in the drawing figures. However, it is to be understood that the invention may assume various alternative variations, except where expressly specified to the contrary. It is also to be understood that the specific devices illustrated in the attached drawings, and described in the following specification, are simply exemplary embodiments of the invention. Hence, specific dimensions and other physical characteristics related to the embodiments disclosed herein are not to be considered as limiting.

[0025] The present disclosure is directed to a blood collection system including an automatic blood collection device and a blood collection constraint and detection device. The automatic blood collection device provides a clamping subsystem, a translation subsystem, and a rotation subsystem that allows a device of the present disclosure to automatically collect a blood sample within a plurality of blood collection containers. The device of the present disclosure frees the hands of a nurse or medical practitioner after a patient’s vein or artery is successfully pierced so that the nurse or medical practitioner can focus on taking care of a patient’s needle side to manage blood collection.

[0026] In an exemplary embodiment, a blood collection system 1 of the present disclosure includes an automatic blood collection device 10 (Figs. 1-9) and a blood collection constraint and detection device 200 (Fig. 10).

[0027] Figs. 1-9 illustrate an exemplary embodiment of the present disclosure. Referring to Figs. 1-9, an automatic blood collection device 10 includes a housing 20, a first clamping subsystem 22, a translation subsystem 24, a rotation subsystem 26, a second clamping subsystem 28, and a detection subsystem 30.

[0028] The automatic blood collection device 10 of the present disclosure provides a first clamping subsystem 22 that is adapted to secure and lock a plurality of collection containers 100 within the housing 20 of the automatic blood collection device 10 to automatically receive a blood sample; a second clamping subsystem 28 that is adapted to secure and lock a first portion 152 of a blood collection set 150 within a portion of the automatic blood collection

device 10 to automatically receive a blood sample; a translation subsystem 24 that is adapted to raise and lower the holder 36 and the collection containers 100 therein; a rotation subsystem 26 that is adapted to rotate the holder 36 relative to the housing 20; and a detection subsystem 30 that monitors a level of the blood sample that is collected within the collection container 100.

[0029] Referring to Fig. 1, in one embodiment, the housing 20 of the automatic blood collection device 10 includes a first end 32, a second end 34, and a holder 36 defining a receiving cavity 38. In an exemplary embodiment, the holder 36 defines a plurality of receiving cavities 38. For example, the holder 36 defines a first and second receiving cavity 38, and with the first clamping subsystem 22 in the first position, a second collection container 100 is receivable within the second receiving cavity 38. With the first clamping subsystem 22 in the second position, the first clamping subsystem 22 locks the second collection container 100 within the second receiving cavity 38. The holder 36 of the automatic blood collection device 10 can include any number of receiving cavities 38 for receiving any number of collection containers 100 for a particular automatic blood collection procedure.

[0030] The receiving cavities 38 of the holder 36 are sized and shaped to receive collection containers 100 that are adapted to receive and store a portion of a blood sample. In one exemplary embodiment, the collection containers are evacuated tubes containing a vacuum that draws a blood sample within a collection chamber or interior 108 of the collection container 100. For example, in one embodiment, the collection container 100 includes a first end 102, a second end 104, and a sidewall 106 extending therebetween and defining an interior 108. The collection container 100 contains the vacuum. The collection container 100 includes a closure 110 sealing the first end 102.

[0031] Referring to Figs. 1-5, in one embodiment, a first clamping subsystem 22 of the automatic blood collection device 10 is adapted to secure and lock a plurality of collection containers 100 within the housing 20 of the automatic blood collection device 10 to automatically receive a blood sample.

[0032] In an exemplary embodiment, the first clamping subsystem 22 is in communication with the receiving cavities 38. The first clamping subsystem 22 is transitionable between a first position in which a collection container 100 is receivable within a respective receiving cavity 38 and a second position in which the first clamping subsystem 22 secures and locks the collection container 100 within the receiving cavity 38.

[0033] Referring to Fig. 4, in one embodiment, the holder 36 includes five receiving cavities 38 for receiving five collection containers 100 therein, respectively. In such an embodiment,

the first clamping subsystem 22 is transitionable between a first position in which the five collection containers 100 are receivable within a respective receiving cavity 38 and a second position in which the first clamping subsystem 22 simultaneously secures and locks all five collection containers 100 within the respective receiving cavity 38. In some embodiments, the holder 36 may define more than five receiving cavities 38 for receiving more than five collection containers 100 therein, respectively. In other embodiments, the holder 36 may define less than five receiving cavities 38 for receiving less than five collection containers 100 therein, respectively.

[0034] Referring to Figs. 4 and 5, in an exemplary embodiment, the first clamping subsystem 22 includes a lock portion 40 and a cam portion 42. In one embodiment, the first clamping subsystem 22 includes five lock portions 40 in communication with the cam portion 42. Each lock portion 40 is able to secure and lock a collection container 100 within a respective receiving cavity 38. Referring to Fig. 4, the cam portion 42 includes ramp portions 44. In one embodiment, the cam portion 42 includes five ramp portions 44. In such an embodiment, each of the ramp portions 44 of the cam portion 42 are able to simultaneously engage a respective lock portion 40.

[0035] In an exemplary embodiment, with the first clamping subsystem 22 in the first position, the cam portion 42 is disengaged from the lock portion 40, e.g., the ramp portions 44 of the cam portion 42 are disengaged from the respective lock portions 40.

[0036] In an exemplary embodiment, with the first clamping subsystem 22 in the second position, the cam portion 42 engages the lock portion 40 to contact and lock the collection container 100 within the receiving cavity 38, e.g., each of the ramp portions 44 of the cam portion 42 simultaneously engage a respective lock portion 40. In this manner, the ramp portions 44 of the cam portion 42 contact and force the lock portions 40, respectively, in a direction generally along arrow A (Fig. 4) to contact and lock each collection container 100 within a respective receiving cavity 38.

[0037] Referring to Fig. 5, the first clamping subsystem 22 includes a first motor 46 that moves the cam portion 42 into engagement with the lock portion 40. The first motor 46 is in communication with the cam portion 42. In an exemplary embodiment, actuation of the first motor 46 rotates the cam portion 42 between the first position and the second position. In one embodiment, the automatic blood collection device 10 includes a first switch 48 and actuation of the first switch 48 activates the first motor 46 thereby moving the cam portion 42 into engagement with the lock portion 40 as described above. In other embodiments, the automatic blood collection device 10 could be programmed to automatically activate the first motor 46

upon a desired event thereby moving the cam portion 42 into engagement with the lock portion 40 as described above.

[0038] In other exemplary embodiments, the first clamping subsystem 22 may include other clamping mechanisms that are transitionable between a first position in which a collection container 100 is receivable within a receiving cavity 38 of the holder 36 and a second position in which the first clamping subsystem 22 locks the collection container 100 within the receiving cavity 38 of the holder 36.

[0039] Referring to Figs. 1-3 and 6A-7, in one embodiment, a second clamping subsystem 28 of the automatic blood collection device 10 is adapted to secure and lock a first portion 152 of a blood collection set 150 within a portion of the automatic blood collection device 10 to automatically receive a blood sample.

[0040] Referring to Figs. 1-3 and 6A-7, in an exemplary embodiment, the housing 20 defines a receiving portion 50. In one embodiment, the receiving portion 50 is located at the first end 32. The second clamping subsystem 28 is in communication with the receiving portion 50. In an exemplary embodiment, the second clamping subsystem 28 is transitionable between a first position in which a first portion 152 of a blood collection set 150 is receivable within the receiving portion 50 and a second position in which the second clamping subsystem 28 locks the first portion 152 of the blood collection set 150 within the receiving portion 50.

[0041] Referring to Figs. 6A and 6B, in one exemplary embodiment, the second clamping subsystem 28 includes a second switch 52, a first clamp link 54, a second clamp link 56, and a pin joint 58. The first clamp link 54 and the second clamp link 56 are movable, pivotable, or slidable relative to the pin joint 58.

[0042] In an exemplary embodiment, positioning the first portion 152, e.g., a draw tip, of a blood collection set 150 within the receiving portion 50 of the housing 20 automatically activates the second clamping subsystem 28 to move from the first position to the second position. In another exemplary embodiment, activation of the second switch 52 causes movement of the first clamp link 54 and the second clamp link 56 from the first position of the second clamping subsystem 28 to the second position of the second clamping subsystem 28.

[0043] In such an embodiment, with the second clamping subsystem 28 in a first position, the first portion 152, e.g., a draw tip, of a blood collection set 150 is positioned within the receiving portion 50 of the housing 20. Next, the second switch 52 can be activated to cause movement of the first clamp link 54 and the second clamp link 56 from the first position of the second clamping subsystem 28 to the second position of the second clamping subsystem 28 to

secure and lock the first portion 152 of the blood collection set 150 within the receiving portion 50 of the housing 20 for an automatic blood collection procedure.

[0044] In one embodiment, the second clamping subsystem 28 provides audible feedback that the second clamping subsystem 28 has transitioned to the locked second position. In this manner, a medical practitioner is provided with feedback that the first portion 152 of the blood collection set 150 is securely clamped to the automatic blood collection device 10.

[0045] After the automatic blood collection procedure, the second switch 52 can be activated again to move the first clamp link 54 and the second clamp link 56 from the second position of the second clamping subsystem 28 to the first position of the second clamping subsystem 28 so that the first portion 152 of the blood collection set 150 can be removed from the receiving portion 50 of the housing 20.

[0046] In another embodiment, with the second clamping subsystem 28 in a first position, positioning the first portion 152, e.g., a draw tip, of a blood collection set 150 within the receiving portion 50 of the housing 20 automatically activates the second clamping subsystem 28 to move from the first position to the second position. For example, in such an embodiment, the receiving portion 50 of the housing 20 may include a sensor to detect when the first portion 152, e.g., a draw tip, of a blood collection set 150 is received within the receiving portion 50 of the housing 20.

[0047] In other exemplary embodiments, the second clamping subsystem 28 may include other clamping mechanisms that are transitionable between a first position in which a first portion 152 of a blood collection set 150 is receivable within the receiving portion 50 and a second position in which the second clamping subsystem 28 locks the first portion 152 of the blood collection set 150 within the receiving portion 50.

[0048] Referring to Figs. 1 and 7, in one embodiment, a translation subsystem 24 of the automatic blood collection device 10 is adapted to raise and lower the holder 36 and the collection containers 100 therein.

[0049] Referring to Figs. 1 and 7, in an exemplary embodiment, the translation subsystem 24 is in communication with the holder 36 and the translation subsystem 24 is transitionable between a first setting in which the translation subsystem 24 moves the holder 36 towards the first end 32 of the housing 20 and a second setting in which the translation subsystem 24 moves the holder 36 away from the first end 32 of the housing 20.

[0050] Referring to Fig. 7, for example, with the translation subsystem 24 in the first setting and a collection container 100 received and secured within a receiving cavity 38 of the holder 36 by the first clamping subsystem 22, and with a first portion 152 of a blood collection set

150 secured within a receiving portion 50 by the second clamping subsystem 28, the translation subsystem 24 moves the holder 36 and the collection container 100, locked within the receiving cavity 38, towards the first end 32 of the housing 20 into engagement with the first portion 152 of the blood collection set 150. The translation subsystem 24 moves the holder 36 and the collection container 100 therein towards the first end 32 of the housing 20 until the closure 110 of the first end 102 of a first collection container 100 is successfully pierced by the first portion 152 of the blood collection set 150. Upon the first portion 152 of the blood collection set 150 piercing the closure 110 of the collection container 100, blood collection is automatically performed due to the vacuum contained within the collection container 100 that draws a blood sample within a collection chamber or interior 108 of the collection container 100. Once the first portion 152 of the blood collection set 150 pierces the closure 110 of the collection container 100, the blood collection set 150 and the collection container 100 are in fluid communication and the vacuum draws a blood sample within the interior 108 of the collection container 100.

[0051] In an exemplary embodiment, with the collection container 100 engaged with the first portion 152 of the blood collection set 150, a blood sample is automatically collected within the collection container 100. In an exemplary embodiment, with the blood sample collected within the collection container 100, and with the translation subsystem 24 in the second setting, the translation subsystem 24 moves the collection container 100 away from the first end 32 of the housing 20 and disengages the collection container 100 from the first portion 152 of the blood collection set 150. In one embodiment, the translation subsystem 24 is manually transitionable from the first setting to the second setting. In other embodiments, the translation subsystem 24 is automatically transitionable from the first setting to the second setting.

[0052] For example, in one exemplary embodiment, the automatic blood collection device 10 includes a detection subsystem 30 that monitors a level of the blood sample that is collected within the collection container 100. Once the detection subsystem 30 detects that a sufficient amount of a blood sample has been collected within the collection container 100, the detection subsystem 30 automatically activates the translation subsystem 24 to the second setting so that the translation subsystem 24 moves the holder 36 and the collection container 100 therein away from the first end 32 of the housing 20 and away from the first portion 152 of the blood collection set 150. In this manner, the translation subsystem 24 moves the collection container 100 out of engagement with the blood collection set 150 thereby automatically stopping blood collection. The translation subsystem 24 moves the holder 36 to its original home position with a collected blood sample within the collection container 100. In one embodiment, the

detection subsystem 30 includes an infrared sensor for monitoring a level of the blood sample that is collected within the collection container 100. In other embodiments, the detection subsystem 30 may include other mechanisms for monitoring a level of the blood sample that is collected within the collection container 100.

[0053] Referring to Figs. 1 and 7, in one exemplary embodiment, the translation subsystem 24 includes a translation gear system 60, a translation component 62 in communication with a portion of the holder 36, and a second motor 64 in communication with the translation gear system 60. In an exemplary embodiment, the translation component 62 includes a screw-nut mechanism.

[0054] In an exemplary embodiment, with the translation subsystem 24 in the first setting, the translation gear system 60 rotates the translation component 62 in a first direction to move the holder 36 towards the first end 32 of the housing 20 and with the translation subsystem 24 in the second setting, the translation gear system 60 rotates the translation component 62 in a second direction to move the holder 36 away from the first end 32 of the housing 20.

[0055] In one embodiment, the translation subsystem 24 includes a second motor 64 that moves the translation gear system 60 between the first direction and the second direction. In one embodiment, the second direction is opposite the first direction.

[0056] In an exemplary embodiment, the automatic blood collection device 10 includes a second switch 66 and actuation of the second switch 66 activates the second motor 64 thereby moving the translation gear system 60 between the first direction and the second direction. In one embodiment, the second switch 66 is the same switch as the first switch 48. In one embodiment, the second switch 66 is a separate switch from the first switch 48.

[0057] In other exemplary embodiments, the translation subsystem 24 may include other mechanisms for raising and lowering the holder 36 and the collection containers 100 therein.

[0058] Referring to Figs. 7-9, in one embodiment, a rotation subsystem 26 of the automatic blood collection device 10 is adapted to rotate the holder 36 relative to the housing 20.

[0059] Referring to Figs. 7-9, in an exemplary embodiment, the rotation subsystem 26 is in communication with the holder 36 and the rotation subsystem 26 is transitionable between an off setting and an on setting in which the rotation subsystem 26 rotates the holder 36 relative to the housing 20.

[0060] Referring to Figs. 7-9, in one exemplary embodiment, the rotation subsystem 26 includes a rotation gear system 70 having a clutch mechanism 72 and a third motor 78 in communication with the rotation gear system 70.

[0061] In one embodiment, the clutch mechanism 72 includes a clutch tab 74 on a portion of the rotation gear system 70 and a clutch slot 76 defined on a portion of the holder 36. In this manner, with the rotation subsystem 26 in the off setting, the clutch tab 74 is disengaged from the clutch slot 76, and with the rotation subsystem 26 in the on setting, the clutch tab 74 engages the clutch slot 76 and the rotation gear system 70 rotates the holder 36 relative to the housing 20.

[0062] In one embodiment, the rotation subsystem 26 is manually transitionable between the off setting and the on setting. In other embodiments, the rotation subsystem 26 is automatically transitionable between the off setting and the on setting. In one embodiment, the third motor 78 is automatically activated to drive the rotation gear system 70. For example, after the translation subsystem 24 moves the collection container 100 out of engagement with the blood collection set 150 and moves the holder 36 to its original home position with a collected blood sample within the collection container 100, the clutch tab 74 of the rotation subsystem 26 will engage the clutch slot 76 to activate the clutch connection. Activation of the clutch connection will automatically activate the third motor 78 to rotate the rotation gear system 70 in one direction until the next available empty collection container 100 is located in a tube piercing position and is ready for blood collection. The third motor 78 of the rotation subsystem 26 of the present disclosure rotates the rotation gear system 70 a predetermined amount in one direction so that the next available empty collection container 100 is rotated into a tube piercing position and in alignment with the first portion 152 of the blood collection set 150 that is securely positioned within the second clamping subsystem 28. In this manner, the next empty collection container 100 is in a tube piercing position and is ready to automatically receive a blood sample in the manner described above.

[0063] In other exemplary embodiments, the rotation subsystem 26 may include other mechanisms for rotating the holder 36 relative to the housing 20.

[0064] In one exemplary embodiment, the automatic blood collection device 10 of the present disclosure is powered by a chargeable battery. In this manner, the automatic blood collection device 10 is a wireless device that is portable and is easily carried by a patient in both in-patient and out-patient environments.

[0065] Referring to Figs. 1-9, the use of an automatic blood collection device 10 having a first and second clamping subsystem 22, 28, a translation subsystem 24, and a rotation subsystem 26 that allows a device 10 of the present disclosure to automatically collect a blood sample within a plurality of blood collection containers 100 will now be described. The device 10 of the present disclosure frees the hands of a nurse or medical practitioner after a patient's

vein or artery is successfully pierced so that the nurse or medical practitioner can focus on taking care of a patient's needle side to manage blood collection.

[0066] Referring to Figs. 1-5, first a medical practitioner inserts a desired number of sterilized empty collection containers 100 within respective receiving cavities 38 of the holder 36, with the first clamping subsystem 22 in the first position. Advantageously, the automatic blood collection device 10 of the present disclosure allows for a plurality of collection containers 100 to be used in an automatic blood collection procedure.

[0067] Next, with the collection containers 100 properly positioned within respective receiving cavities 38 of the holder 36, the medical practitioner can press the first switch 48 to activate the first motor 46 thereby moving the cam portion 42 into engagement with the lock portion 40 of the first clamping subsystem 22. In this manner, the ramp portions 44 of the cam portion 42 contact and force the lock portions 40, respectively, in a direction generally along arrow A (Fig. 4) to contact and lock each collection container 100 within a respective receiving cavity 38.

[0068] Next, a medical practitioner prepares a blood collection set 150 having a first portion 152, e.g., a draw tip end, and a patient end needle. Referring to Figs. 6A and 6B, in one exemplary embodiment, with the second clamping subsystem 28 in a first position, positioning the first portion 152, e.g., a draw tip, of a blood collection set 150 within the receiving portion 50 of the housing 20 automatically activates the second clamping subsystem 28 to move from the first position to the second position in which the second clamping subsystem 28 locks the first portion 152 of the blood collection set 150 within the receiving portion 50. In one embodiment, the second clamping subsystem 28 provides audible feedback that the second clamping subsystem 28 has transitioned to the locked second position. In this manner, a medical practitioner is provided with feedback that the first portion 152 of the blood collection set 150 is securely clamped to the automatic blood collection device 10. With the first portion 152 of the blood collection set 150 secured to the automatic blood collection device 10, the medical practitioner uses the patient end needle of the blood collection set 150 to pierce into the patient's vein for a blood collection procedure.

[0069] After the medical practitioner completes the preparation for the blood collection procedure on the patient side, the medical practitioner can press the second switch 66 which activates the second motor 64 thereby moving the translation gear system 60 in the first setting in a first direction in which the translation subsystem 24 moves the holder 36 towards the first end 32 of the housing 20. In this manner, the translation subsystem 24 moves the holder 36 and the collection container 100, locked within the receiving cavity 38, towards the first end

32 of the housing 20 into engagement with the first portion 152 of the blood collection set 150. The translation subsystem 24 moves the holder 36 and the collection container 100 therein towards the first end 32 of the housing 20 until the closure 110 of the first end 102 of a first collection container 100 is successfully pierced by the first portion 152 of the blood collection set 150. Upon the first portion 152 of the blood collection set 150 piercing the closure 110 of the collection container 100, blood collection is automatically performed due to the vacuum contained within the collection container 100 that draws a blood sample within a collection chamber or interior 108 of the collection container 100. Once the first portion 152 of the blood collection set 150 pierces the closure 110 of the collection container 100, the blood collection set 150 and the collection container 100 are in fluid communication and the vacuum draws a blood sample within the interior 108 of the collection container 100. Advantageously, the automatic blood collection device 10 of the present disclosure allows the medical practitioner to automatically collect a blood sample within the collection container 100 and frees the hands of the medical practitioner so that the medical practitioner can focus on taking care of a patient's needle side during blood collection.

[0070] As described above, the automatic blood collection device 10 includes a detection subsystem 30 that monitors a level of the blood sample that is collected within the collection container 100. Once the detection subsystem 30 detects that a sufficient amount of a blood sample has been collected within the collection container 100, the detection subsystem 30 automatically activates the translation subsystem 24 to the second setting so that the translation subsystem 24 moves the holder 36 and the collection container 100 therein away from the first end 32 of the housing 20 and away from the first portion 152 of the blood collection set 150. In this manner, the translation subsystem 24 moves the collection container 100 out of engagement with the blood collection set 150 thereby automatically stopping blood collection. The translation subsystem 24 moves the holder 36 to its original home position with a collected blood sample within the collection container 100.

[0071] Next, in some embodiments, the automatic blood collection device 10 provides automatic activation of the rotation subsystem 26. For example, in one exemplary embodiment, the third motor 78 is automatically activated to drive the rotation gear system 70. For example, after the translation subsystem 24 moves the collection container 100 out of engagement with the blood collection set 150 and moves the holder 36 to its original home position with a collected blood sample within the collection container 100, the clutch tab 74 of the rotation subsystem 26 will engage the clutch slot 76 to activate the clutch connection. Activation of the clutch connection will automatically activate the third motor 78 to rotate the

rotation gear system 70 in one direction until the next available empty collection container 100 is located in a tube piercing position and is ready for blood collection. In this manner, the automatic blood collection device 10 of the present disclosure automatically rotates a collection container 100 that includes an appropriate amount of a blood sample out of a tube piercing position and rotates a new empty collection container 100 into the tube piercing position for automatic blood collection.

[0072] Next, the automatic blood collection device 10 is used as described above to repeat the collection steps for the next collection container 100. The automatic blood collection device 10 can be used in this manner until all the desired collection containers 100 include an appropriate amount of a blood sample. After each of the collection containers 100 are filled with a blood sample, the automatic blood collection device 10 of the present disclosure automatically terminates all rotary and translational motors. The collection containers 100 are maintained in a locked position by the first clamping subsystem 22 while the medical practitioner removes the first portion 152 of the blood collection set 150 from the second clamping subsystem 28. At an appropriate time, the medical practitioner can then transition the first clamping subsystem 22 from the second position to the first position to safely remove the collection containers 100 from the automatic blood collection device 10.

[0073] Fig. 10 illustrates an exemplary embodiment of the present disclosure. Referring to Fig. 10, a blood collection constraint and detection device 200 of the present disclosure includes a constraint subsystem 202 and a detection subsystem 204. The blood collection constraint and detection device 200 of the present disclosure can be used with the automatic blood collection device 10 (Figs. 1-9). For example, the blood collection constraint and detection device 200 provides help to a medical practitioner at a patient's side while the automatic blood collection device 10 helps with automatically collecting a blood sample.

[0074] In one exemplary embodiment, the constraint subsystem 202 includes a housing 210 defining an arm receiving cavity 212 and a securement mechanism 214 in communication with the arm receiving cavity 212. The securement mechanism 214 is transitionable between a first position in which an arm of a patient is receivable within the arm receiving cavity 212 and a second position in which the securement mechanism 214 secures the arm within the arm receiving cavity 212. In one embodiment, the securement mechanism 214 automatically transitions from the first position to the second position when the arm is received within the arm receiving cavity 212. With the securement mechanism 214 in the second position, the securement mechanism 214 secures the arm within the arm receiving cavity 212 such that the blood circulation portion of the arm of the patient is exposed. The constraint subsystem 202

of the present disclosure provides a device for a medical practitioner to automatically secure a patient's arm during a blood collection procedure. In this manner, the constraint subsystem 202 of the present disclosure frees the medical practitioner from the time and efforts of manually fastening an elastic rubber bandage to a patient. This is especially critical when a large number of patients are treated within a short period of time and the device of the present disclosure allows the medical practitioner to be more efficient and focus on more critical aspects during a blood collection procedure.

[0075] In one exemplary embodiment, the detection subsystem 204 is in communication with the constraint subsystem 202. For example, with the arm within the arm receiving cavity 212 and the securement mechanism 214 in the second position, the detection subsystem 204 identifies a blood circulation portion of the arm of the patient. In one embodiment, with the arm within the arm receiving cavity 212 and the securement mechanism 214 in the second position, the detection subsystem 204 automatically identifies the blood circulation portion of the arm of the patient. In an exemplary embodiment, the detection subsystem 204 includes an infrared lighting mechanism.

[0076] The detection subsystem 204 of the present disclosure provides a device for a medical practitioner to automatically identify a patient's vein or artery before inserting a needle during a blood collection procedure.

[0077] While this disclosure has been described as having exemplary designs, the present disclosure can be further modified within the spirit and scope of this disclosure. This application is therefore intended to cover any variations, uses, or adaptations of the disclosure using its general principles. Further, this application is intended to cover such departures from the present disclosure as come within known or customary practice in the art to which this disclosure pertains and which fall within the limits of the appended claims.

WHAT IS CLAIMED IS:

1. An automatic blood collection device, comprising:
a housing having a first end, a second end, and a holder defining a receiving cavity;
a clamping subsystem in communication with the receiving cavity, the clamping subsystem transitionable between a first position in which a collection container is receivable within the receiving cavity and a second position in which the clamping subsystem locks the collection container within the receiving cavity;
a translation subsystem in communication with the holder, the translation subsystem transitionable between a first setting in which the translation subsystem moves the holder towards the first end and a second setting in which the translation subsystem moves the holder away from the first end; and
a rotation subsystem in communication with the holder, the rotation subsystem transitionable between an off setting and an on setting in which the rotation subsystem rotates the holder relative to the housing.
2. The automatic blood collection device of claim 1, further comprising a second clamping subsystem in communication with a receiving portion, the second clamping subsystem transitionable between a first position in which a first portion of a blood collection set is receivable within the receiving portion and a second position in which the second clamping subsystem locks the first portion of the blood collection set within the receiving portion.
3. The automatic blood collection device of claim 2, wherein the receiving portion is located at the first end.
4. The automatic blood collection device of claim 2, wherein with the translation subsystem in the first setting, the translation subsystem moves the collection container, locked within the receiving cavity, towards the first end into engagement with the first portion of the blood collection set.
5. The automatic blood collection device of claim 4, wherein with the collection container engaged with the first portion of the blood collection set, a blood sample is collected within the collection container.

6. The automatic blood collection device of claim 5, further comprising a detection subsystem that monitors a level of the blood sample that is collected within the collection container.

7. The automatic blood collection device of claim 5, wherein with the blood sample collected within the collection container, and with the translation subsystem in the second setting, the translation subsystem moves the collection container away from the first end and disengages the collection container from the first portion of the blood collection set.

8. The automatic blood collection device of claim 1, wherein the holder defines a second receiving cavity, and with the clamping subsystem in the first position, a second collection container is receivable within the second receiving cavity.

9. The automatic blood collection device of claim 8, wherein with the clamping subsystem in the second position, the clamping subsystem locks the second collection container within the second receiving cavity.

10. The automatic blood collection device of claim 1, wherein the clamping subsystem includes a lock portion and a cam portion, with the clamping subsystem in the first position, the cam portion is disengaged from the lock portion, and with the clamping subsystem in the second position, the cam portion engages the lock portion to contact and lock the collection container within the receiving cavity.

11. The automatic blood collection device of claim 10, wherein the clamping subsystem includes a first motor that moves the cam portion into engagement with the lock portion.

12. The automatic blood collection device of claim 11, further comprising a first switch, wherein actuation of the first switch activates the first motor thereby moving the cam portion into engagement with the lock portion.

13. The automatic blood collection device of claim 1, wherein the translation subsystem includes a translation gear system and a translation component in communication

with a portion of the holder, wherein with the translation subsystem in the first setting, the translation gear system rotates the translation component in a first direction to move the holder towards the first end, and with the translation subsystem in the second setting, the translation gear system rotates the translation component in a second direction to move the holder away from the first end.

14. The automatic blood collection device of claim 13, wherein the translation subsystem includes a second motor in communication with the translation gear system.

15. The automatic blood collection device of claim 14, further comprising a second switch, wherein actuation of the second switch activates the second motor thereby driving the translation gear system.

16. The automatic blood collection device of claim 13, wherein the second direction is opposite the first direction.

17. The automatic blood collection device of claim 1, wherein the rotation subsystem includes a rotation gear system having a clutch mechanism.

18. The automatic blood collection device of claim 17, wherein the clutch mechanism includes a clutch tab on a portion of the rotation gear system and a clutch slot defined on a portion of the holder, wherein with the rotation subsystem in the off setting, the clutch tab is disengaged from the clutch slot, and with the rotation subsystem in the on setting, the clutch tab engages the clutch slot and the rotation gear system rotates the holder relative to the housing.

19. The automatic blood collection device of claim 18, wherein the rotation subsystem includes a third motor in communication with the rotation gear system.

20. The automatic blood collection device of claim 19, wherein the third motor is automatically activated to drive the rotation gear system.

21. A blood collection system, comprising:
the automatic blood collection device of claim 1; and

a blood collection constraint and detection device, comprising:

a constraint subsystem having a housing defining an arm receiving cavity and a securement mechanism in communication with the arm receiving cavity, the securement mechanism transitionable between a first position in which an arm of a patient is receivable within the arm receiving cavity and a second position in which the securement mechanism secures the arm within the arm receiving cavity; and

a detection subsystem in communication with the constraint subsystem, wherein with the arm within the arm receiving cavity and the securement mechanism in the second position, the detection subsystem identifies a blood circulation portion of the arm of the patient.

22. The blood collection system of claim 21, wherein the securement mechanism automatically transitions from the first position to the second position when the arm is received within the arm receiving cavity.

23. The blood collection system of claim 22, wherein with the arm within the arm receiving cavity and the securement mechanism in the second position, the detection subsystem automatically identifies the blood circulation portion of the arm of the patient.

24. The blood collection system of claim 23, wherein with the securement mechanism in the second position, the securement mechanism secures the arm within the arm receiving cavity such that the blood circulation portion of the arm of the patient is exposed.

25. The blood collection system of claim 21, wherein the detection subsystem includes an infrared lighting mechanism.

26. The blood collection system of claim 21, wherein the blood circulation portion is a vein.

27. The blood collection system of claim 21, wherein the blood circulation portion is an artery.

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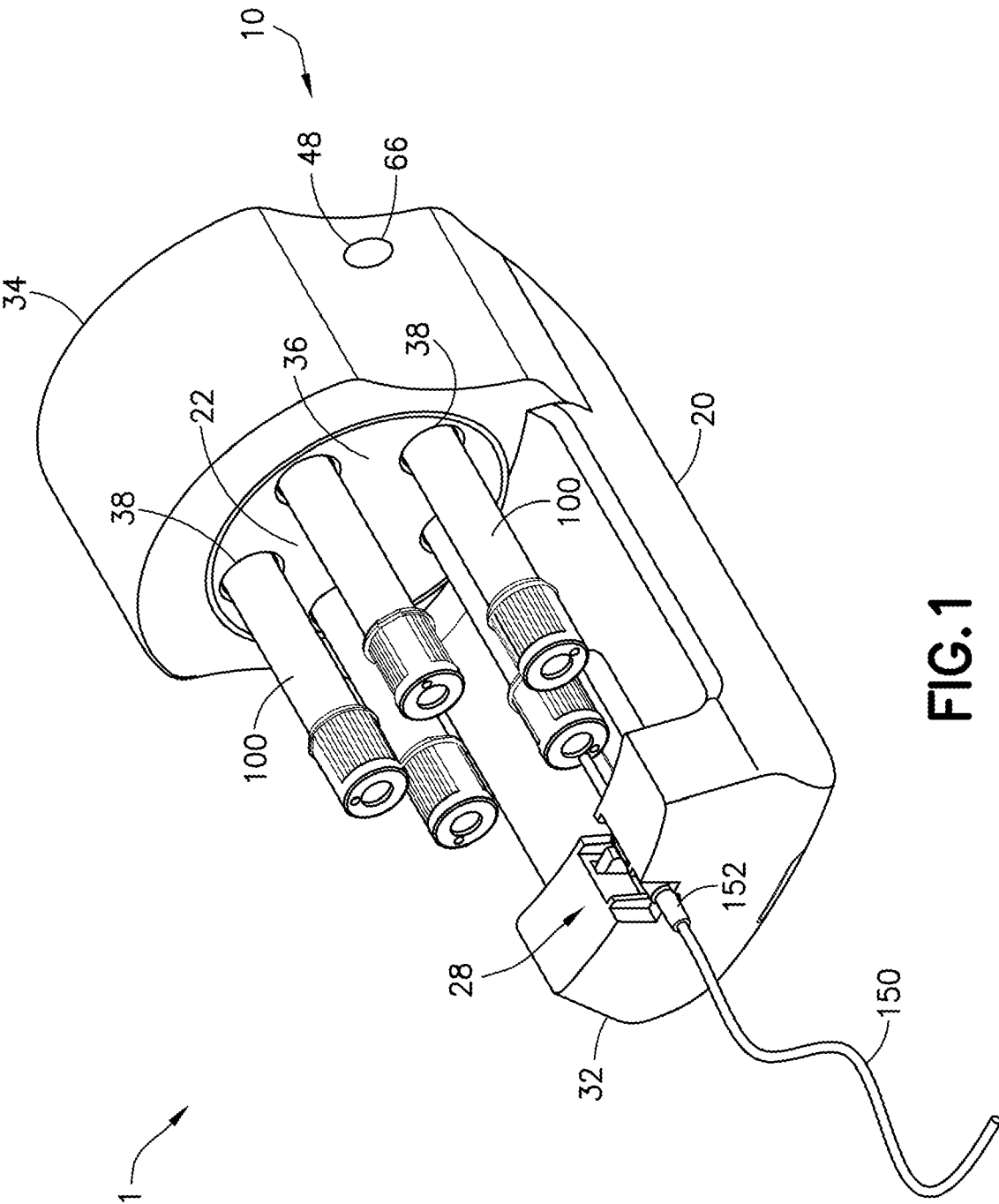


FIG.1

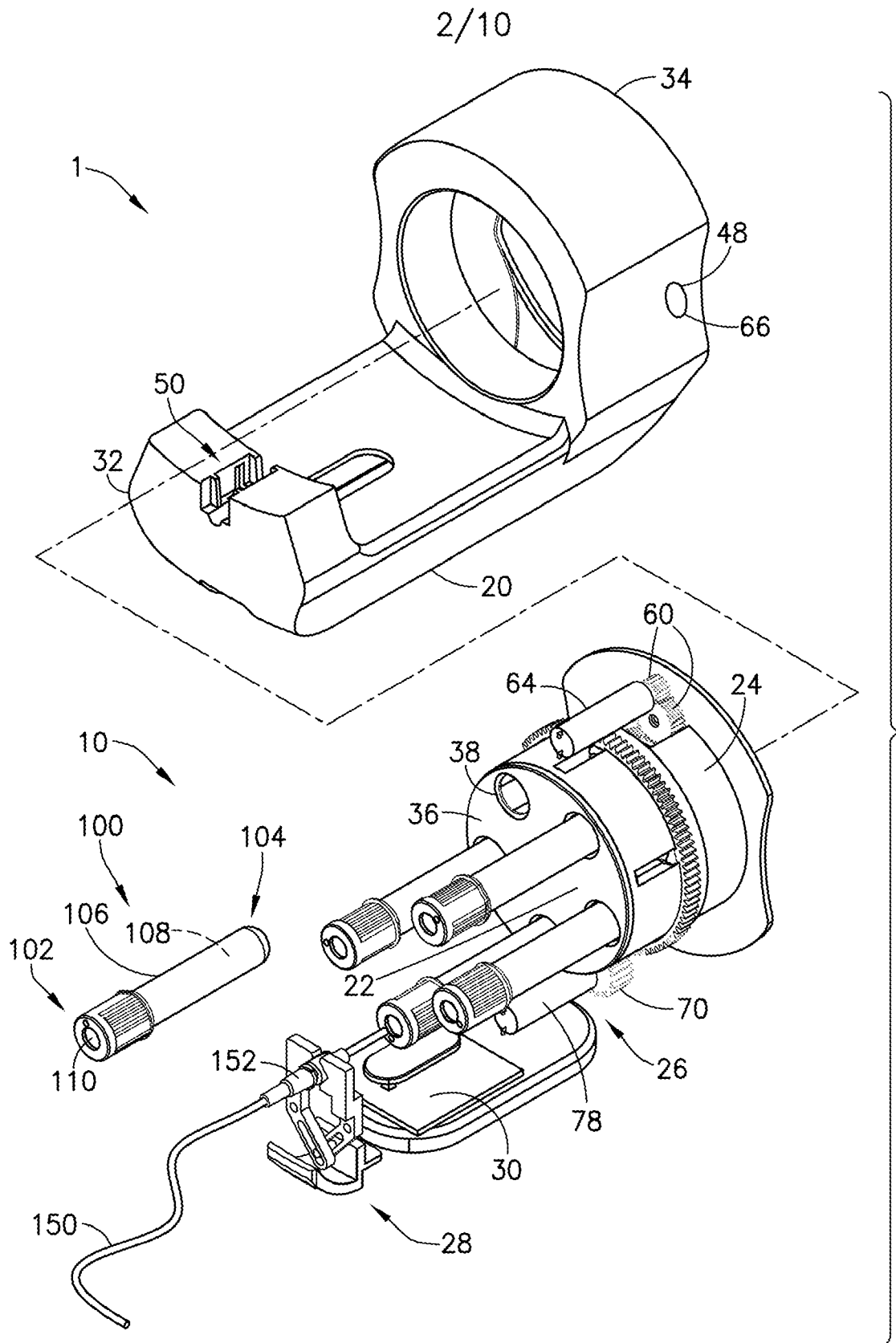
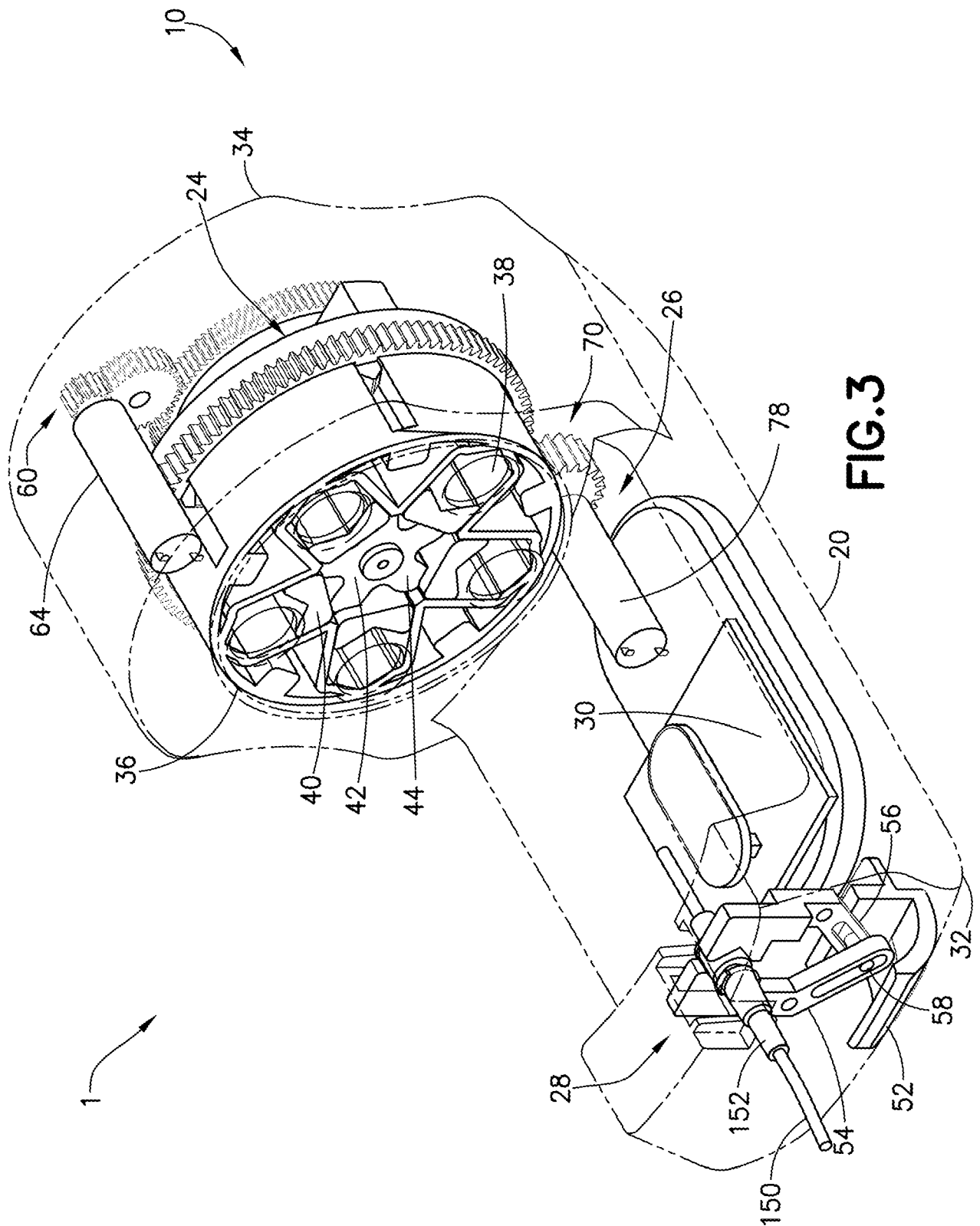


FIG.2

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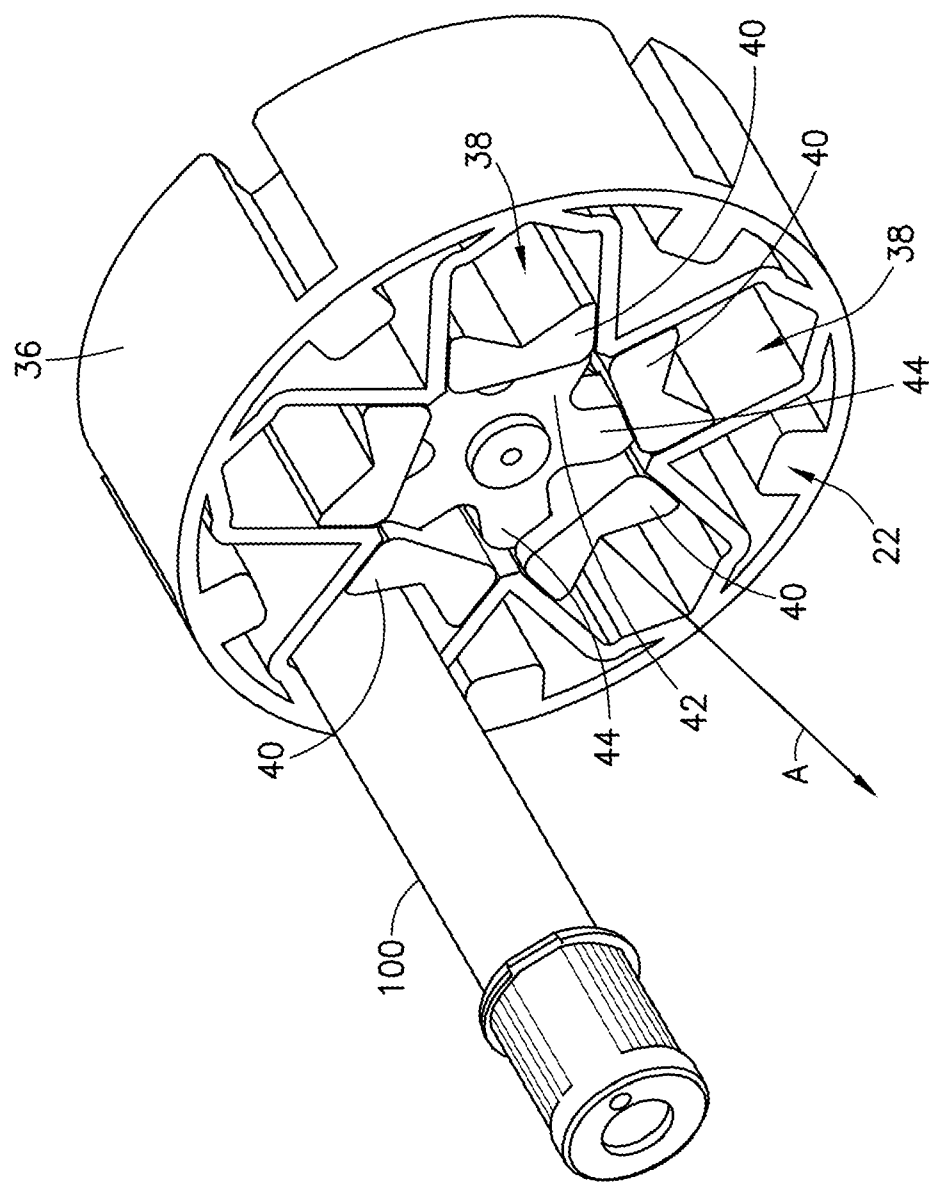


FIG. 4

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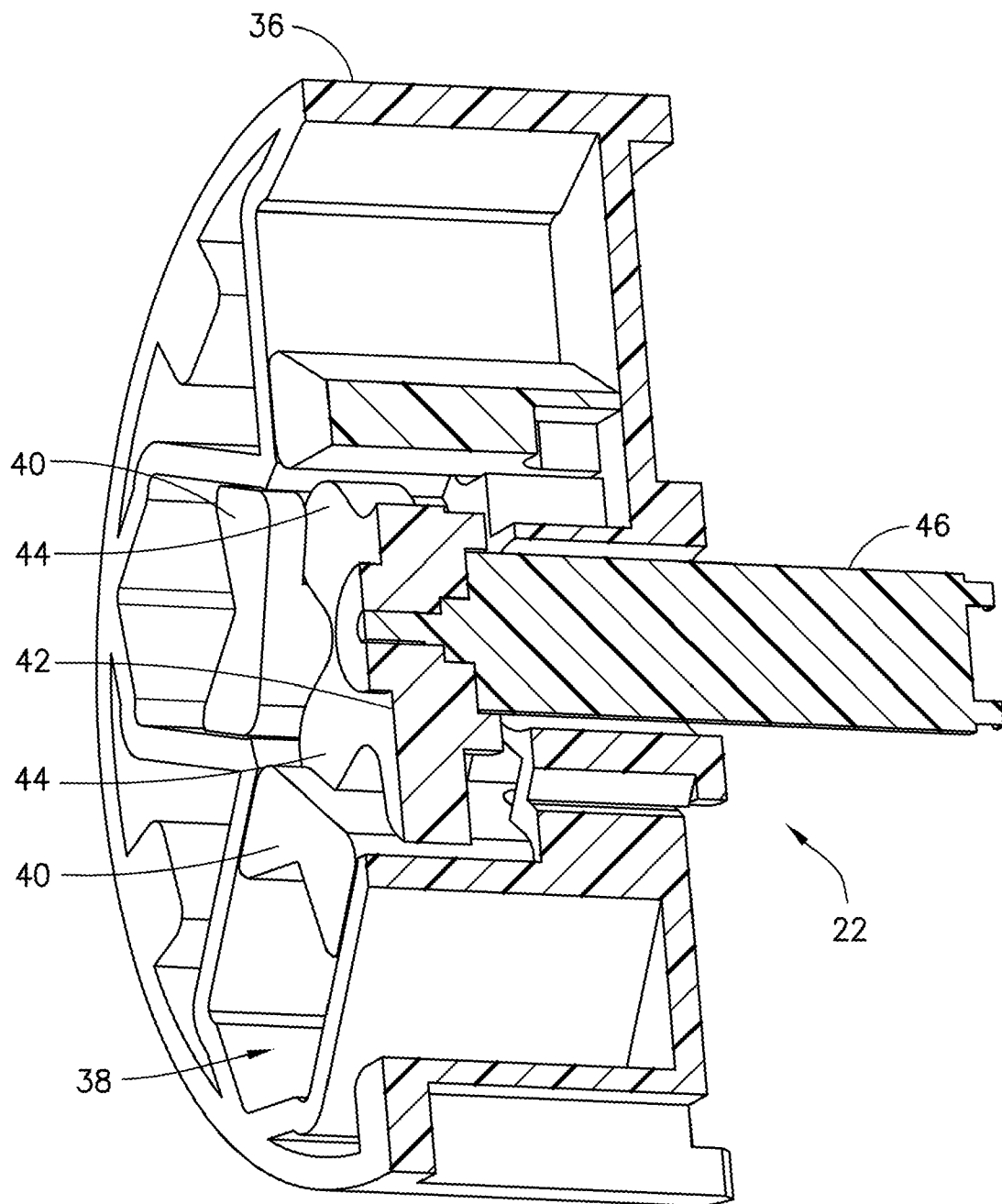
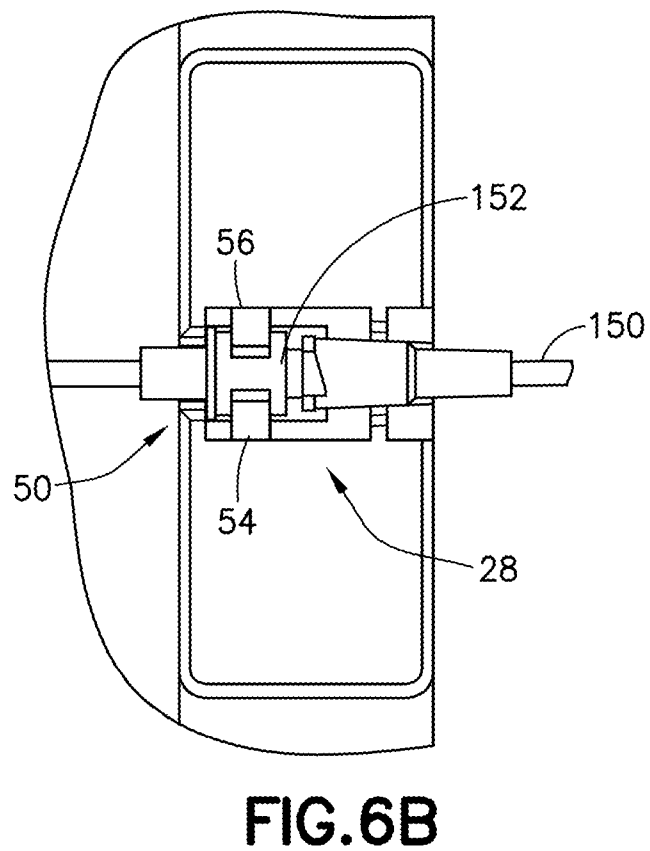
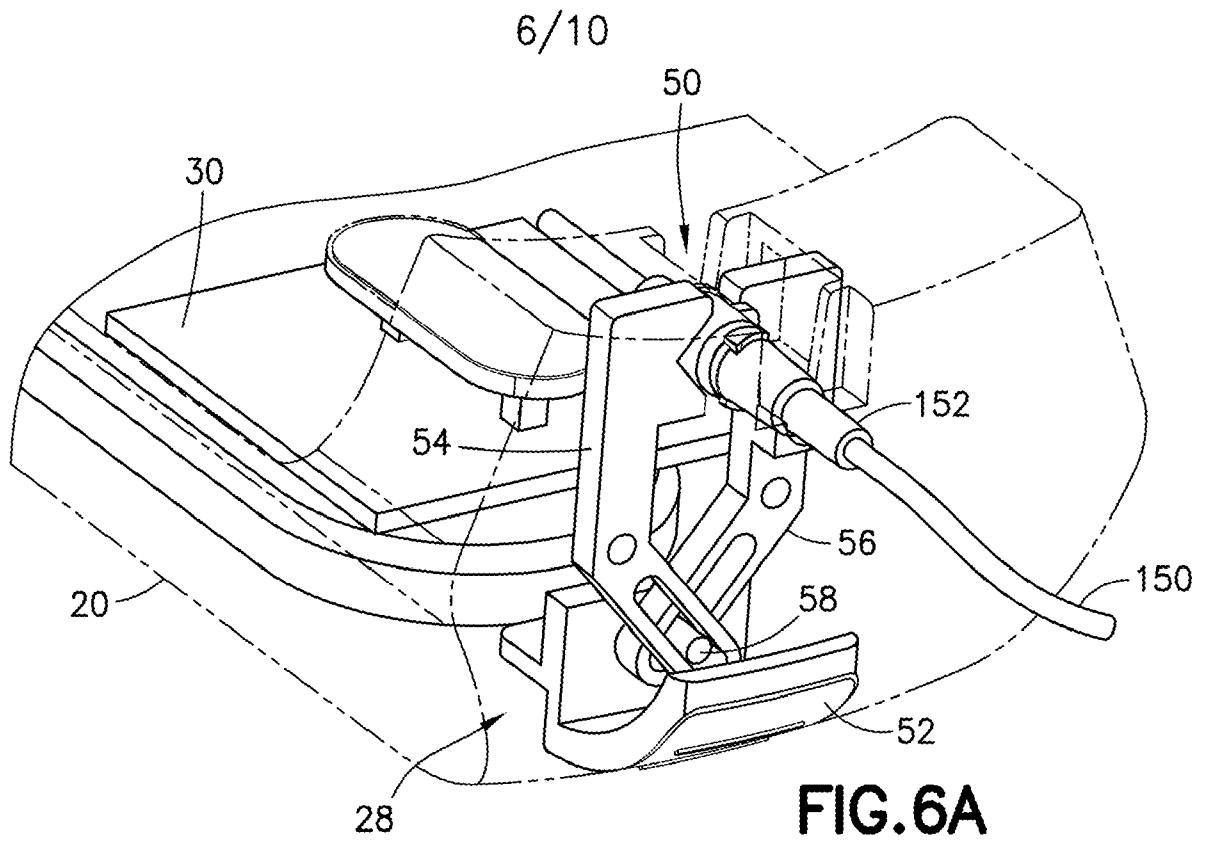
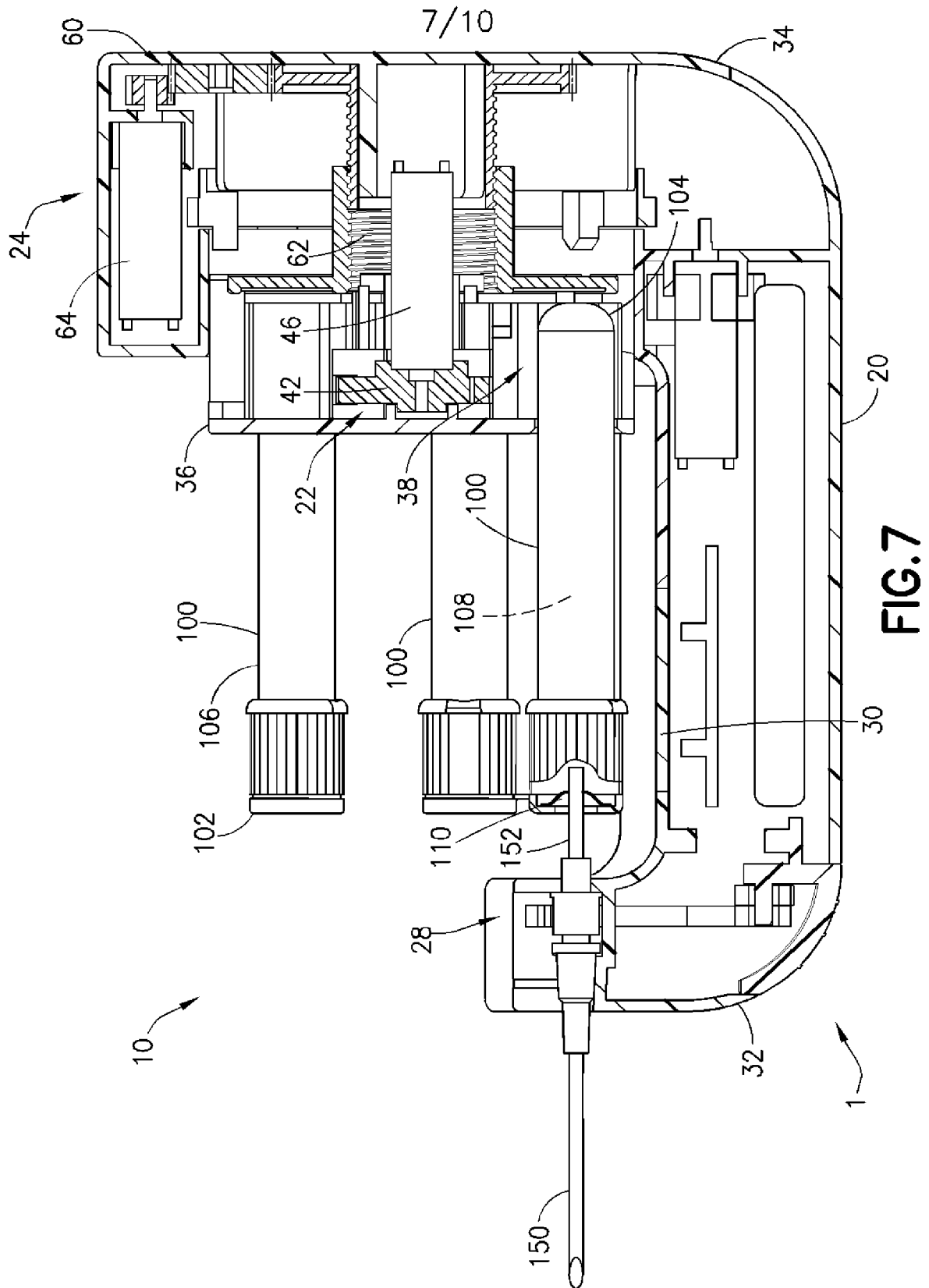


FIG.5





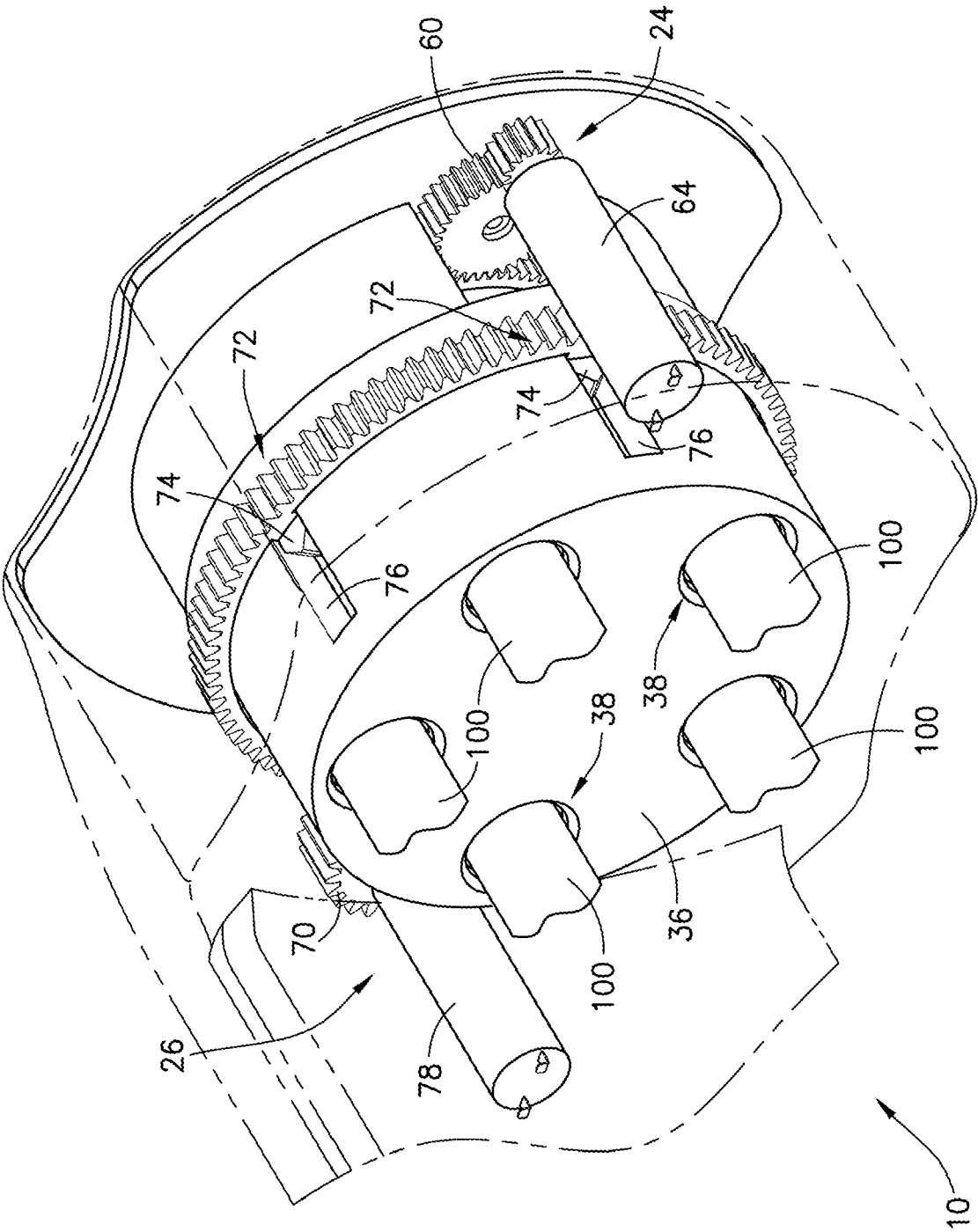


FIG. 8

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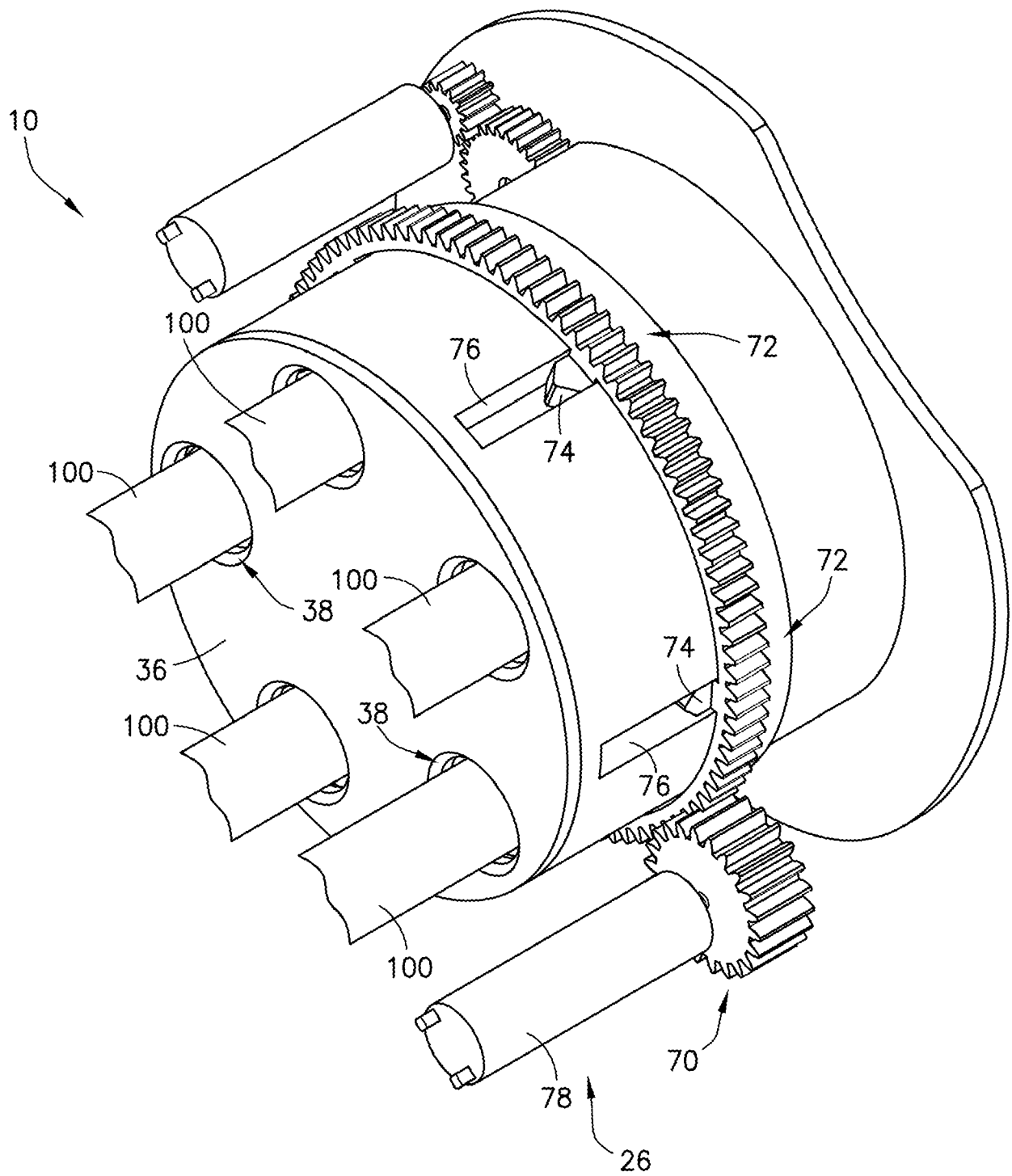


FIG.9

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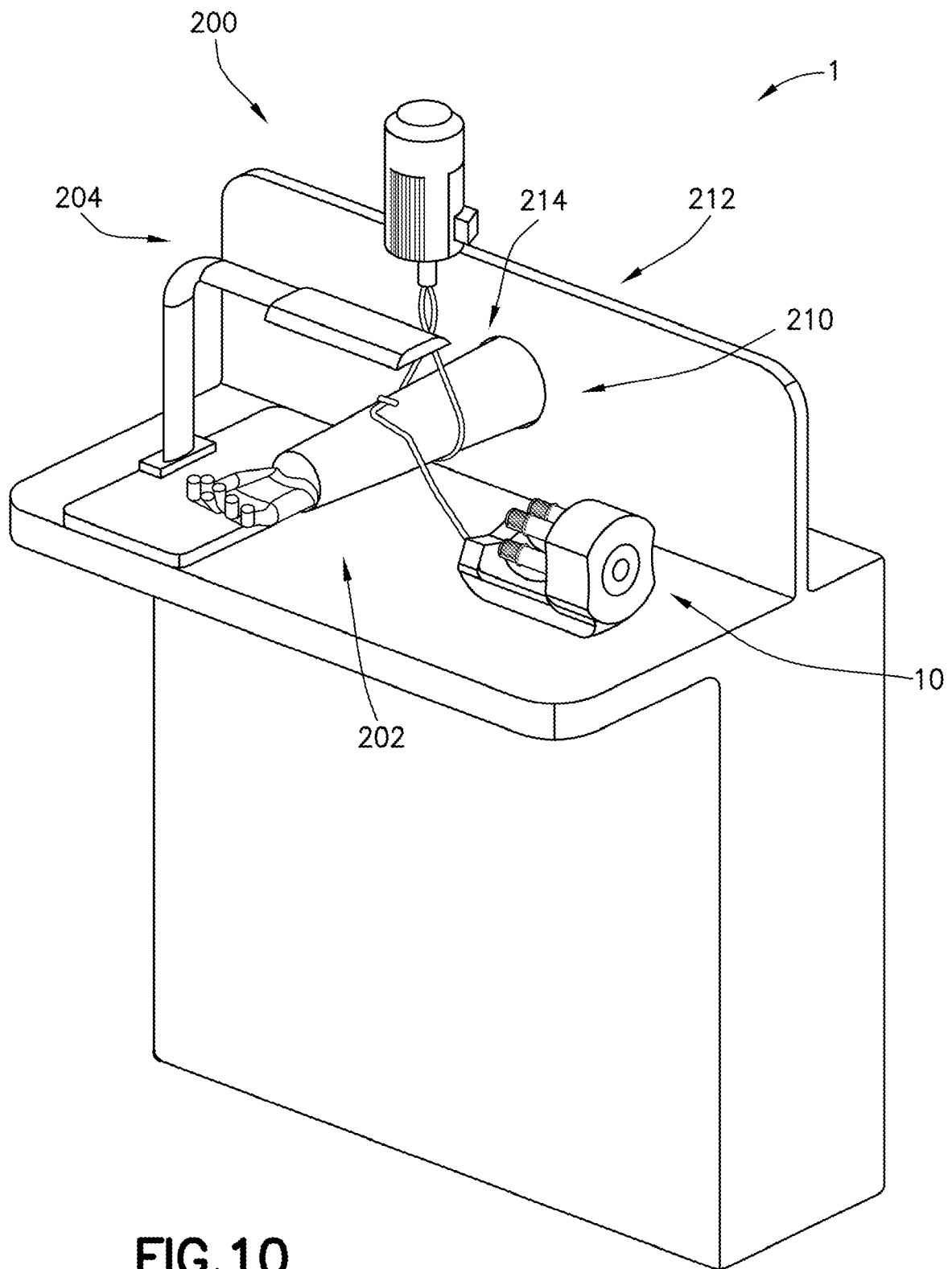


FIG.10

INTERNATIONAL SEARCH REPORT

International application No
PCT/US2019/060890

A. CLASSIFICATION OF SUBJECT MATTER

INV. A61B5/15 A61B5/153 A61B5/155 A61M5/42
ADD.

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)

A61B A61M

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	US 3 765 402 A (GRABHORN R) 16 October 1973 (1973-10-16) abstract; figure 1 column 3, lines 3-45; figures 2,3 column 4, line 9 - column 6, line 19 column 6, line 55 - column 8, line 57 -----	1-27
A	WO 2006/079345 A1 (DANMARKS JORDBRUGSFORSKNING FO [DK]; FONSS ANDER [DK]) 3 August 2006 (2006-08-03) abstract; figure 2 -----	1-27
A	US 4 077 395 A (WOOLNER RONALD ALFRED) 7 March 1978 (1978-03-07) abstract ----- -/-	1-27



Further documents are listed in the continuation of Box C.



See patent family annex.

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Date of the actual completion of the international search

25 March 2020

Date of mailing of the international search report

09/04/2020

Name and mailing address of the ISA/

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INTERNATIONAL SEARCH REPORT

International application No
PCT/US2019/060890

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	WO 97/45055 A1 (ALEXANDER GARY E [US]) 4 December 1997 (1997-12-04) abstract; figure 3 -----	1-27
A	WO 2006/111939 A2 (KONINKL PHILIPS ELECTRONICS NV [NL]; NEERKEN SIEGLINDE [FR] ET AL.) 26 October 2006 (2006-10-26) abstract -----	1-27
A	US 2011/009738 A1 (ZEMEL MARC I [US]) 13 January 2011 (2011-01-13) abstract -----	1-27

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/US2019/060890

Patent document cited in search report		Publication date	Patent family member(s)	Publication date
US 3765402	A	16-10-1973	BE 750378 A	16-10-1970
			CA 926718 A	22-05-1973
			DE 2022116 A1	26-11-1970
			FR 2047706 A5	12-03-1971
			GB 1313331 A	11-04-1973
			NL 7007075 A	17-11-1970
			SE 354962 B	02-04-1973
			US 3633566 A	11-01-1972
			US 3765402 A	16-10-1973

WO 2006079345	A1	03-08-2006	AT 474501 T	15-08-2010
			EP 1850750 A1	07-11-2007
			US 2006173378 A1	03-08-2006
			WO 2006079345 A1	03-08-2006

US 4077395	A	07-03-1978	GB 1562686 A	12-03-1980
			US 4077395 A	07-03-1978

WO 9745055	A1	04-12-1997	AU 3147797 A	05-01-1998
			US 5785662 A	28-07-1998
			WO 9745055 A1	04-12-1997

WO 2006111939	A2	26-10-2006	AT 424872 T	15-03-2009
			CN 101163516 A	16-04-2008
			EP 1874378 A2	09-01-2008
			JP 2008536612 A	11-09-2008
			US 2009118670 A1	07-05-2009
			WO 2006111939 A2	26-10-2006

US 2011009738	A1	13-01-2011	AU 2010271418 A1	02-02-2012
			BR 112012000392 A2	27-02-2018
			CN 102481098 A	30-05-2012
			EP 2451343 A2	16-05-2012
			ES 2573504 T3	08-06-2016
			JP 5784600 B2	24-09-2015
			JP 2012532682 A	20-12-2012
			US 2011009738 A1	13-01-2011
			WO 2011005954 A2	13-01-2011
