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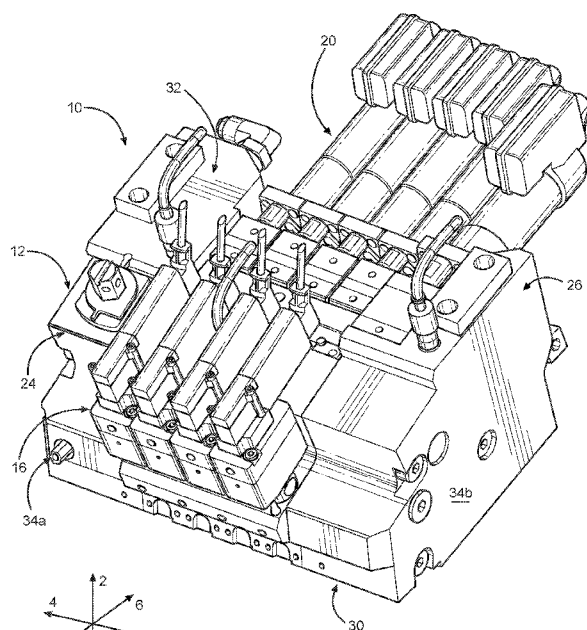


FIG. 1

(57) Abstract: An embodiment of the present disclosure is an applicator for dispensing adhesive onto a substrate. The applicator includes a manifold and at least one dispensing module coupled to the manifold. The applicator may include a least one pump assembly removably mounted the manifold. Each pump assembly having an outlet in flow communication with the manifold, and an inlet in flow communication with the adhesive. The pump assembly includes a gear assembly for pumping adhesive from said inlet to said outlet and a drive motor with a drive shaft connected to the gear assembly. The drive motor has a shaft with an axis that intersects said front surface of the pump assembly. In another example, the shaft has an axis that does not intersect both of a first side and a second side of said manifold.

APPLICATOR WITH AT LEAST ONE PUMP HAVING AN INTEGRATED DRIVE**CROSS REFERENCE TO RELATED APPLICATIONS**

[0001] This application claims the benefit of U.S. Provisional Patent App. No. 62/385,238, filed September 8, 2016, the disclosure of which is hereby incorporated by reference herein.

TECHNICAL FIELD

[0002] The present disclosure relates to an applicator for dispensing a hot-melt adhesive onto a substrate having at least one pump with the pump having an integrated drive. The applicator can be a hybrid applicator for having both metered outputs and pressure fed outputs.

BACKGROUND

[0003] Typical adhesive applicators for applying hot-melt adhesive onto a substrate contain multiple positive-displacement gear pumps connected to a unitary manifold or segmented manifold (hereafter referred to as a manifold). Multiple modules, each including a nozzle, are applied across the face the manifold as is well known in the industry. These gear pumps have a common drive shaft to turn all the pumps to dispense adhesive. A common drive shaft provides the means to turn the pumps. However, a common drive shaft configuration has drawbacks.

[0004] For example, when all of the pumps are the same size, all of the pumps operate at the same speed (rpm) resulting in uniform flow rates from each pump. Furthermore, it is time consuming to change/replace a pump if defective or if a different size is needed, as the common drive shaft and motor must first be removed from the applicator.

[0005] In typical applicators, the flow paths between the pumps and the manifolds are somewhat fixed. This, in turn, eliminates the ability to adjust or change adhesive flow streams across the width of the applicator. Furthermore, typical applicators using the pumps described above are considered metered type applicators. However, applicators may be pressure fed. But typical applicators do not include combination of metered feeds and pressure feeds in single applicator design.

BRIEF DESCRIPTION OF THE DRAWINGS

[0006] The detailed description of illustrative embodiments of the present application will be better understood when read in conjunction with the appended drawings. For the purposes of illustrating the present application, there is shown in the drawings illustrative embodiments of the disclosure. It should be understood, however, that the application is not limited to the precise arrangements and instrumentalities shown.

[0007] Figure 1 is a front perspective view of an applicator according to an embodiment of the present disclosure;

[0008] Figure 2 is a top view of the applicator shown in Figure 1;

[0009] Figure 3 is a rear view of the applicator shown in Figure 1;

[0010] Figure 4 is a side view of the applicator shown in Figure 1;

[0011] Figure 5 is a rear perspective view illustrating a pump assembly removed from the applicator;

[0012] Figure 6 is a front perspective view a pump assembly used in the applicator shown in Figure 1;

[0013] Figure 7 is a rear perspective view a pump assembly used in the applicator shown in Figure 1;

[0014] Figure 8 is an exploded view the pump assembly shown in Figures 6 and 7;

[0015] Figure 9 is a sectional view of the pump assembly shown in Figures 6 and 7;

[0016] Figure 10 is a perspective of a gear assembly used in the pump assembly shown in Figures 6 and 7;

[0017] Figure 11 is a schematic block diagram of a control system used that controls operation of the drive motor unit in the pump assemblies in the applicator shown in Figure 1;

[0018] Figure 12 is a front perspective view of an applicator according to another embodiment of the present disclosure;

[0019] Figure 13 is a perspective view a pump assembly used in the applicator shown in Figure 10;

[0020] Figure 14 is an exploded view the pump assembly shown in Figure 13; and

[0021] Figure 15 illustrates an applicator configured for metered and pressure feed inputs.

DETAILED DESCRIPTION OF ILLUSTRATIVE EMBODIMENTS

[0022] Embodiments of the present disclosure include an applicator 10 for dispensing a hot melt adhesive on to a substrate during, for example, the manufacture of personal disposable hygiene products, such as diapers. Referring to Figures 1-4, the applicator 10 includes a manifold 12, at least one dispensing module 16 coupled to the manifold 12, at least one air control valve 18 coupled to the dispensing module 16, and at least one pump assembly 20 removably mounted to the manifold 12. The manifold 12 may include a plurality of manifold segments 22 with a pair of end plates 24 and 26 on either side of manifold segments 22. Alternatively, the manifold may be a unitary manifold. The applicator may include a plurality of nozzles (not shown) through which the adhesive is ejected on the substrate. The nozzles can be spray nozzles or coating nozzles.

[0023] In various embodiments of the present disclosure the applicator 10 may include multiple sets of a dispensing module 16, manifold segment(s) 22, and a pump assembly 20 arranged in a side-by-side relationship to increase the processing width of the applicator 10. Accordingly, the applicator may include a plurality of dispensing modules 16 and a plurality of pump assemblies 20. As illustrated, for example, the applicator 10 has five pump assemblies 20a, 20b, 20c, 20d, and 20e. Although the figures illustrate five pump assemblies 20a-20e, the applicator 10 can include a single pump assembly, two pump assemblies, or more than two pump assemblies. For clarity, a single pump assembly is described below and reference number 20 can be used interchangeably with reference numbers 20a-20e. Each pump assembly 20 can be coupled to and associated with one manifold segment 22 and one dispensing module 16. In addition, each dispensing module 16 is coupled to and associated with one manifold segment 22. However, two or more pump assemblies and two or more dispensing modules 16 may be coupled to single manifold segment 22, as illustrated in Figure 2.

[0024] Referring to Figures 1-4, the manifold 12 has a base 30, a top 32 spaced from the base 30 along a vertical direction 2, a first side 34a and a second side 34b opposite the first side 34a along a lateral direction 4 that is perpendicular to the vertical direction 2. The first side 34a lies within a first plane P1 and the second side surface lies within a second plane P2 that is parallel to the first plane P1. The first and second planes P1 and P2 may not be parallel if the first

and second sides 34a and 34b are angled with respect to each other. The manifold 12 further has a front 36 and a back 38 spaced apart with respect to other along a forward-rearward direction 6 that is perpendicular to the vertical direction 2 and the lateral direction 4. The first side 34a and the second side 34b extend from the front 36 to the back 38 and also from the base 30 to the top 32. The forward-rearward direction 6 is referred to as the machine direction and the lateral direction 4 is referred to as the cross-machine direction. The directional components described in this paragraph also apply to components of the applicator 10.

[0025] Referring to Figures 6-8, the pump assembly 20 is configured to supply heated adhesive to the manifold 12 at a given volumetric flow (or flow rate). Each pump assembly 20a-20e includes a pump 40 and a dedicated drive motor unit 60 that powers the pump 40. Because each pump 40 has a dedicated drive motor unit 60, the each pump assembly 20 can be independently controlled by the operator and/or a control system 110 (reference 110 shown in Figure 11), as will be described further below. The pump assembly 20 also includes a thermal isolation region 70 between the pump 40 and the drive motor unit 60. Thermal elements 23 may be used to elevate the temperature of the manifold 12, which in turn, elevates the temperature of the pump 40 in each pump assembly 20. The thermal isolation region 70 minimizes thermal transfer from the pump 40 to the drive motor unit 60, thereby minimizing the affect of temperature on the electronic components in the drive motor unit 60.

[0026] Continuing with Figures 6-8, the drive motor unit 60 includes a motor 62, an output drive shaft 66, and one or more connectors 64 (illustrated as wires) that are coupled to a power source (not shown) and a control unit 150 with a control system 110 (control system 110 and control unit 150 shown in Fig. 10). The drive motor unit 60 may also include a rotational sensor 68 that is electronically coupled to the control unit 150. The drive motor unit 60 may also include a gear assembly 67, such as a planetary gear, that transfers rotational motion from an output drive shaft 66 of the motor to the input drive shaft (not shown) of the pump to attain the desired pump rotational speed. The output drive shaft 66 has a drive axis A about which the drive shaft 66 rotates.

[0027] Referring back to Figures 3 and 4, the pump assembly 20 may be mounted to the manifold 12 in a number of different configurations. In one example, the pump assembly 20 is mounted to the manifold 12 so that the front surface 41 of the pump 40, which includes the outlet, faces a manifold 12. The drive shaft axis A intersects the front surface 41 of the pump assembly 20 and manifold 12 at a location that is spaced apart from and located between sides 34a and 34b. In this configuration, the drive motor axis A does not intersect the first side 34a

and the second side 34b of the applicator 10. Rather, the pump assembly 20 is positioned on the manifold 12 so that the drive motor axis A of the drive motor unit 60 lies in a plane Y that is parallel to the first plane P1 and the second plane P2 of the first side 34a and the second side 34b, respectively. Each pump assembly 20a-20e has a respective drive axis A that lies within a respective plane that is parallel to the first plane P1 and the second plane P2.

[0028] Continuing with Figures 3 and 4, it should be appreciated that the pump assembly 20 can be positioned on the manifold 12 such that the drive motor axis A is oriented in any particular direction within plane Y. For example, the pump assembly 20 can be positioned on the manifold 12 such that the drive motor axis A lies within plane Y and is angularly offset with respect to the plane X. For instance, pump assembly 20 can be positioned on the manifold 12 such that the drive motor axis A defines an angle θ with the plane X. The angle θ can be an acute angle, an obtuse angle, or an angle greater than 180 degrees.

[0029] Referring to Figures 6-8, the pump 40 includes a housing assembly 42 and one or more gear assembly 50 (or more than one gear assembly) contained within the housing assembly 42, an inlet 52 for receiving liquid from the manifold segment 22 and an outlet 54 for discharging liquid back into the manifold segment 22. In accordance with the illustrated embodiment, the inlet and the outlet of the pump are oriented in a direction that is parallel to a drive motor axis A of the drive motor.

[0030] Continuing with Figures 6-8, the housing assembly 42 comprises an upper plate 44a, a lower plate 44b, and a central block 46. The upper and lower plates 44a and 44b are spaced from each other along a direction that is aligned with a drive axis A of the drive motor unit 60. The upper plate 44a, central block 46, and lower plate 44b are coupled together with bolts 48. The bolts 48 that are received by and fixed within bores 49a, 49b, 49c(not shown) in the upper plate 44a, central block 46, and lower plate 44b, respectively. The central block 46 defines an internal chamber 56 (Fig. 8) sized to conform generally to the profile of the gear assembly 50. The plate 44b defines a front surface 41. The drive motor axis A extends through the front surface 41.

[0031] Continuing with Figures 8-10, the pump 40 includes a gear assembly 50. In accordance with the illustrated embodiment, the gear assembly 50 has, for example, a driven gear 55a and an idler gear 55b, as is known to a person of ordinary skill in the art. The driven gear 55a is coupled to the drive shaft 66 of the drive motor unit 60 such that rotation of the drive shaft 66 rotates the driven gear 55a, which, in turn, rotates the idler gear 55b. The driven gear

55a rotates about a first axis (not shown) and the idler gear rotates about a second axis (not shown). The driven gear rotational axis is coaxial with the drive motor axis A. The gear assembly 50 may include an elongate gear shaft that is coupled to an end of the drive shaft 66 via a coupling. The gear shaft extends into the driven gear 55a and is keyed to drive the driven gear 55a. A seal member, such as a coating and encasement, can be placed around the elongate gear shaft to facilitate sealing the gear assembly. The elongate gear shaft, coupling, and the sealing member are not shown for clarity.

[0032] In use, rotation of the gears 55a and 55b drive adhesive in the pump from a first section 58a of the chamber 56 to a second section 58b of the chamber 56, which is then routed to outlet 54. In accordance with the illustrated embodiment, each gear in gear assembly 50 has a length L that is greater than or equal to its outer diameter D. While a gear assembly with two gears is shown, the pump 40 can have any number of gears and/or any number of gear configurations for the desired flow rate of the pump 40. The central block 46 can be segmented to support gear stacking. For example, a plurality of gear assemblies can be stacked along the pump input shaft. In such an example, the gear assemblies can have different outputs that are combined into a single output stream. In other example, the gear assemblies have different outputs that can be kept separate to provide multiple outputs through additional porting in plate 44b and the manifold 12.

[0033] Continuing with Figures 6-8, the thermal isolation region 70 is defined by a thermal isolation plate 72 and a gap 74 between the thermal isolation plate 72 and housing assembly 42. Bolts 75 couple the thermal isolation plate 72 to the top of the housing assembly 42 so that the gap 74 is formed between the housing assembly 42 and the thermal isolation plate 72. The thermal isolation plate 72 can include a plurality of spacers 76 that are disposed around the bolts 75 and between a surface of the thermal isolation plate 72 and the housing assembly 42. The spacers 76 can be monolithic with the plate 72 or may be separate from the plate 72 so as to define the depth of the gap 74. The thermal isolation region 70 inhibits transfer of heat from the pump 40 to the drive motor unit 60. The thermal isolation plate 72 and spacers are can be made of material that is a lower thermal conductivity compared the materials that form the housing assembly 42 and the outer casing (not numbered) of the drive motor unit 60. Furthermore, the use of the spacers 76 creates the standoff region 74, which minimizes direct contact between the housing assembly and the drive motor unit 60.

[0034] Referring to Figures 4 and 5, the applicator 10 is configured to facilitate removal of a pump assembly 20a-20e from the applicator. As shown in Figure 4, the pump assemblies

20a-20e are held in place with an elongate plate 27 that is coupled to the end plates 24 and 26. A fastener 29 is coupled to the pump assembly 20 and to the elongate plate 29, thereby securing the pump assembly 20 in place on the manifold 12. The fastener 29 may be a captive fastener. In order to remove and/or replace the pump assembly 20 (or multiple pump assemblies 20a-20e), the operator can loosen the fastener 29 from the elongate plate 29 and then remove the pump assembly 20. This feature reduces the time required to replace and/or remove the pump assembly 20 compared to typical applicators that use a common drive shaft to operate the pumps.

[0035] Figure 11 is a schematic block diagram a control system 110 configured as a closed feedback loop for controlling aspects of pump assembly 20 operation. As can be seen in Figure 11, the control system 110 includes at least one control unit 150, which may be a logic unit. In the embodiment where multiple pump assemblies 20a, 20b...20n, are used as illustrated in Figure 11, the control unit 150 is electronically coupled to rotational sensor 68a, 68b...68n. Each rotational sensor 68a, 68b...68n is coupled to a respective motor 62a, 62b...62n, as described above. The rotational sensors may include rotational encoders, a Hall Effect sensor, and any device that can measure rotation. Alternatively, furthermore, the control unit 150 is also electronically coupled to each motor 62a, 62b...62n. The control unit 150 may include one or more memories, one or more processors used to execute instructions stored in the memory, and input and output portions. The input and output portions may be typical transmit/receive devices that can transmit to and/or receive signals from other components of the control system 110.

[0036] The control system 110 operates as a closed loop feedback to maintain pump speeds within a targeted operating range. The control unit 150 may have a target drive motor rotational speed (or “target RPM”) set by the operator and stored in memory. The encoder 68 can determine the actual drive motor rotational speed (or the “actual RPM”). The actual RPM is sent to the control unit 150. Software executed by the control unit 150 determines 1) if the actual RPM is different from the target RPM, and 2) the magnitude of variance (+/-) from the target RPM if any is detected. If the control unit 150 determines a variance between target RPM and the actual RPM, the control unit 150 transmits a signal to the motor 62 to either increase or decrease the draft rotational speed until the actual RPM is consistent with the target RPM (within reasonable processing limits typical in metered applications). This feedback loop may be applied across each pump assembly installed on the applicator. In this way, the control system 110 functions to maintain the target rotation speed at the drive motor 62, which in turn, maintain a consistent volumetric flow rate over time. This can limit processing drift that may occur

gradually over time in conventional systems. Because each pump assembly is independently driven, the feedback loops for each particular pump assembly help control individual pump outputs.

[0037] Figures 12-14 illustrate another embodiment of the present disclosure. Figure 12 shows an applicator 210 that is similar to the applicator 10 shown in Figures 1-4 and described above. However, the applicator 210 includes pump assemblies 220 that each has drive shaft axes B that are orientated in a direction offset with respect to the lateral direction 4. As illustrated, the pump assembly 220 has a drive motor axis that angularly offset with respect to the vertical plane X and is parallel to the horizontal plane Y. In most other aspects, the applicator 10 and applicator 210 are substantially similar. Accordingly, the same reference signs will be used to identify features that common to the applicator 10 and applicator 210.

[0038] Continuing with to Figures 12-14, the pump assembly 220 is configured to supply heated liquid to the manifold 12 at a given volumetric flow (or flow rate). Each pump assembly 220 includes a pump 240 and a dedicated drive motor unit 260 that powers the pump 240. The pump assembly 220 may also include a thermal isolation region 270 between the pump 240 and the drive motor unit 260. The thermal isolation region 270 minimizes thermal transfer of heat generated by pump 240 to the drive motor unit 260, thereby minimizing the affect of temperature on the electronic components in the drive motor unit 260. The dedicated drive motor unit 260 and thermal isolation region 270 are same as the drive motor unit 60 and the thermal isolation region 70 described above an illustrated in Figures 6-8.

[0039] Continuing with Figures 12-14, the drive motor unit 260 includes a motor 62 and one or more connectors 64 (illustrated as wires), and an output drive shaft 266. The connectors 64 are coupled to a power source (not shown) and a control system 110. The drive shaft 266 has a drive axis B about which the drive shaft 266 rotates. When the pump assembly 220 is coupled to the applicator 210, the drive axis B intersects and/or is angularly offset with respect to the plane X that is parallel to the plane Y. In this configuration, the drive motor axis B does not intersect the first side 34a and the second side 34b of the applicator 210. Rather, the pump assembly 20 is positioned on the manifold 12 so that drive motor axis B of the drive motor unit 60 lies in a plane Y that is parallel to the first plane P1 and the second plane P2 of the first side 34a and the second side 34b, respectively.

[0040] The pump 240 includes a housing assembly 242 and one or more gear assemblies 250 contained within the housing assembly 242, an inlet 252 for receiving liquid from the

manifold segment 22 and an outlet 254 for discharging liquid back into the manifold segment 22. In accordance with illustrated embodiment, the inlet and the outlet of the pump 240 are oriented in a direction that is perpendicular to a drive motor axis B of the drive motor unit 260.

[0041] The pump assembly 20, 220, 420 as described herein can be independently controlled. For instance, a control system 110 may be used to independently adjust the RPM of the drive motor unit 60. Changes in the drive motor RPM vary the volumetric flow rate of the pump assembly 20 and thus the flow rate of the adhesive exiting the nozzle of the dispensing module. Accordingly, each stream of adhesive exiting the dispensing module may be individually controlled by adjusting the RPM of the drive motor unit 60. Independent adjustment or control of the flow rate at the pump assembly 20 is possible without having to change the pump. Furthermore, the pump assemblies 20 have a wide range of flow rates for given range of RPM compared to conventional pumps used in adhesive applicators. In other words, one pump assembly 20 as described herein has an effective operating range of two or more convention pumps designed for adhesive applicators. Furthermore, such an operating range of the pump is possible in a compact size.

[0042] In conventional pumps used with hot-melt adhesives, it is necessary to change the pumps to vary the flow rate outside of the certain operating ranges. For example, one gear set within a pump may be designed for a range of flow rates given a set of input rotational speeds. To achieve higher flow rates (or lower flow rates), a different pump with the gear set designed for the higher (or lower) flow rates must be used. Table 1 below include the volumetric flow rates in cubic centimeter per minute (cc/min) for a conventional small pump (“Pump 1”), a conventional large pump (“Pump 2”) and the pump assembly 20, 120, 420 as described in the present disclosure. Pump 1 in the table below has a cubic centimeter per revolution (cc/rev) of 0.16. Pump 2 in the table below has a cc/rev of 0.786. The “pump assembly” in the table below has a cc/rev of 0.34. Pump 1 and Pump 2 are representative of the smaller sized pumps and larger (or largest) sized pumps, respectively, used in conventional adhesive applicators.

Table 1

RPM	Pump 1 (0.16 cc/rev)	Pump 2 (0.786 cc/rev)	Pump Assembly (0.34 cc/rev)
10	1.6	7.86	3.4
20	3.2	15.72	6.8
30	4.8	23.58	10.2
40	6.4	31.44	13.6
50	8	39.3	17
60	9.6	47.16	20.4
70	11.2	55.02	23.8

80	12.8	62.88	27.2
90	14.4	70.74	30.6
100	16	78.6	34
110	17.6	86.46	37.4
120	19.2	94.32	40.8
130	20.8	102.18	44.2
140	22.4	110.04	47.6
150	24	117.9	51
160			54.4
170			57.8
180			61.2
190			64.6
200			68
210			71.4
220			74.8
230			78.2
240			81.6
250			85
260			88.4
270			91.8
280			95.2
290			98.6
300			102

[0043] As can be seen in the table above, the pump assembly 20, 220, 420 (pump assembly 420) as described herein has a wide range of volumetric flow rates for a given range of motor RPM's. For pump speed of 10-150 rpm, the volumetric flow rate for Pump 1 ranges from 1.6 to 24 cc/min, and the volumetric flow rates for Pump 2 ranges from 7.86 to 117.9 cc/min. The pump assembly 20, 220, 420 can provide a range of volumetric flow rates that is as wide as the flow rates of two different conventional pumps, at a wide range of pump speeds. In other words, the pump assembly 20, 220, 220 is operable to provide a volumetric flow rate that current typical pumps require two different pumps to accomplish. This results in greater process flexibility because each pump assembly can be separately controlled to provide a targeted flow volumetric among a wider range of possible volumetric flow rate. Furthermore, this level of control, and possible variation, is possible across multiple pumps and adhesive streams.

[0044] Furthermore, the pump assemblies 20, 220, 420 offer the operator more in-process flexibility. In conventional pumps used with hot-melt adhesives, the only way to change or adjust the RPM of the pumps was to the change the RPM of the common drive shaft driving each pump. Because a common drive shaft is used to drive the pumps, different pumps are used across the width of the applicator in order to vary the flow rate across the width of the applicator. Increasing (or decreasing) the RPM of the common drive draft resulted in the same increase (or decrease) in flow rates across all of the pumps. Thus, conventional pumps designs limit the ability to adjust process parameters, such as volumetric flow rate across the width, in-line. Rather, to change flow rates outside the desirable operating ranges of the pumps installed on the

machine, the pumps must be replaced with the pumps sized for the application. As discussed above, replacing typical pumps is time intensive and complex. The pump assembly as described herein allows for individual pump control while also minimizing removal/replacement times.

[0045] There are several additional advantages to using the applicator and pump assembly. As noted above, volumetric displacement of each pump assembly within an adhesive applicator can be controlled independently. With independent displacement control of adjacent pumps along the applicator length, differential flow rates can now be varied by changing the drive motor speed. Less pump assemblies are required for a wide range of processing needs, e.g. a wide flow rates. This reduces part numbers and helps manage product changeover during use. Furthermore, adhesive flow streams can be easily added (or removed).

[0046] Another embodiment of the present disclosure is a hybrid applicator for dispensing hot-melt adhesive. Figure 15 illustrates an applicator 410. The hybrid applicator 410 is configured for both metered output and pressure fed output. The applicator 410 is similar to the applicator 10 and 210 described above. For instance, the hybrid applicator 410 includes dispensing module(s) 416, air control valves(s) a manifold 412 (segmented or unitary).

[0047] The hybrid applicator 410 includes at least one pump assembly 420 (or pump assembly 220) and at least one pressure feed block 520, each of which is coupled to the manifold. In the present disclosure reference number 420 can be used interchangeably with the reference number 420a-420c unless noted otherwise. In accordance with the embodiment illustrated in Figure 15, the applicator 10 includes three pump assemblies 420a, 420b and 420c, and four pressure feed blocks 520a, 520b 520c and 520d. However, the applicator 410 can include any number of pump assemblies and pressure feed blocks.

[0048] Continuing with Figure 15, the pump assembly 420 is substantially the same as pump assembly 20 (or pump assembly 220) described above. The pump assembly 420 receives adhesive from flow channels in the manifold which are ported to the input 419c. Pressure feed blocks 520a and 520c include inlet and outlets that receive adhesive from the manifold supplied through the input 419c. The pressure feed blocks 520b and 520d are supplied adhesive through inputs 419a and 419b. The inputs 419a and 419b receive adhesive from a melting unit (not shown) located upstream. A pump(not shown) near the melting unit is used to feed adhesive through hoses to inputs 419a and 419b coupled to the pressure feed blocks 520b and 520d, respectively. Heat from the manifold 412 is transferred to the pressure feed blocks 520a-520d thereby heating the adhesive within the pressure feed block 520. As shown, the hybrid

applicator 410 has multiple input fittings 419a-419c, some which are associated with a pressure feed block(s), can be used to supply different types of adhesives to the applicator.

[0049] Combining a pump assembly 420 with a pressure feed block 520 increases process flexibility to the applicator 410. For example, the pump assembly 420 permits precise metering of adhesive streams from the dispensing module, while other adhesive streams are associated with the less precise pressure feed blocks 520. It should be appreciated that the hybrid applicator 410 can be metered, pressure-fed, and multi-zone pressure-fed, all in a single manifold as needed.

[0050] While the disclosure is described herein using a limited number of embodiments, these specific embodiments are not intended to limit the scope of the disclosure as otherwise described and claimed herein. The precise arrangement of various elements and order of the steps of articles and methods described herein are not to be considered limiting. For instance, although the steps of the methods are described with reference to sequential series of reference signs and progression of the blocks in the figures, the method can be implemented in a particular order as desired.

What is claimed is:

1. An applicator for dispensing adhesive, the applicator comprising:
a manifold having a front, a back opposite to said front, a first side, and a second side that is opposite the first side;
at least one dispensing module coupled to said front of said manifold; and
at least one modular pump assembly removably mounted to said manifold, each said modular pump assembly comprising:
a front surface;
an outlet on said front surface in fluid communication with said manifold;
an inlet for receiving said adhesive;
a gear assembly; and
a drive motor coupled to said gear assembly and operable for pumping the adhesive from said inlet to said outlet, said drive motor having a shaft, said shaft having an axis that intersects said front surface.
2. The applicator of claim 1, wherein said axis is aligned with a plane that is parallel to said first side and said second side.
3. The applicator of claim 1, wherein said axis of said shaft does not intersect both of said first side and said second side.
4. The applicator of claim 1, wherein each gear has an outer diameter and a length that is greater than or equal to said outer diameter.
5. The applicator of claim 1, wherein said pump assembly includes a thermal isolation region between said pump and said drive motor.
6. The applicator of claim 1, wherein said manifold comprises a plurality of manifold segments.
7. The applicator of claim 1, further comprising at least one pressure feed block coupled to said manifold.
8. The applicator of claim 1, further comprising a control unit and a rotational sensor coupled to the said control unit and said drive motor, said rotational sensor configured to provide data indicative an actual rotation speed of the drive motor to said control unit, said control unit configured to receive data indicative of a target rotational speed of said drive motor, said control

unit configured to a) determine an extent of a variance between said target rotational speed of the drive motor and said actual rotational speed of the drive motor, and b) adjust the rotational speed of said drive motor to reduce the variance.

9. An applicator for dispensing adhesive onto a substrate, the applicator comprising:
 - a manifold having a front, a back opposite to the front, a first side, and a second side that is opposite the first side;
 - at least one dispensing module coupled to said manifold; and
 - at least one modular pump assembly removably mounted to said manifold, each said modular pump assembly comprising:
 - an inlet for receiving the adhesive and an outlet in flow communication with said manifold;
 - a gear assembly; and
 - a drive motor coupled to said gear assembly and operable for pumping adhesive from said inlet to said outlet, said drive motor having a drive shaft connected to said gear assembly, said drive shaft having an axis that does not intersect both of said first side and said second side of said manifold.
10. The applicator of claim 9, wherein said axis is aligned within a plane that is substantially parallel to said first side and said second side.
11. The applicator of claim 9, wherein each gear has an outer diameter and a length that is greater than or equal to said outer diameter.
12. The applicator of claim 9, wherein said pump assembly includes a thermal isolation region between said pump and said drive motor.
13. The applicator of claim 9, wherein said manifold comprises a plurality of manifold segments.
14. The applicator of claim 9, further comprising at least one pressure feed block coupled to said manifold.
15. The applicator of claim 9, further comprising a control unit and a rotational sensor coupled to the said control unit and said drive motor, said rotational sensor configured to provide data indicative an actual rotation speed of the drive motor to said control unit, said control unit configured to receive data indicative of a target rotational speed of said drive motor, said control unit configured to a) determine an extent of a variance between said target rotational speed of the

drive motor and said actual rotational speed of the drive motor, and b) adjust the rotational speed of said drive motor to reduce the variance.

16. A pump assembly configured to connect to a manifold of an applicator for dispensing adhesive, the pump assembly comprising:

- a front surface;
- an outlet on said front surface;
- an inlet for receiving said adhesive;
- a gear assembly; and

a drive motor coupled to said gear assembly and operable for pumping the adhesive from said inlet to said outlet, said drive motor having a shaft, said shaft having an axis that intersects said front surface.

17. The pump assembly of claim 16, wherein each gear has an outer diameter and a length that is greater than or equal to said outer diameter.

18. A pump assembly configured to connect to a manifold of an applicator for dispensing adhesive, the manifold having a front, a back opposite to the front, a first side, and a second side, the pump assembly comprising:

- an inlet for receiving the adhesive;
- an outlet in flow communication with said manifold;
- a gear assembly; and

a drive motor coupled to said gear assembly and operable for pumping adhesive from said inlet to said outlet, said drive motor having a drive shaft connected to said gear assembly, said drive shaft having an axis that does not intersect both of the first side and the second side of the manifold when the pump assembly is connected to the manifold.

19. The pump assembly of claim 18, wherein each gear has an outer diameter and a length that is greater than or equal to said outer diameter.

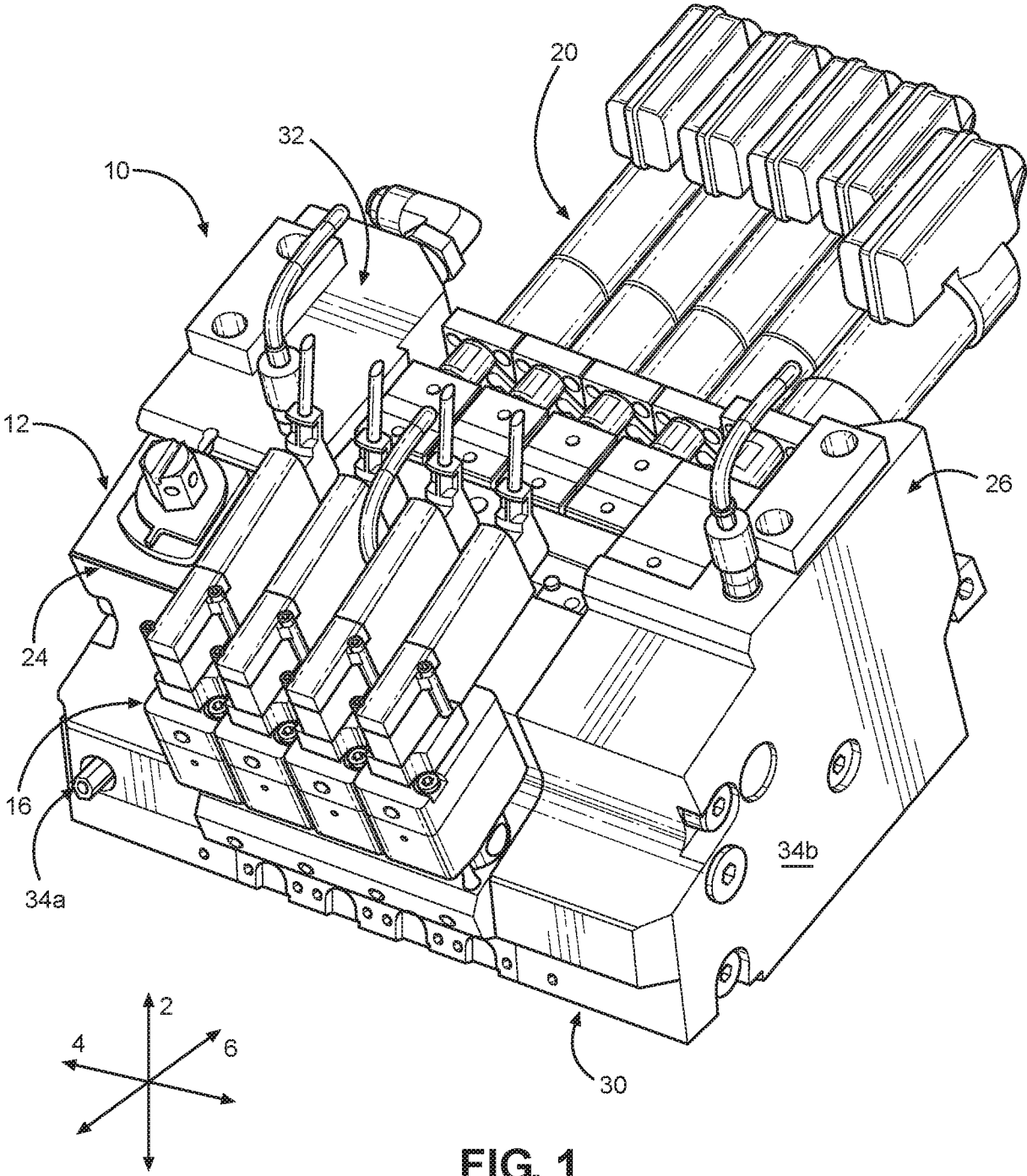


FIG. 1

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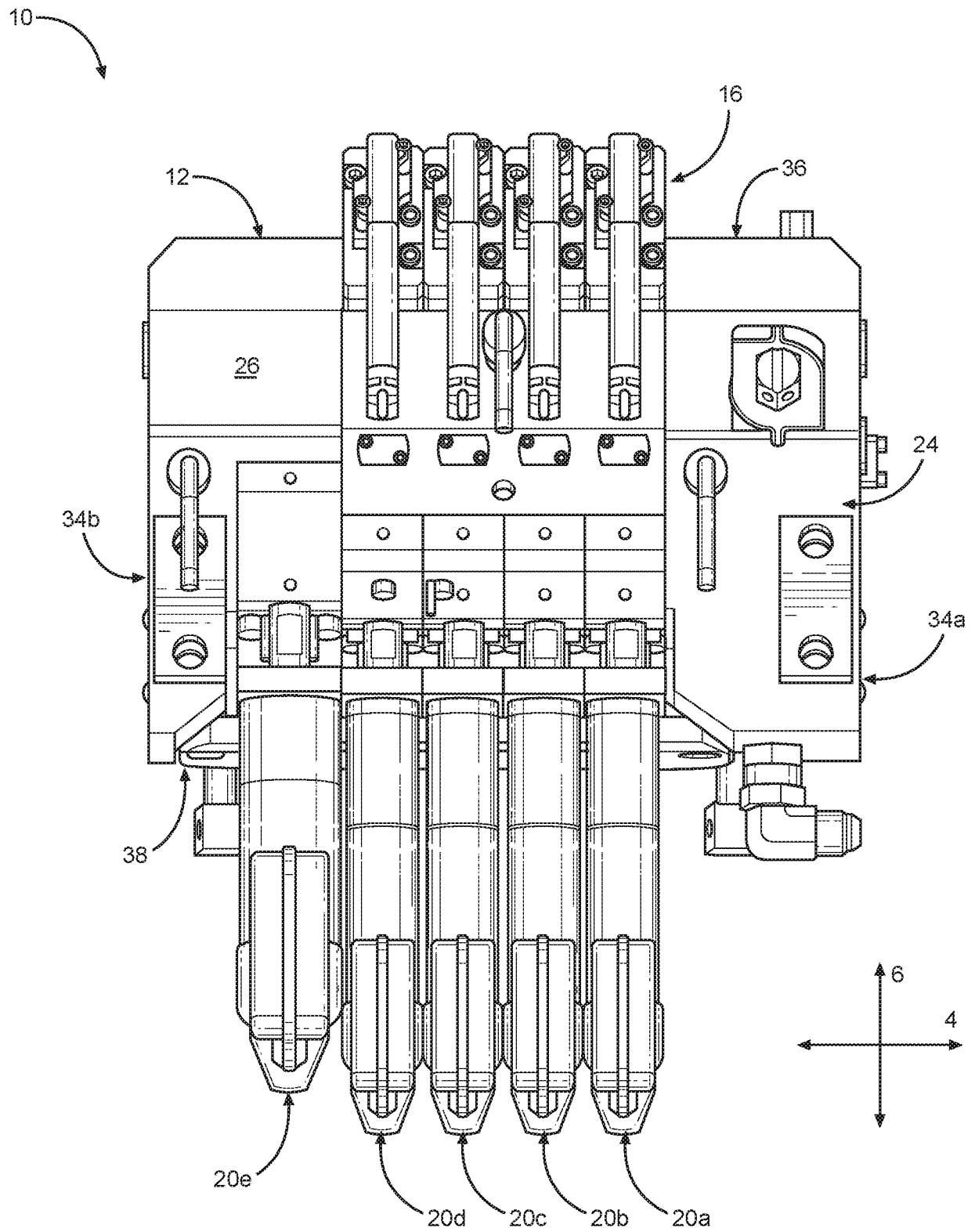
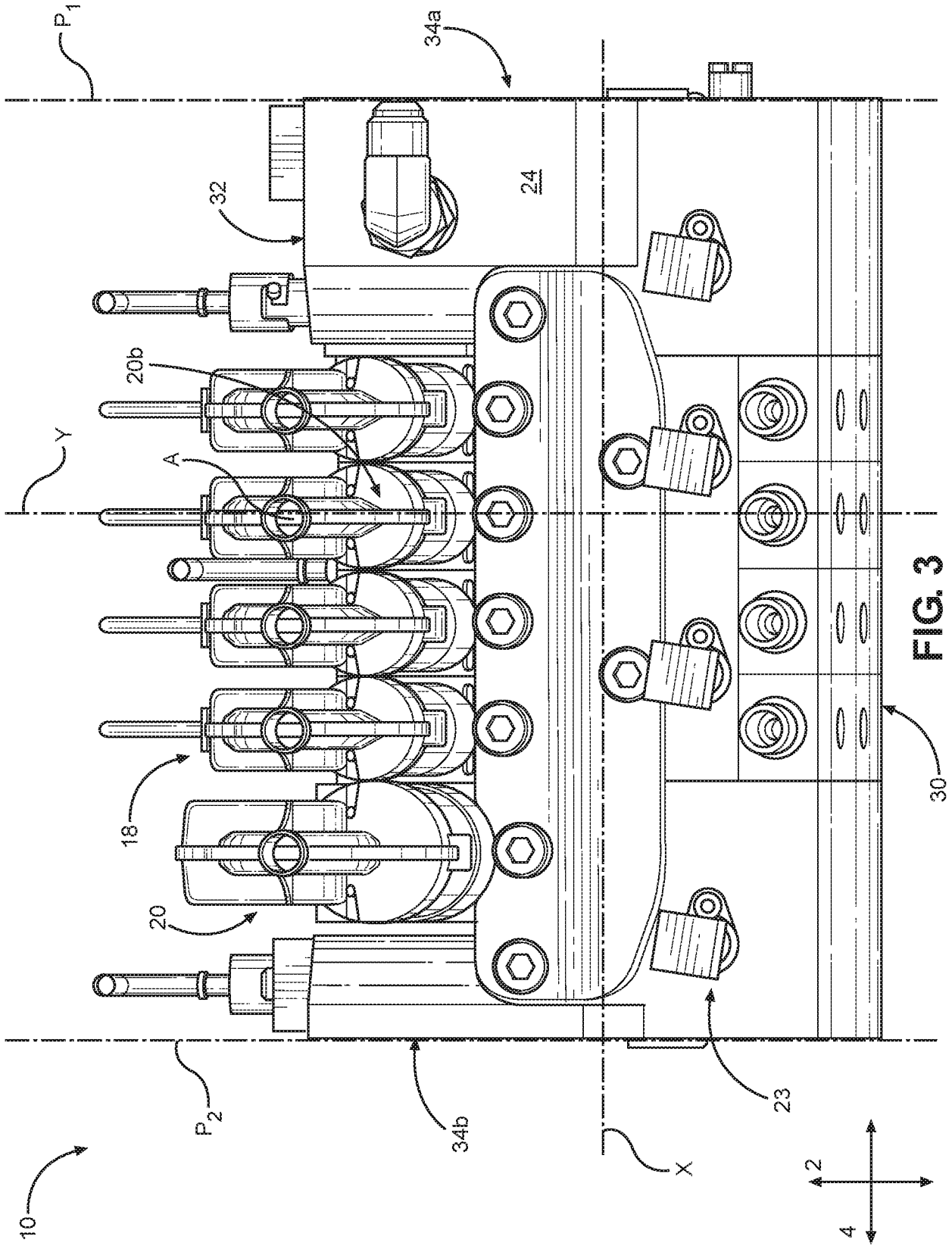


FIG. 2



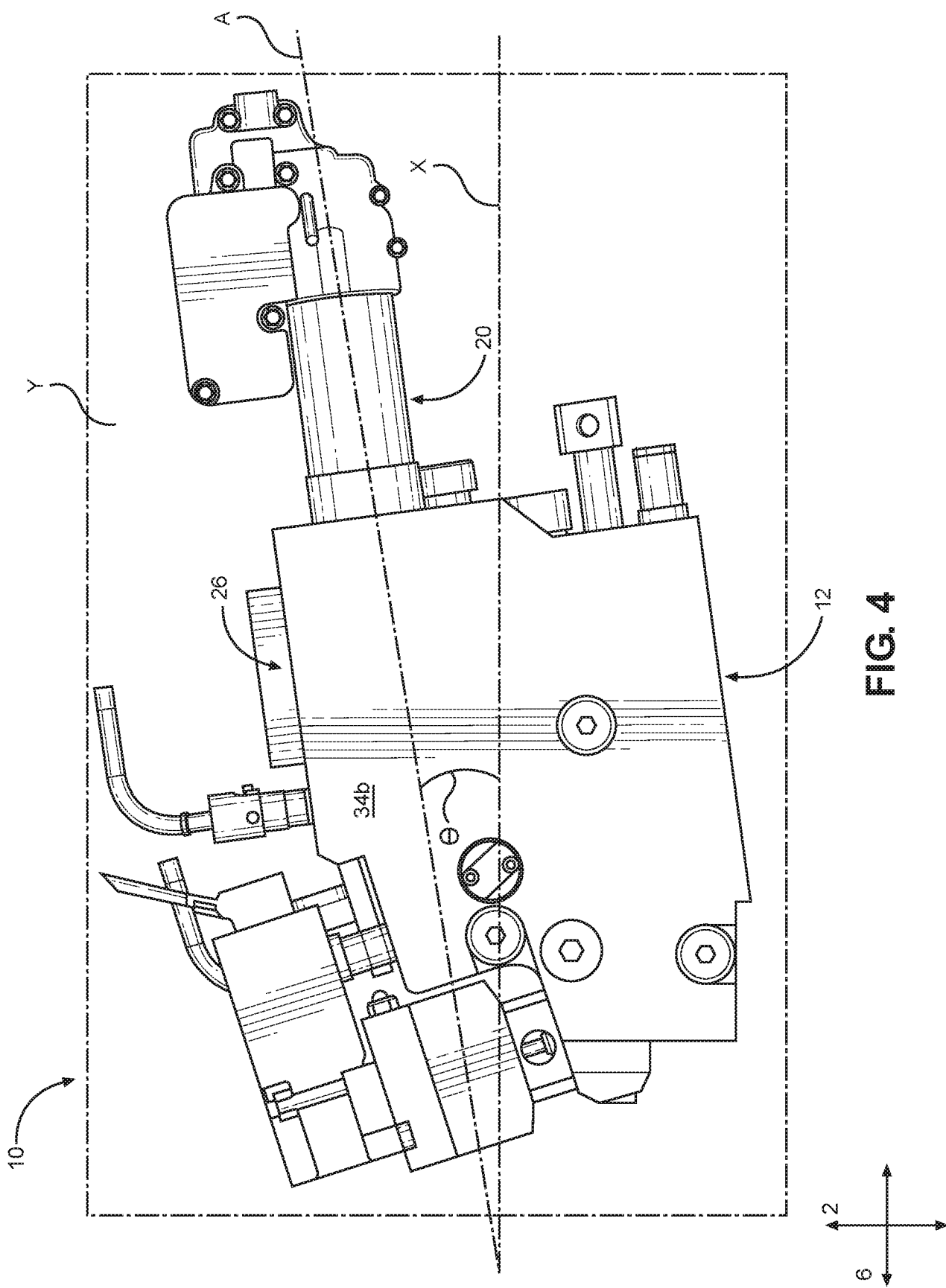
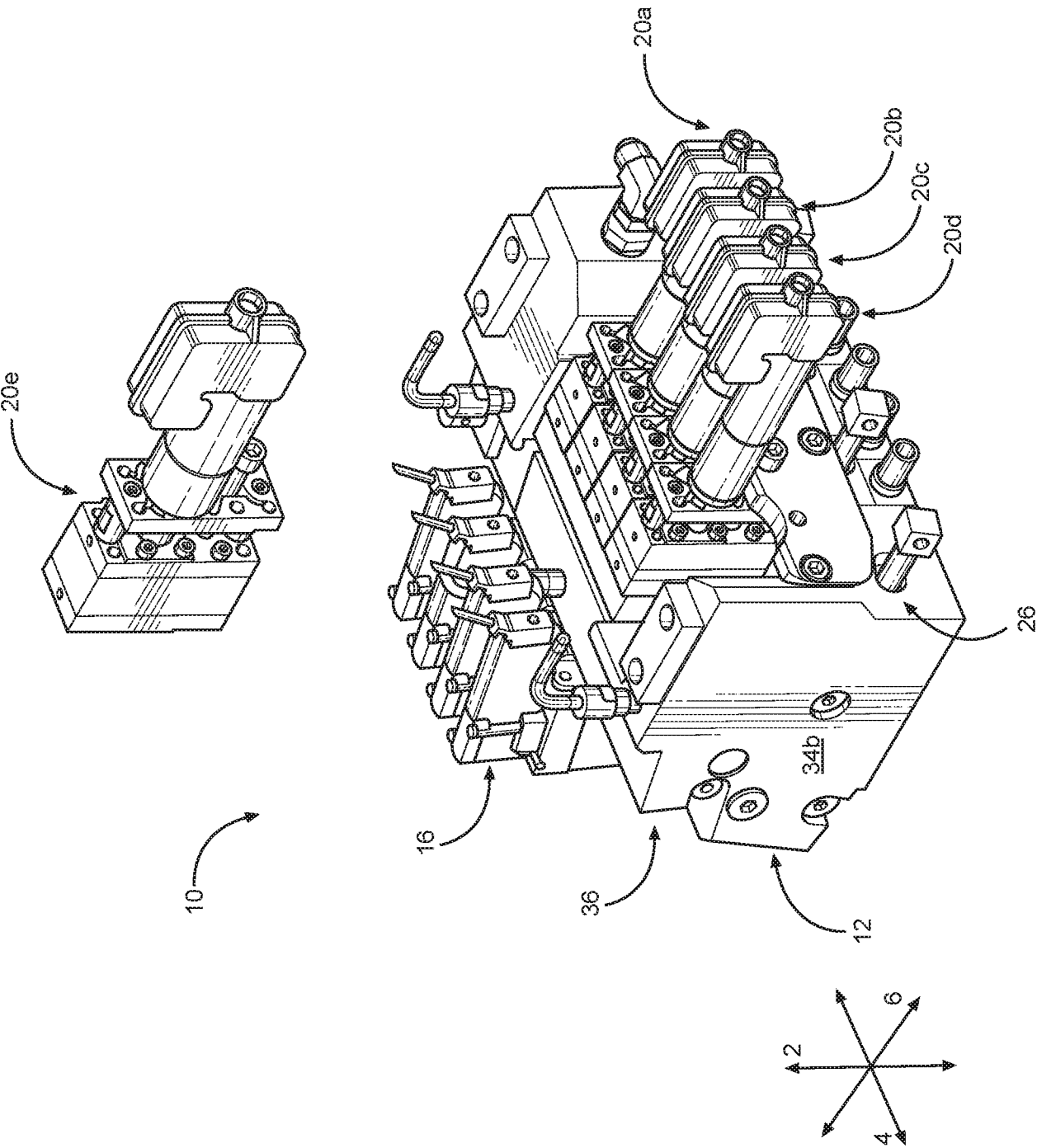


FIG. 5



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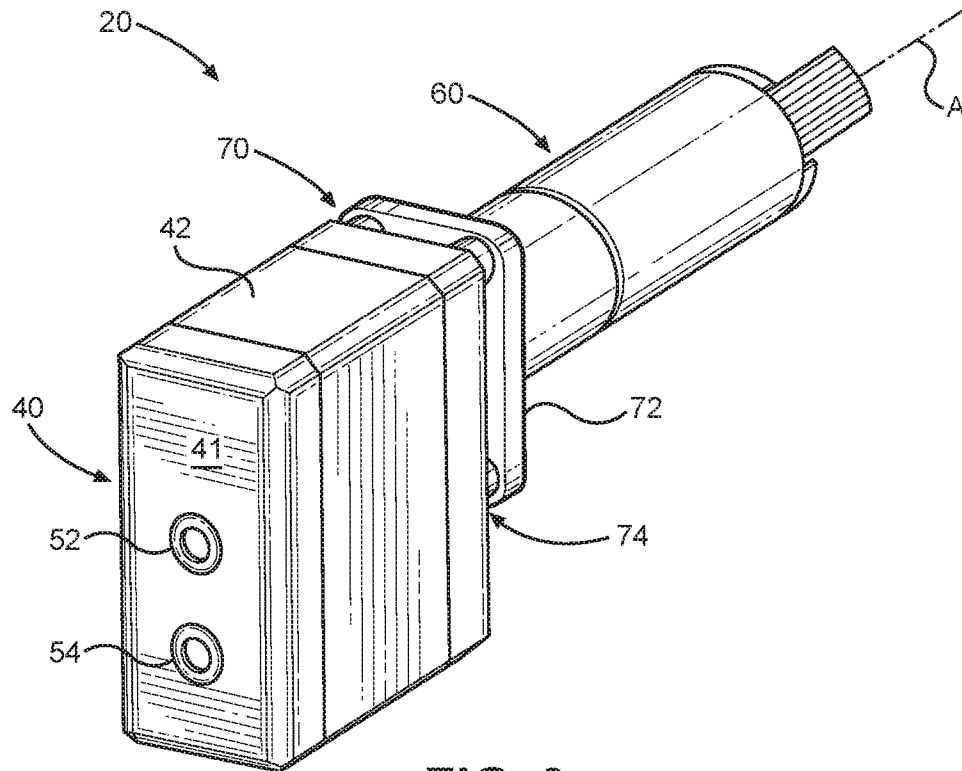


FIG. 6

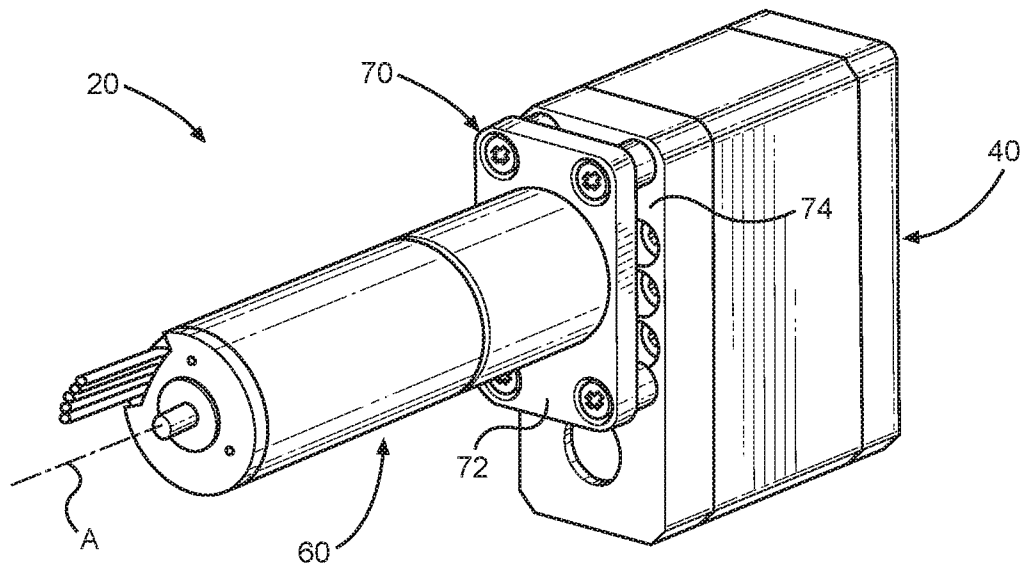
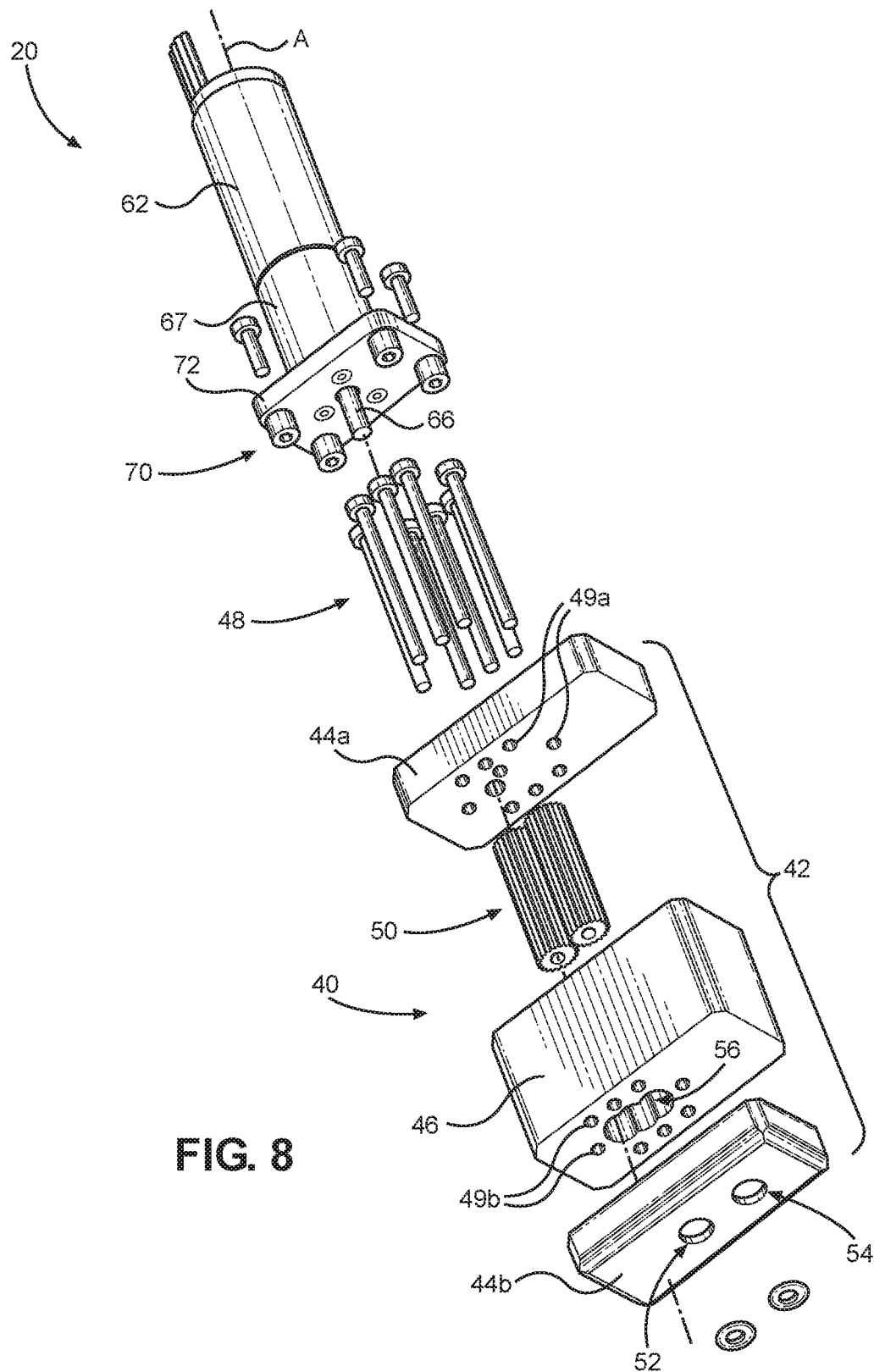


FIG. 7



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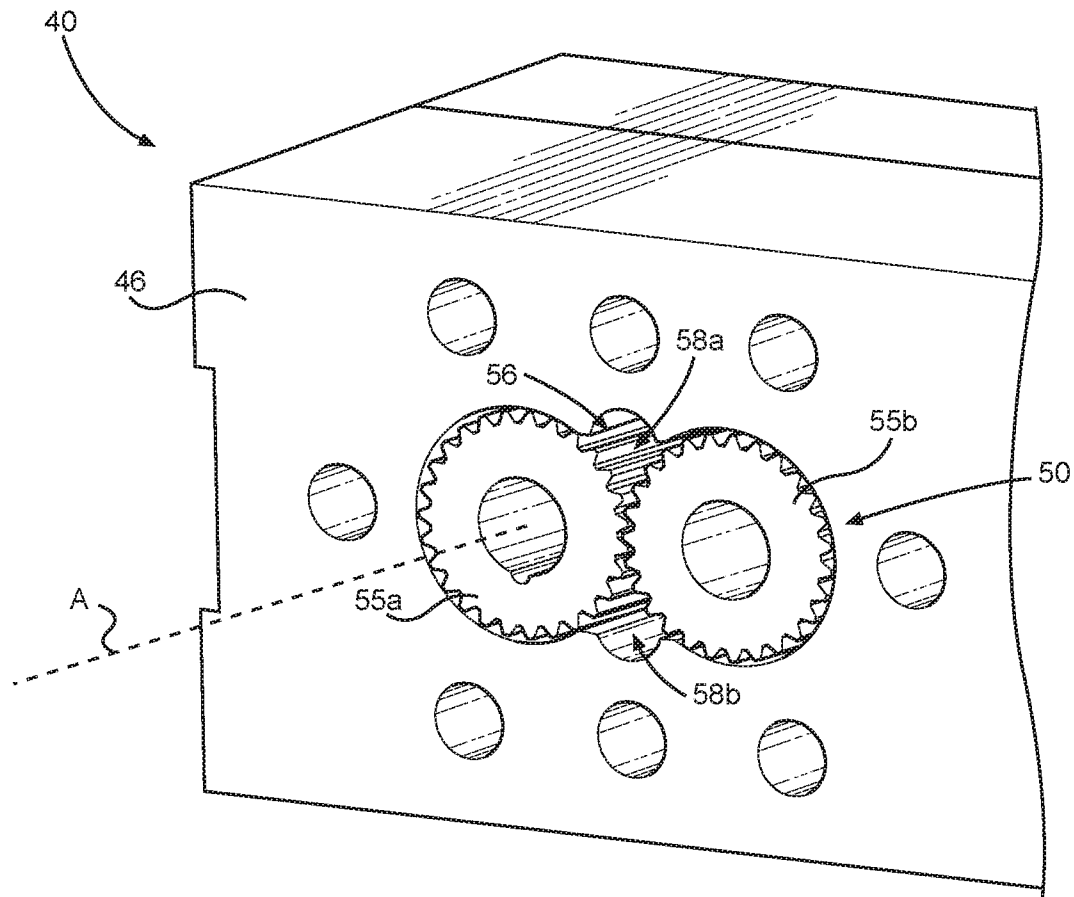


FIG. 9

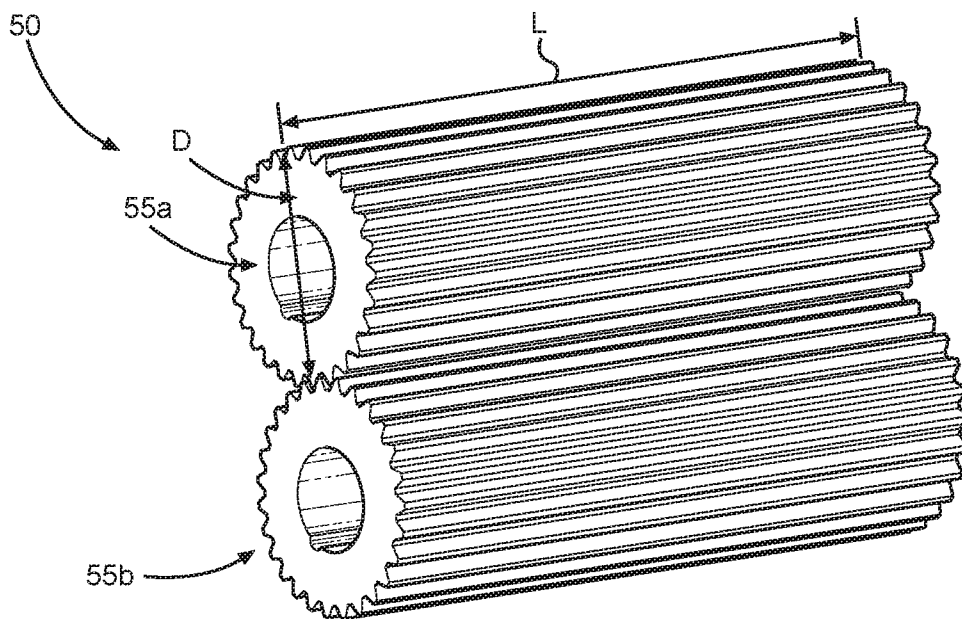


FIG. 10

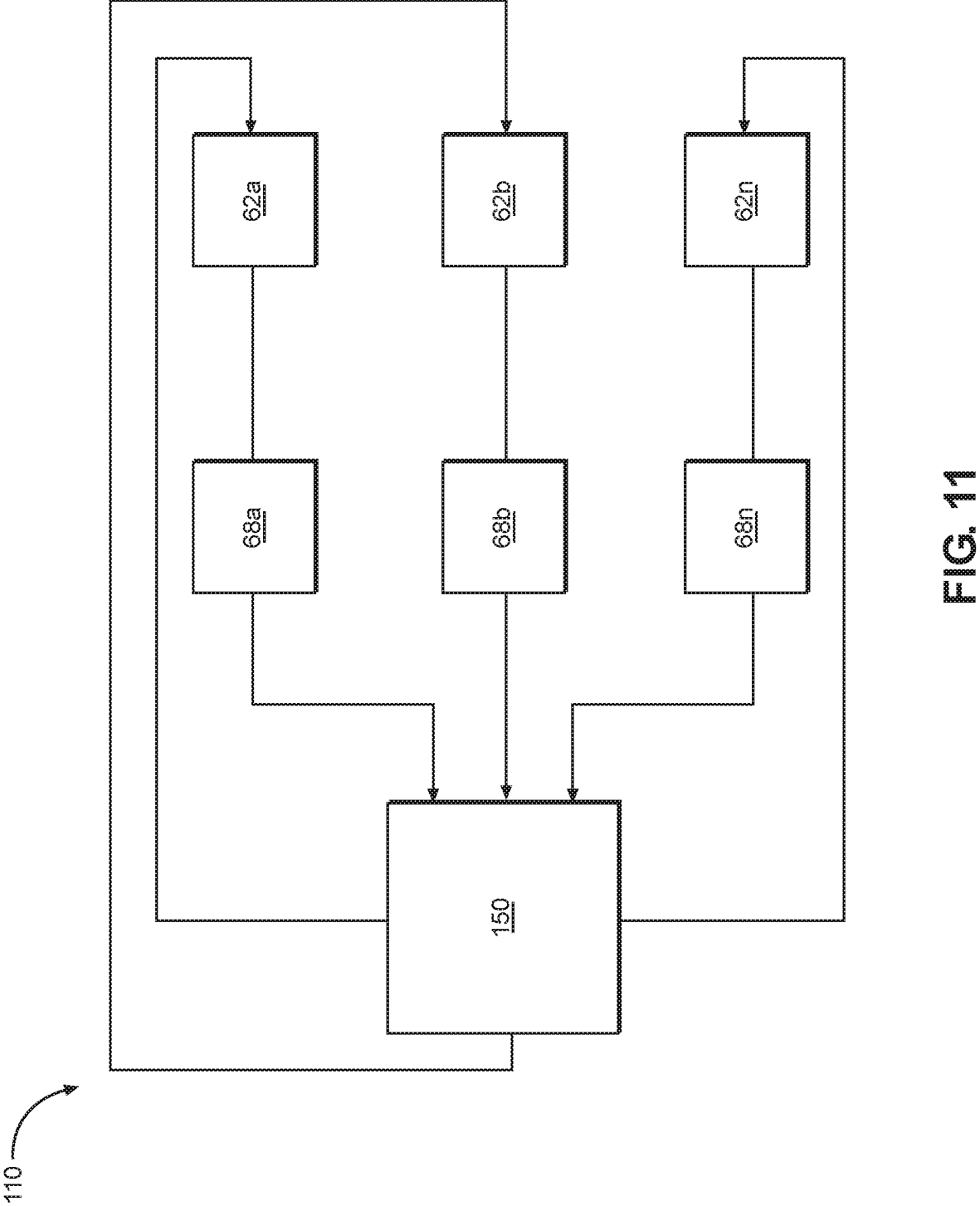


FIG. 11

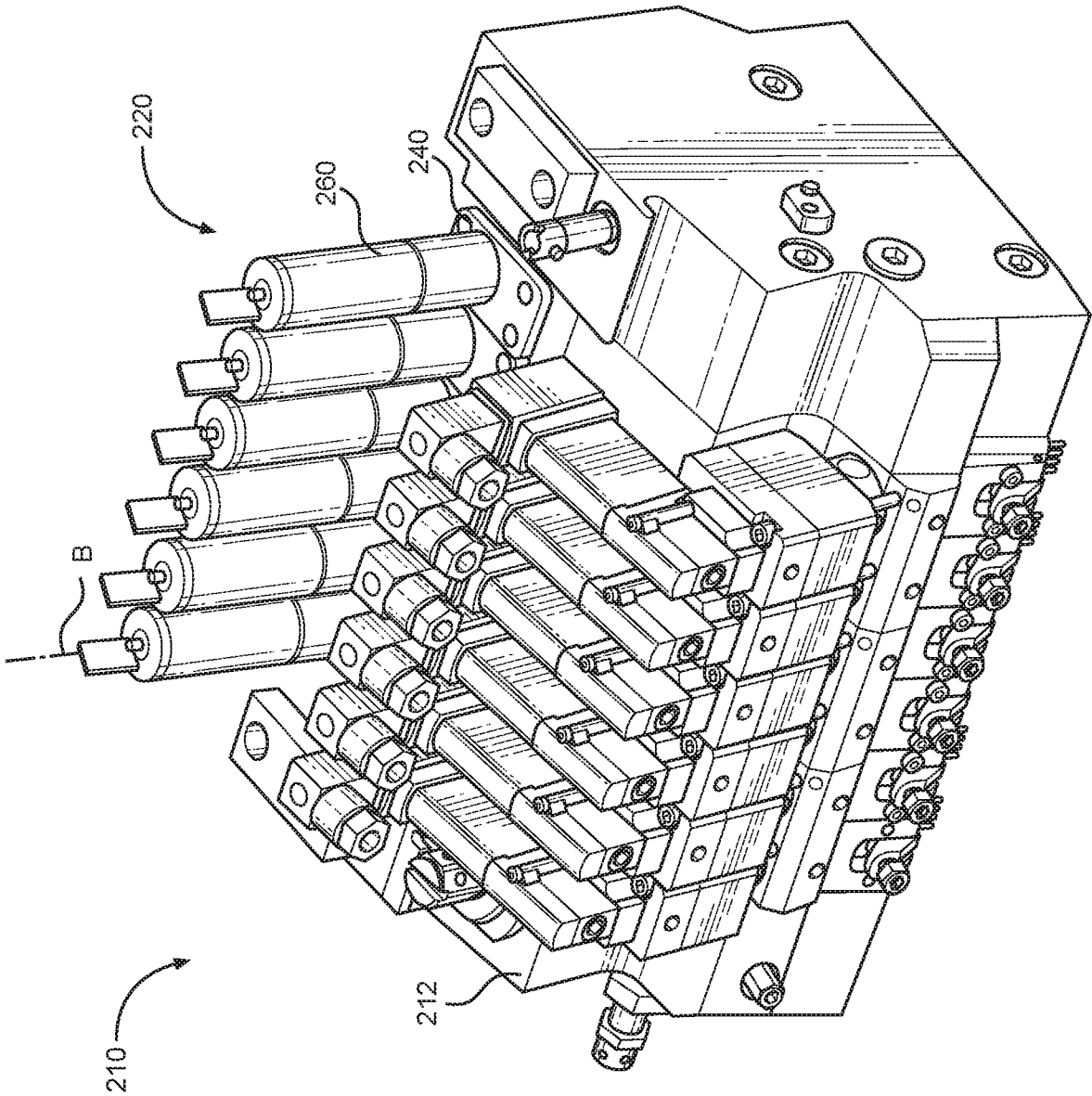


FIG. 12

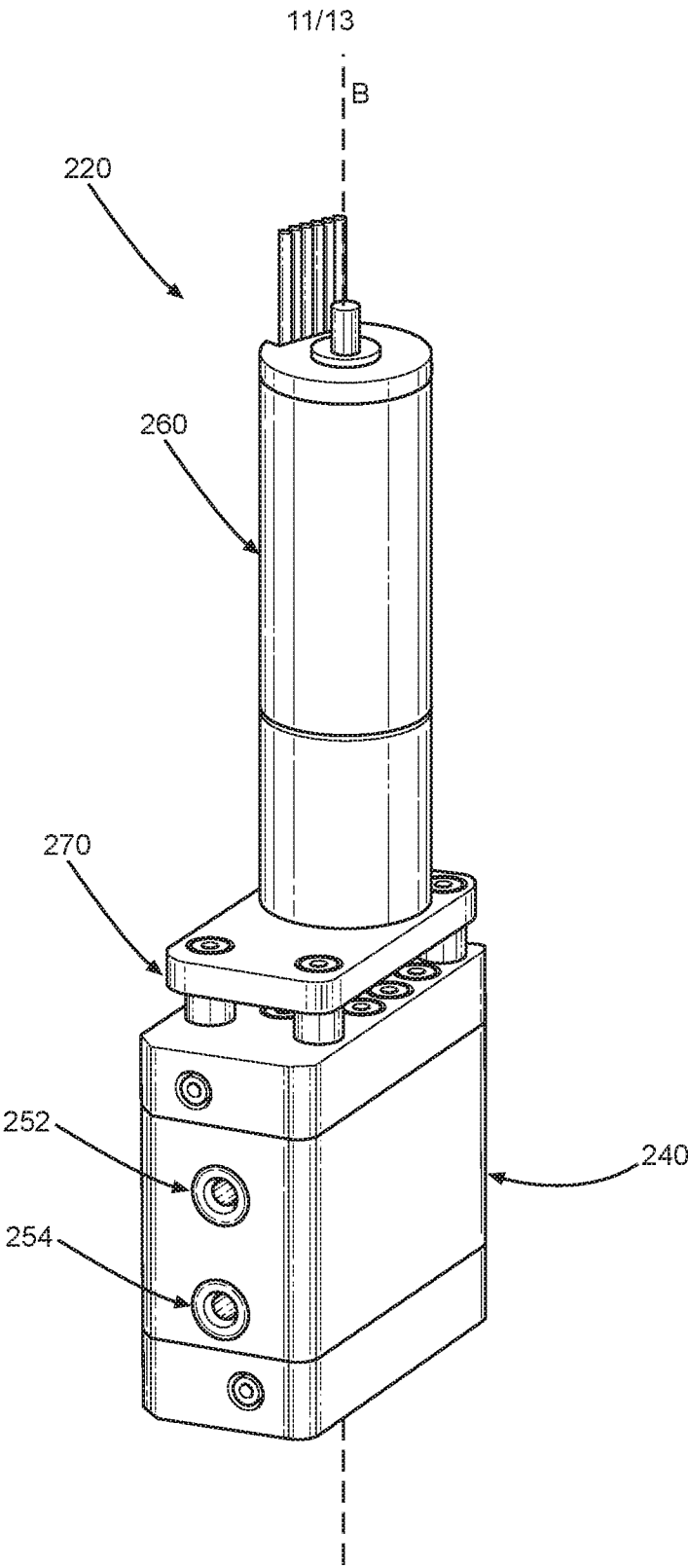


FIG. 13

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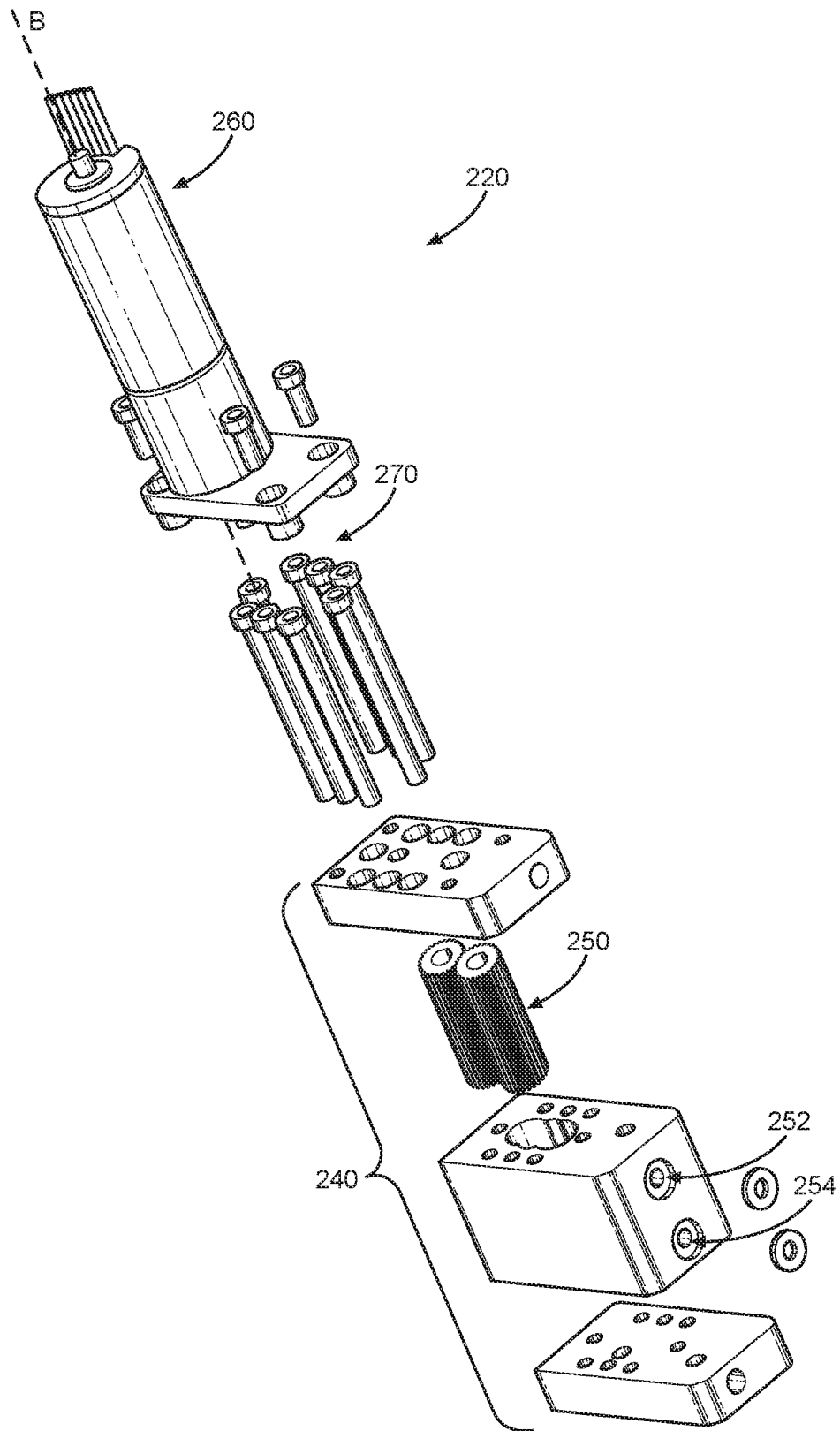


FIG. 14

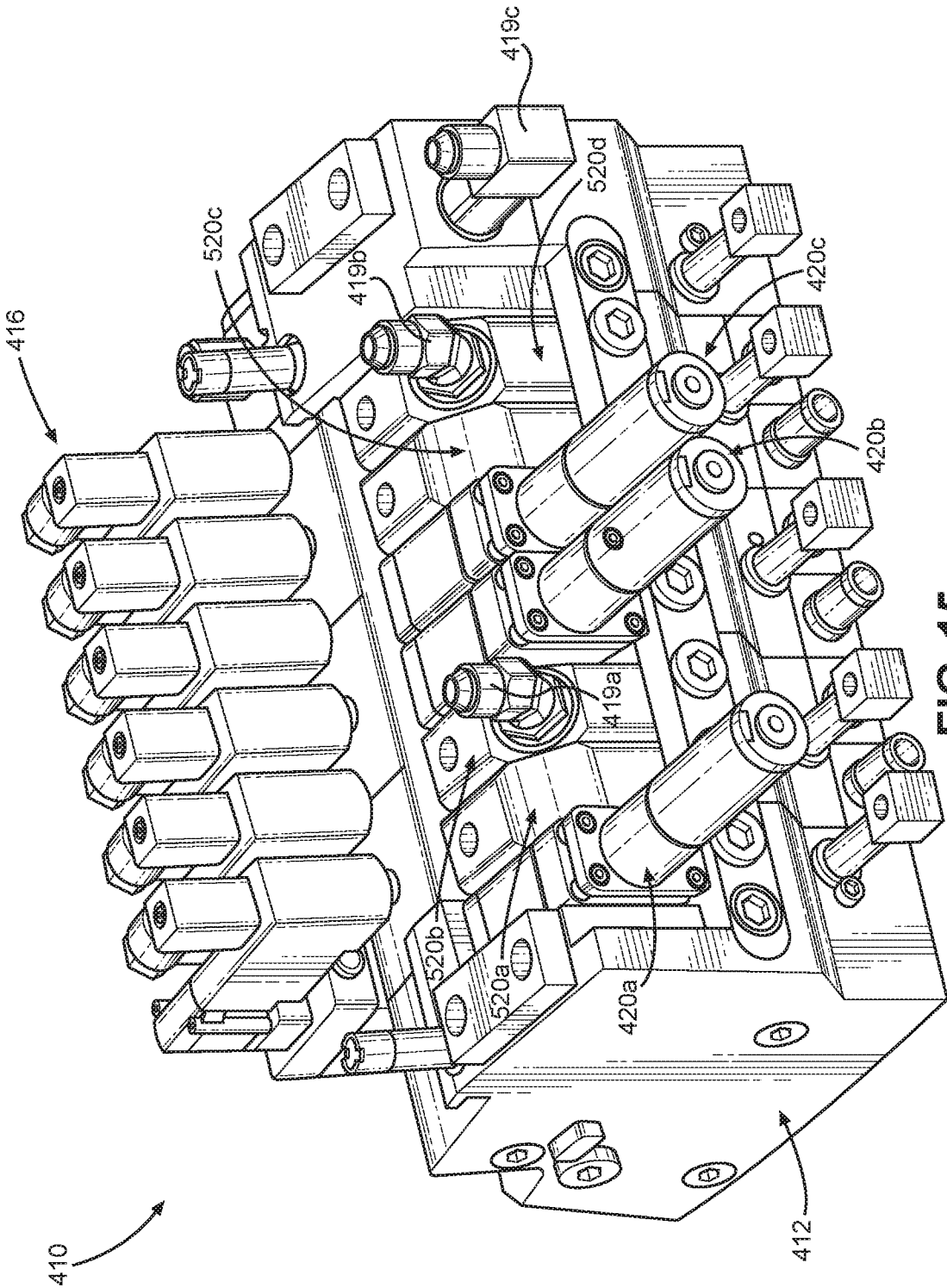


FIG. 15

INTERNATIONAL SEARCH REPORT

International application No

PCT/US2017/050368

A. CLASSIFICATION OF SUBJECT MATTER

INV. B05C5/02 B05C11/10
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)

B05C B29C F04C F04B

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.
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X	US 5 409 642 A (ALLEN MARTIN A [US] ET AL) 25 April 1995 (1995-04-25) abstract; figures 1-6 column 6, line 57 - column 7, line 11 -----	1-3,6, 8-10,13, 15,16,18
X	US 2005/230423 A1 (RINEY JOHN M [US] ET AL) 20 October 2005 (2005-10-20) abstract; figures 1-8 -----	1,9,16, 18
A	US 6 422 428 B1 (ALLEN MARTIN A [US] ET AL) 23 July 2002 (2002-07-23) abstract; figures 1-6 ----- -/-	5



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

7 December 2017

Date of mailing of the international search report

20/12/2017

Name and mailing address of the ISA/

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Authorized officer

Ciotta, Fausto

INTERNATIONAL SEARCH REPORT

International application No
PCT/US2017/050368

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 9 415 415 B1 (NORDSON CORP [US]) 16 August 2016 (2016-08-16) abstract; figure 1 column 7, line 13 - line 33 -----	1-19
A	US 2002/102324 A1 (GROLEAU RODNEY J [US]) 1 August 2002 (2002-08-01) abstract; figure 4 -----	4

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

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