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Ford et al.

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(45) **Date of Patent: Apr. 30, 2024**

(54) **AUTOMATIC GIN BLADE TRAINER AND METHOD OF USE**

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(73) Assignee: **Ford Gin Services LLC**, Lubbock, TX (US)

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(65) **Prior Publication Data**

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Related U.S. Application Data

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(51) **Int. Cl.**
B23D 59/00 (2006.01)
G01B 7/31 (2006.01)

(52) **U.S. Cl.**
CPC ***B23D 59/002*** (2013.01); ***G01B 7/31*** (2013.01)

(58) **Field of Classification Search**
CPC B23D 59/002; G01B 7/31; B27B 5/34
See application file for complete search history.

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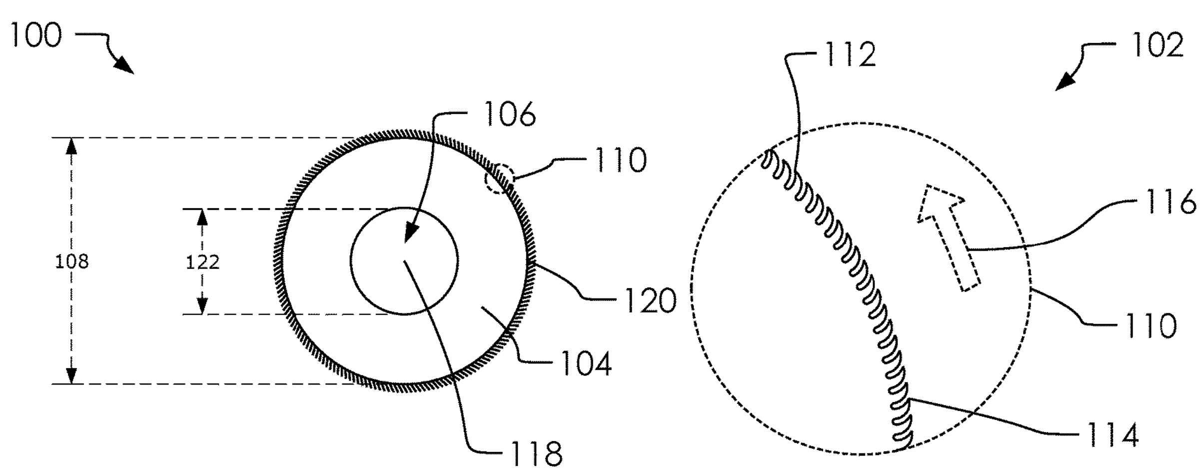
(74) *Attorney, Agent, or Firm* — Shannon Warren

(57) **ABSTRACT**

A training system comprises a training stand, a width, a length, a spacing measurement assembly, a training assembly, and a controller. each among a plurality of blade disks comprise a blade disk having a body portion, a center aperture, a diameter, a plurality of punched teeth, a sharpened edge, a center point, an outer edge and a center aperture diameter. portions of the plurality of blade disks comprises one or more misaligned disks and one or more nominal disks. The plurality of blade disks comprise at least a first disk and a last disk. each among the plurality of blade disks are attached to a mandrel along a center axis.

13 Claims, 29 Drawing Sheets



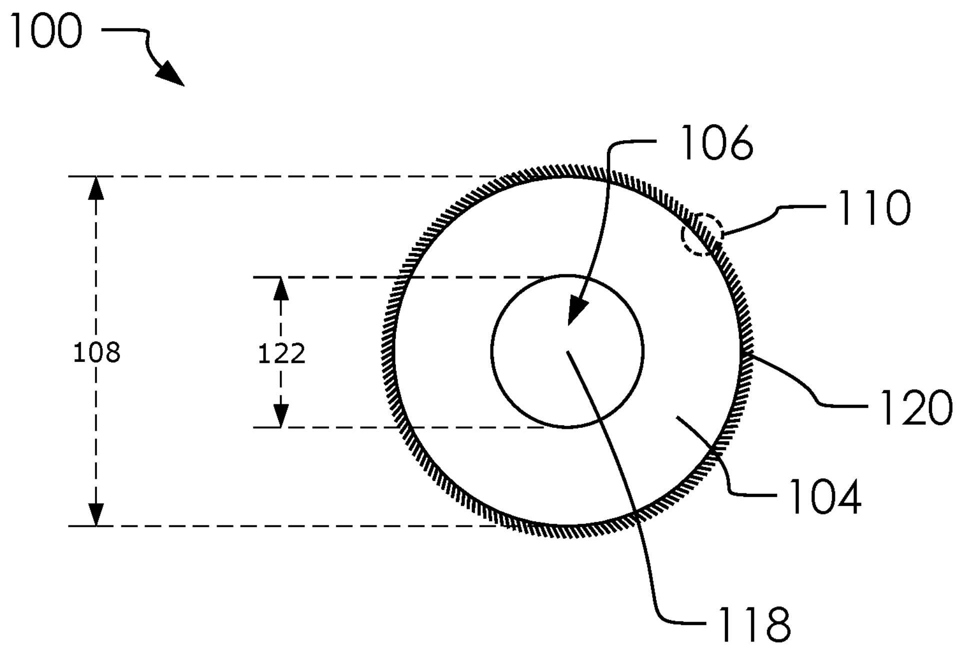


FIG. 1A

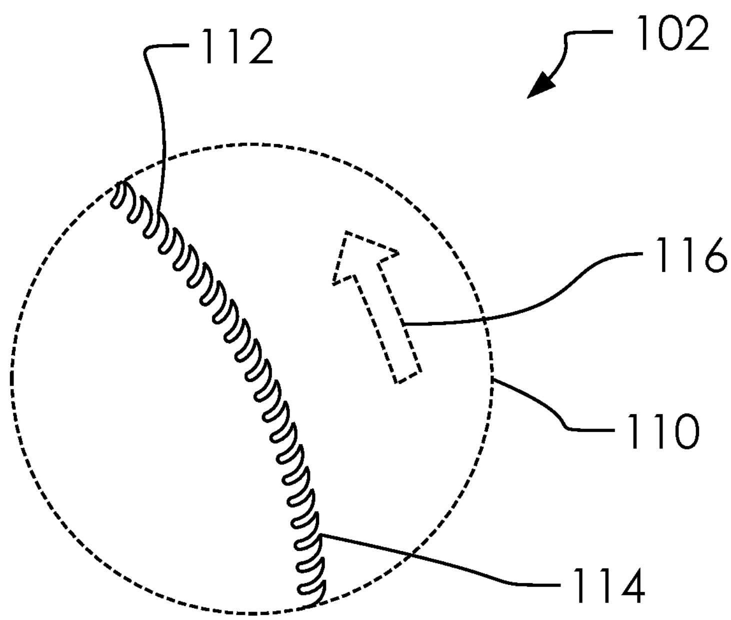


FIG. 1B

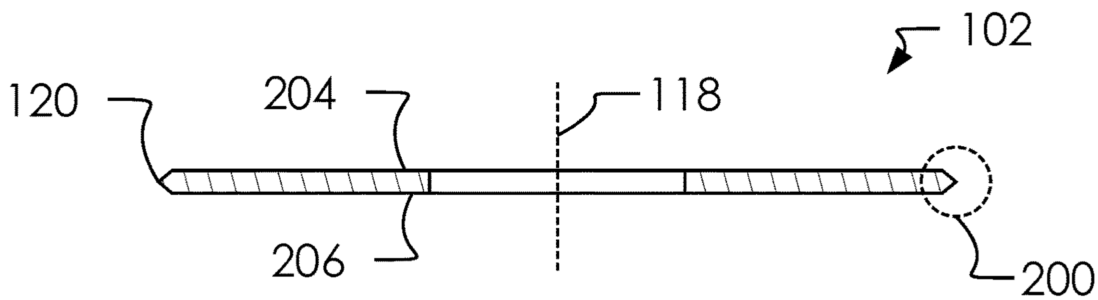


FIG. 2A

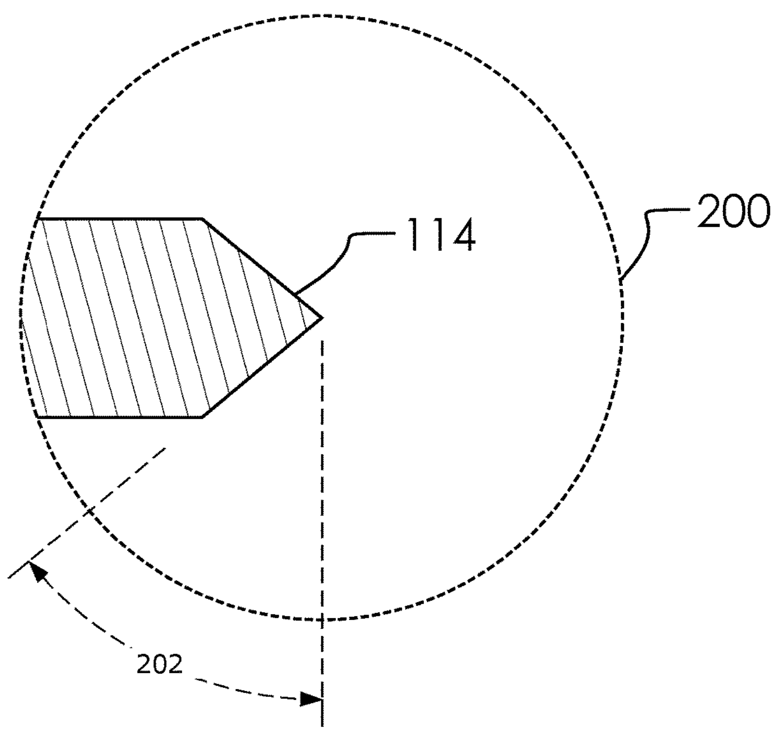


FIG. 2B

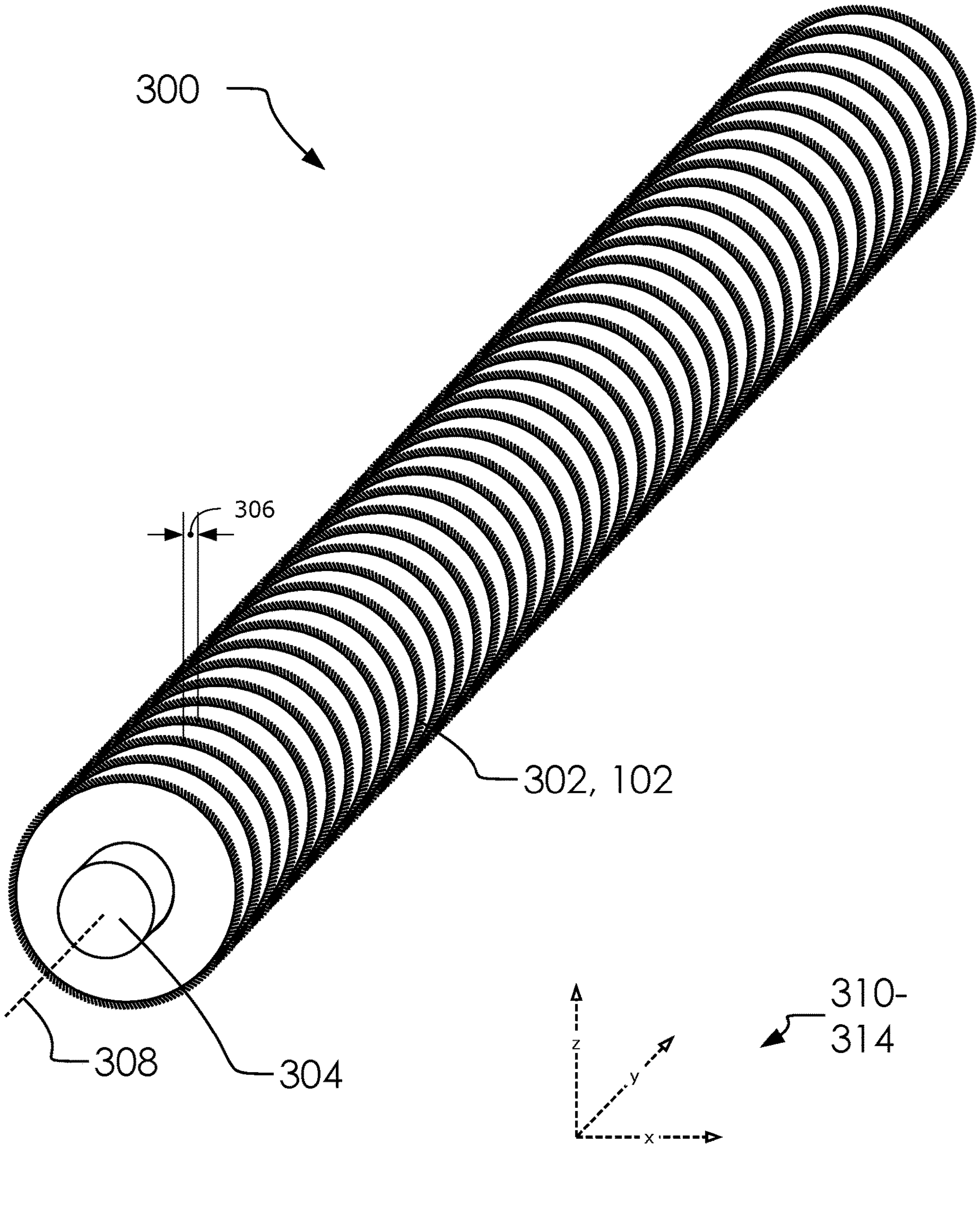


FIG. 3

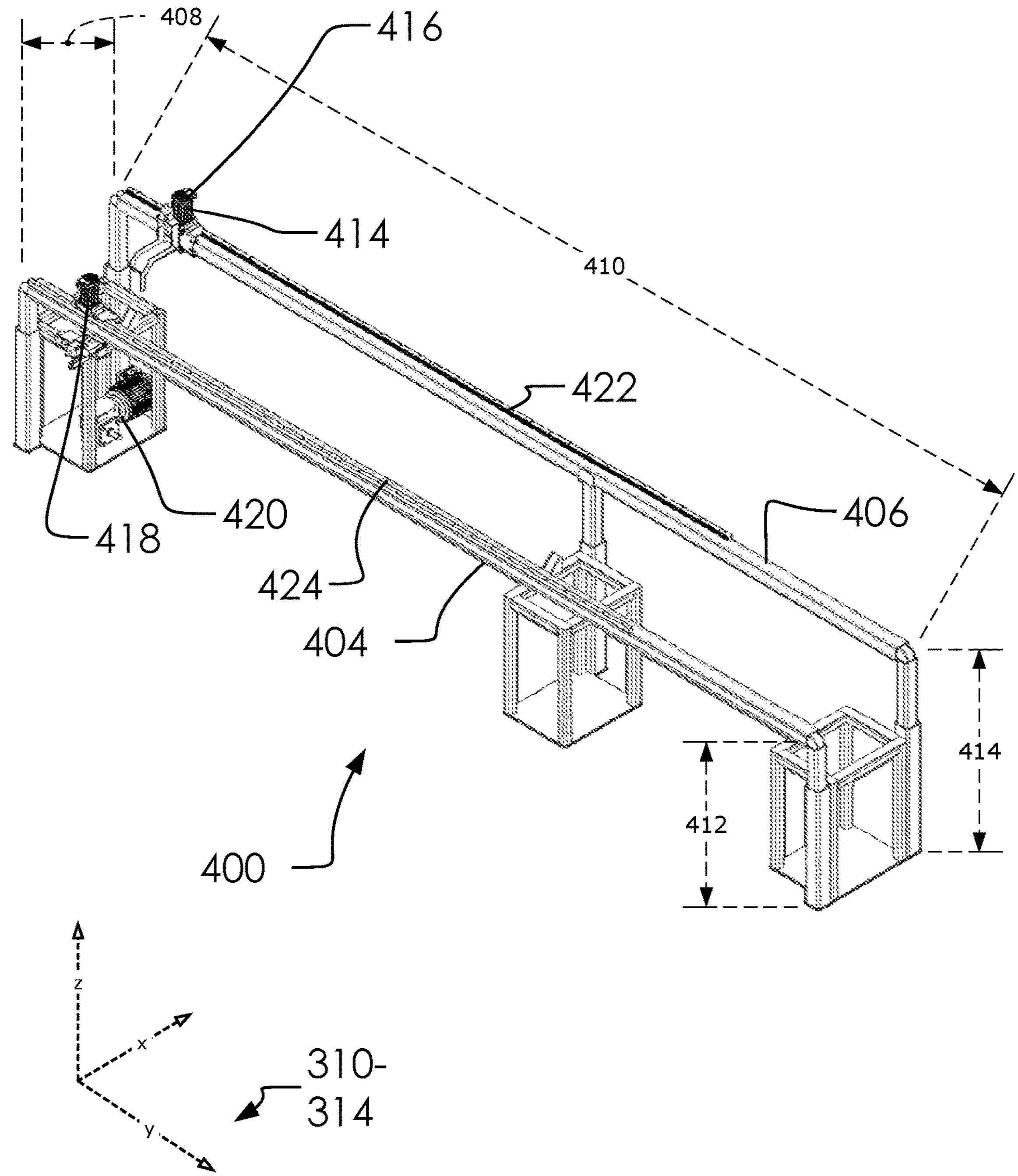


FIG. 4

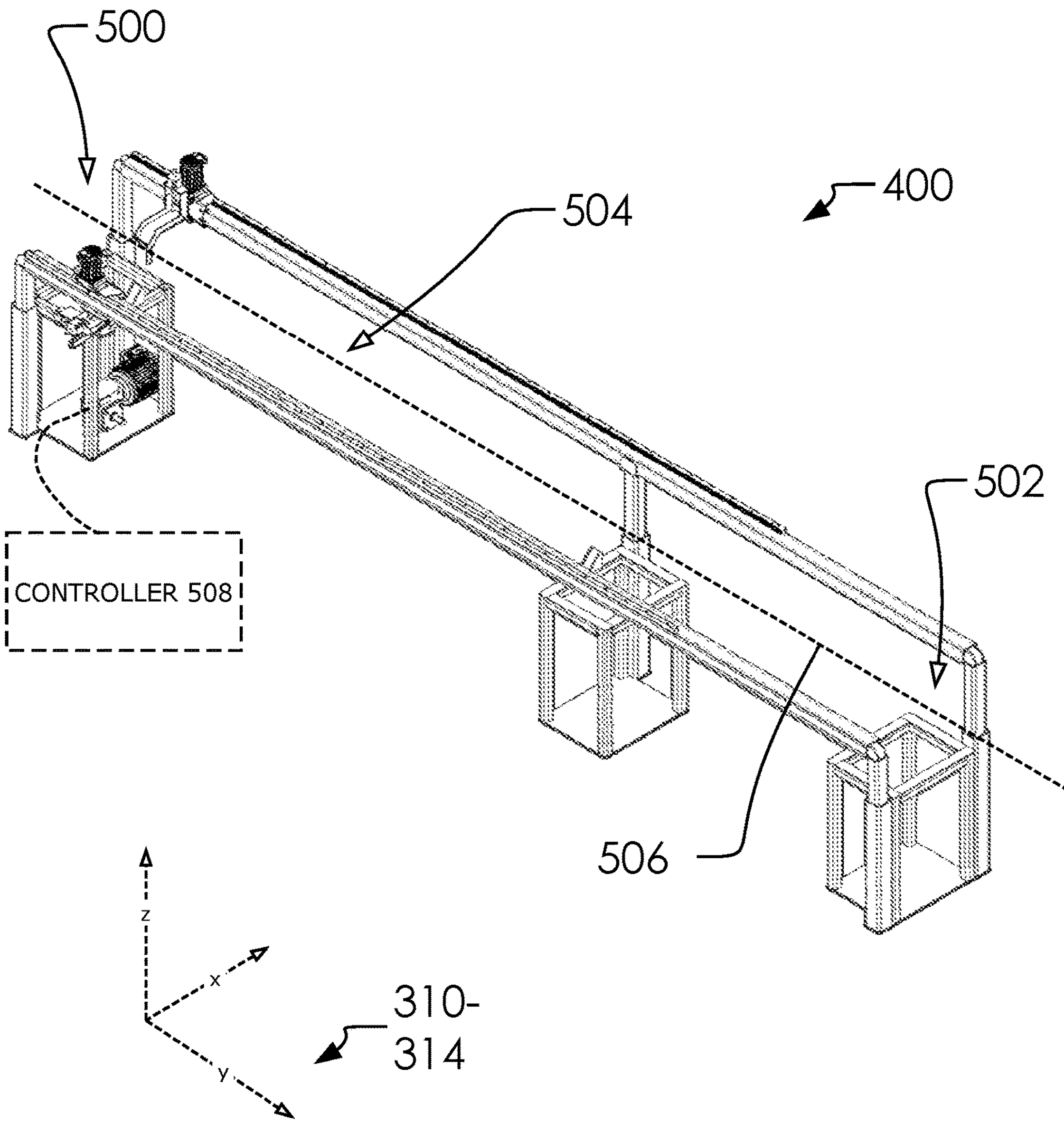
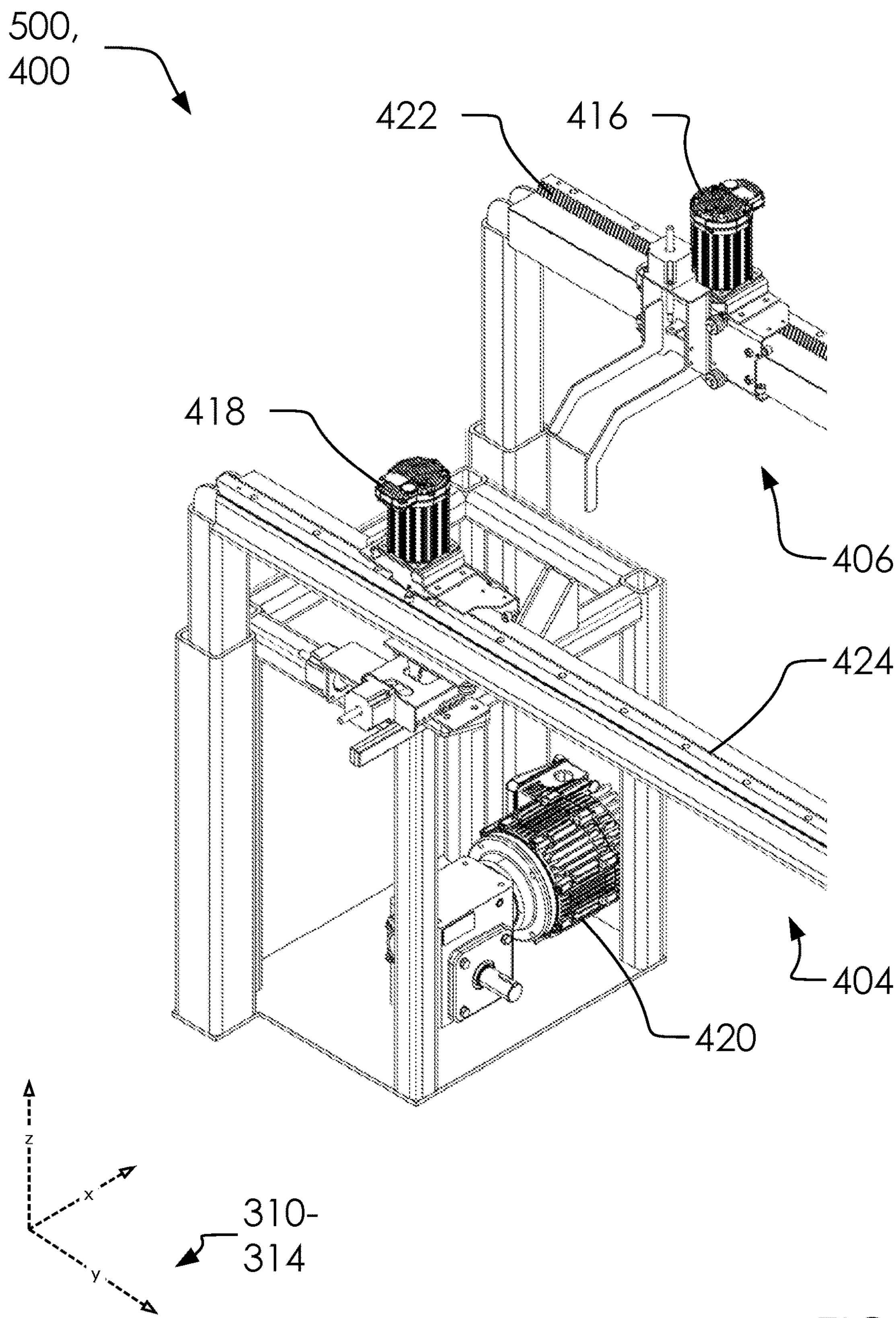


FIG. 5



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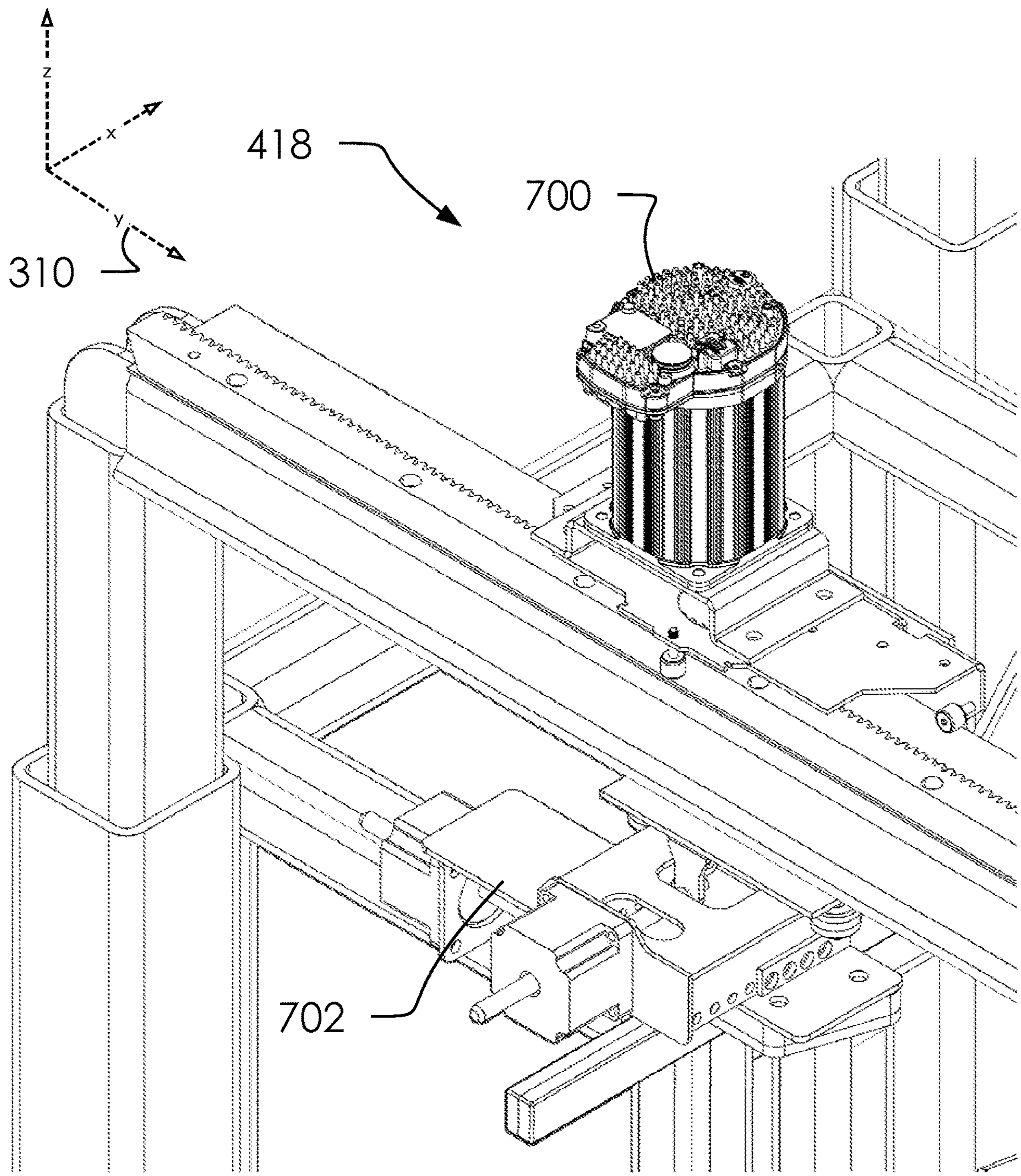


FIG. 7

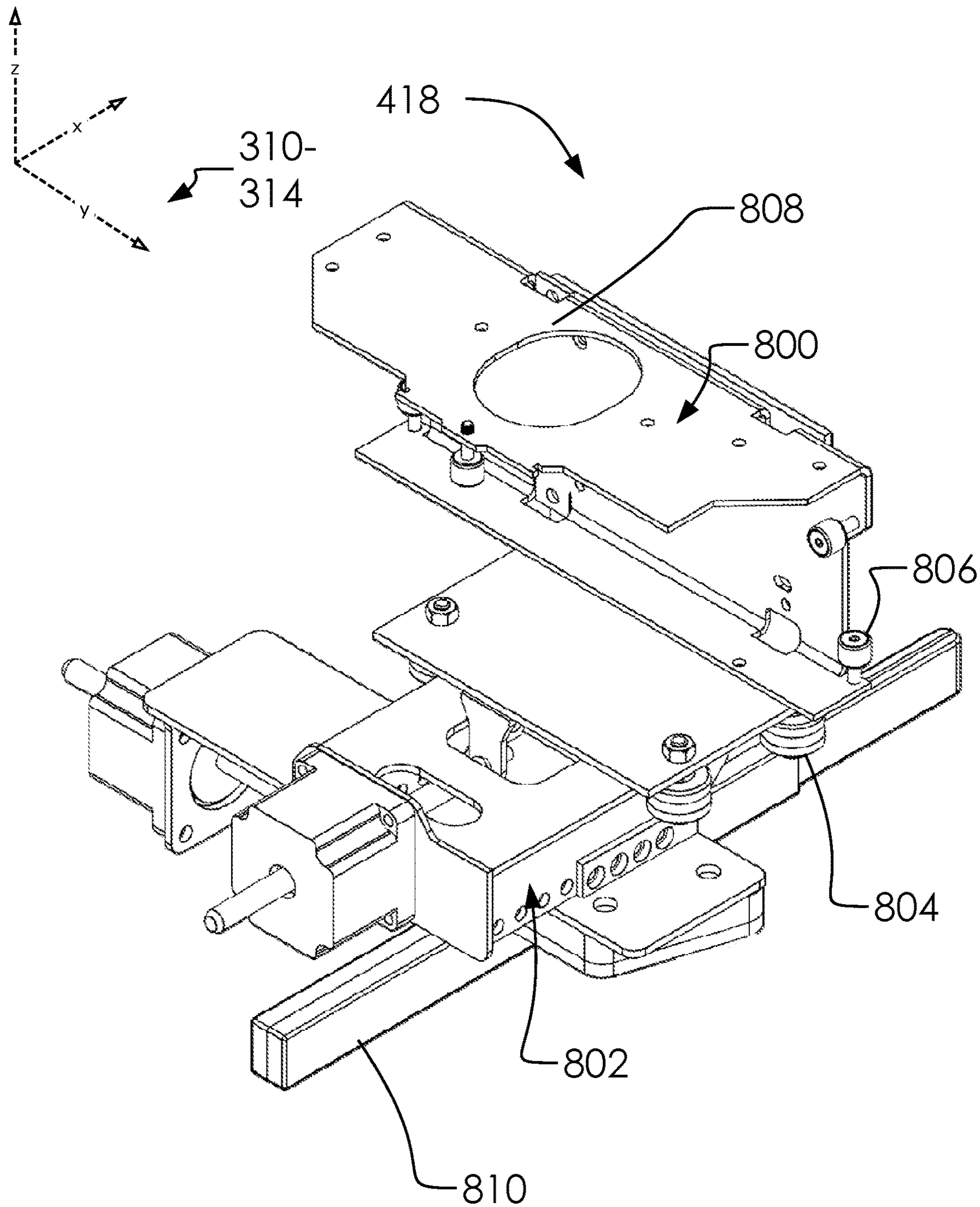
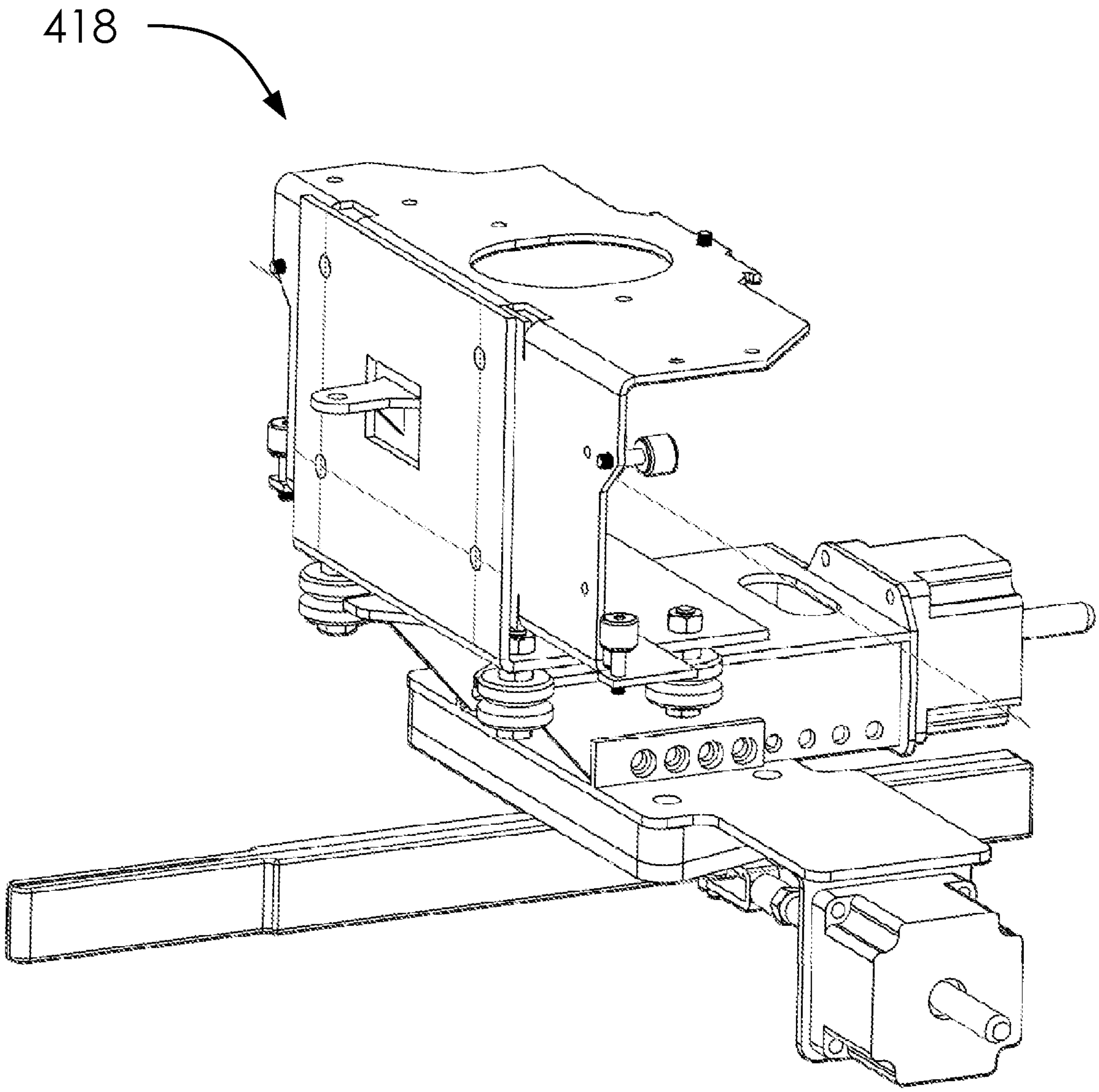


FIG. 8



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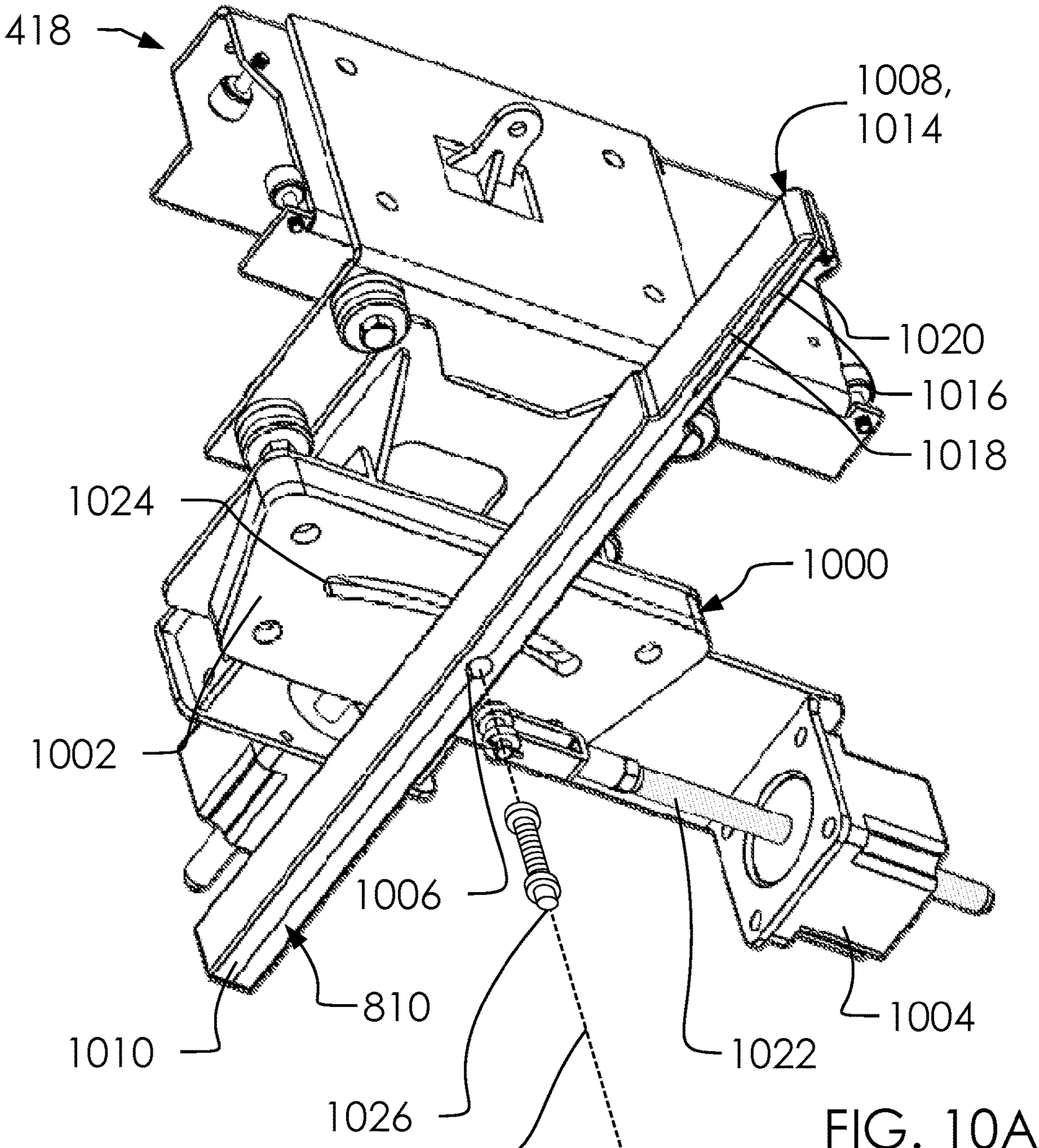


FIG. 10A

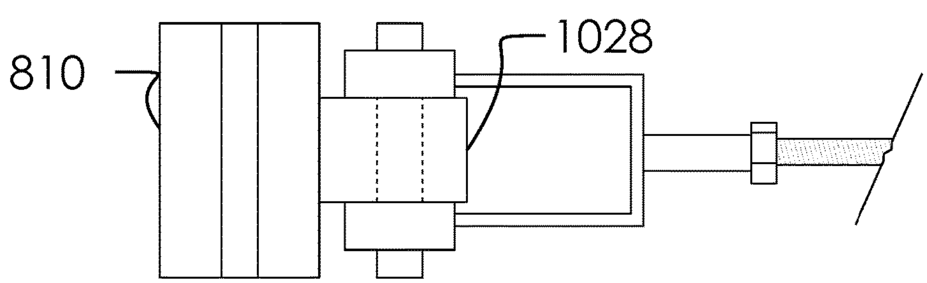


FIG. 10B

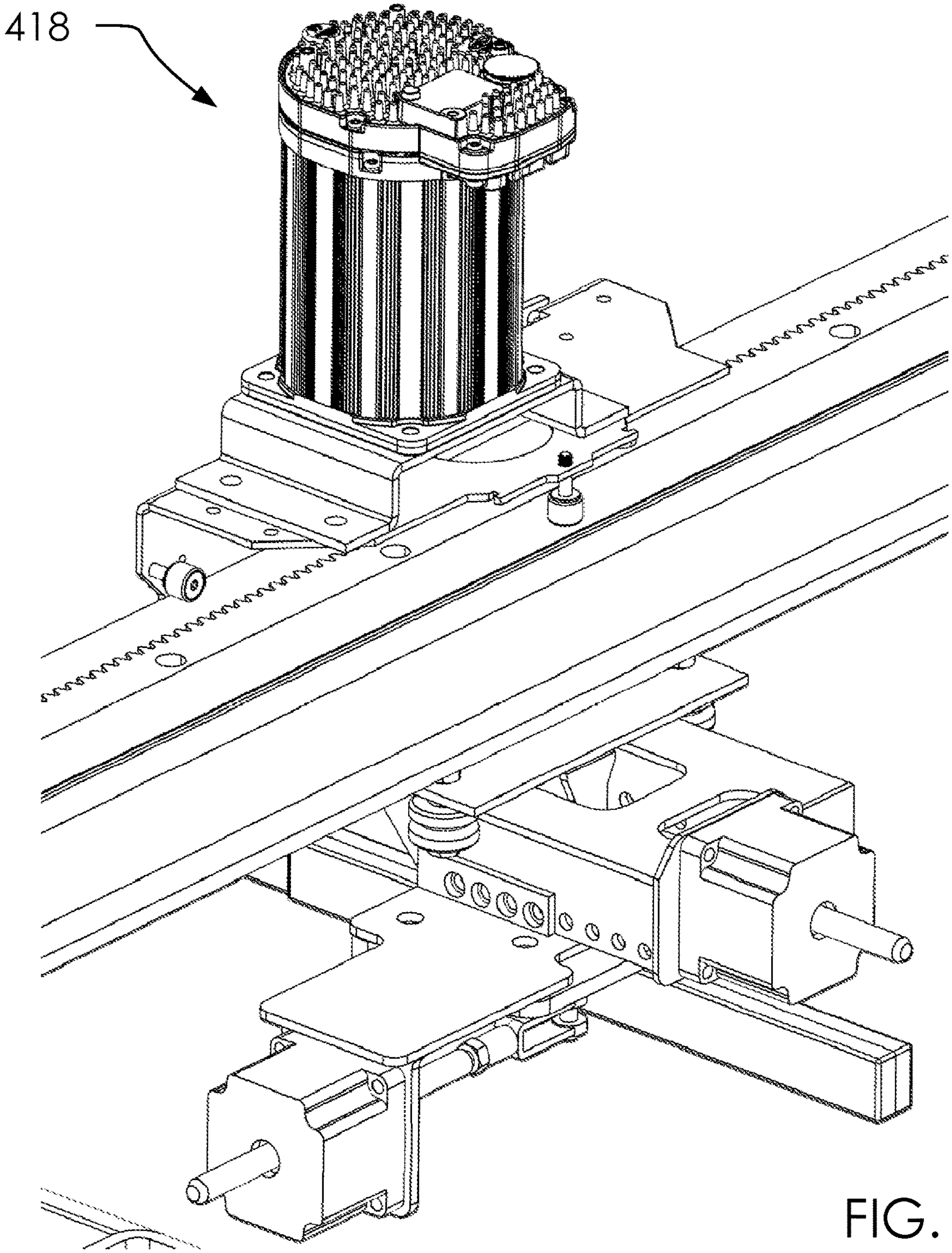


FIG. 11

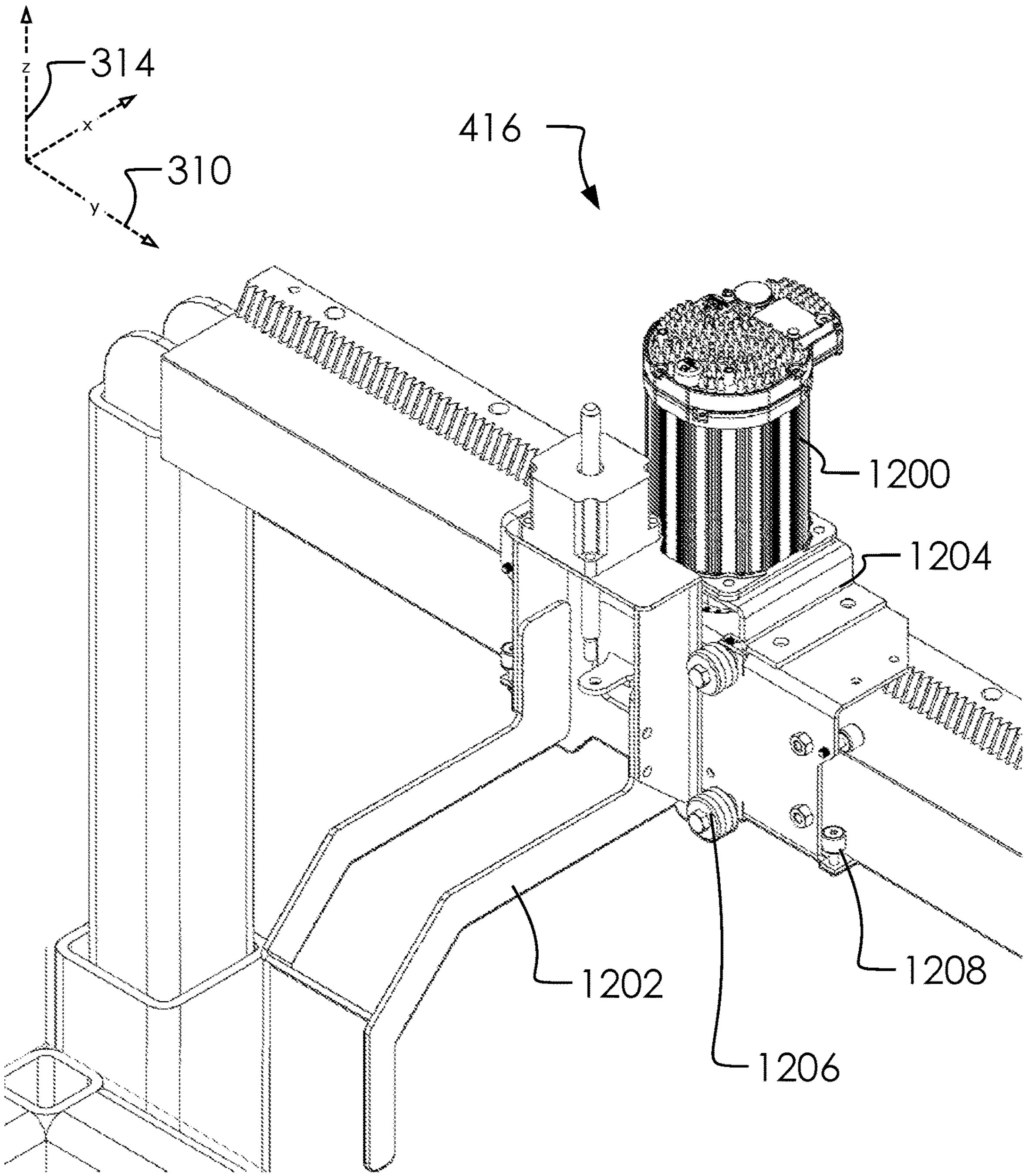
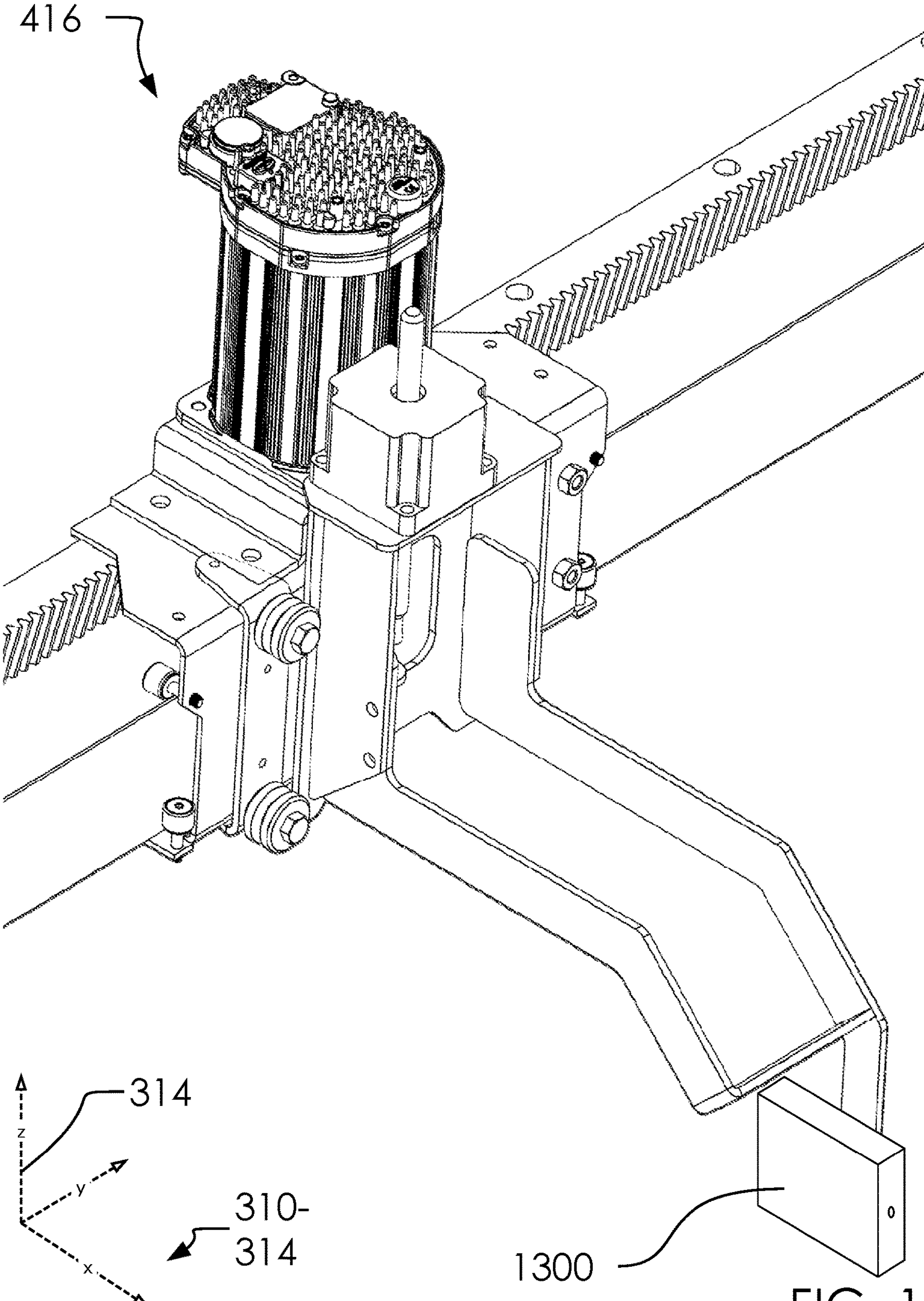


FIG. 12



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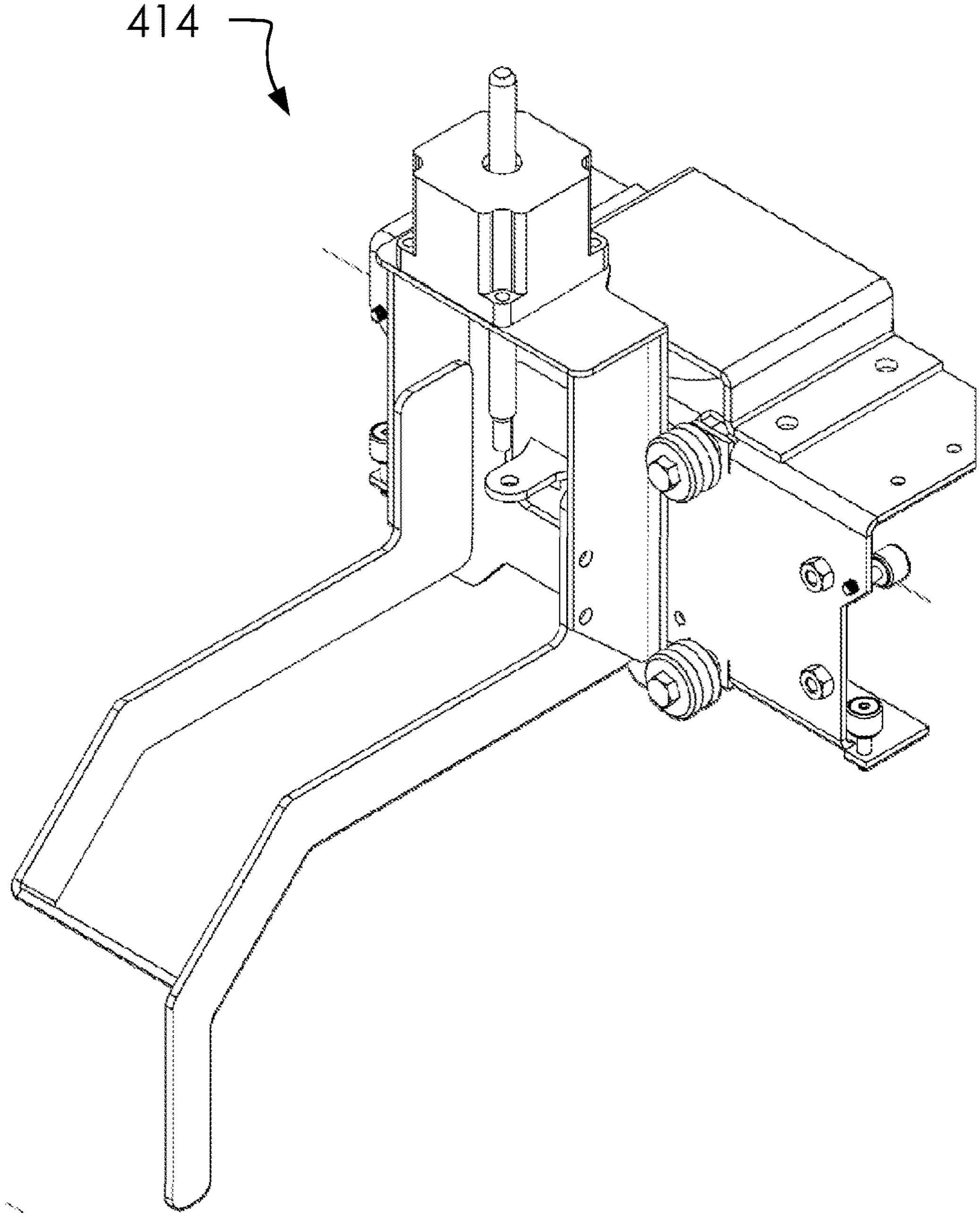

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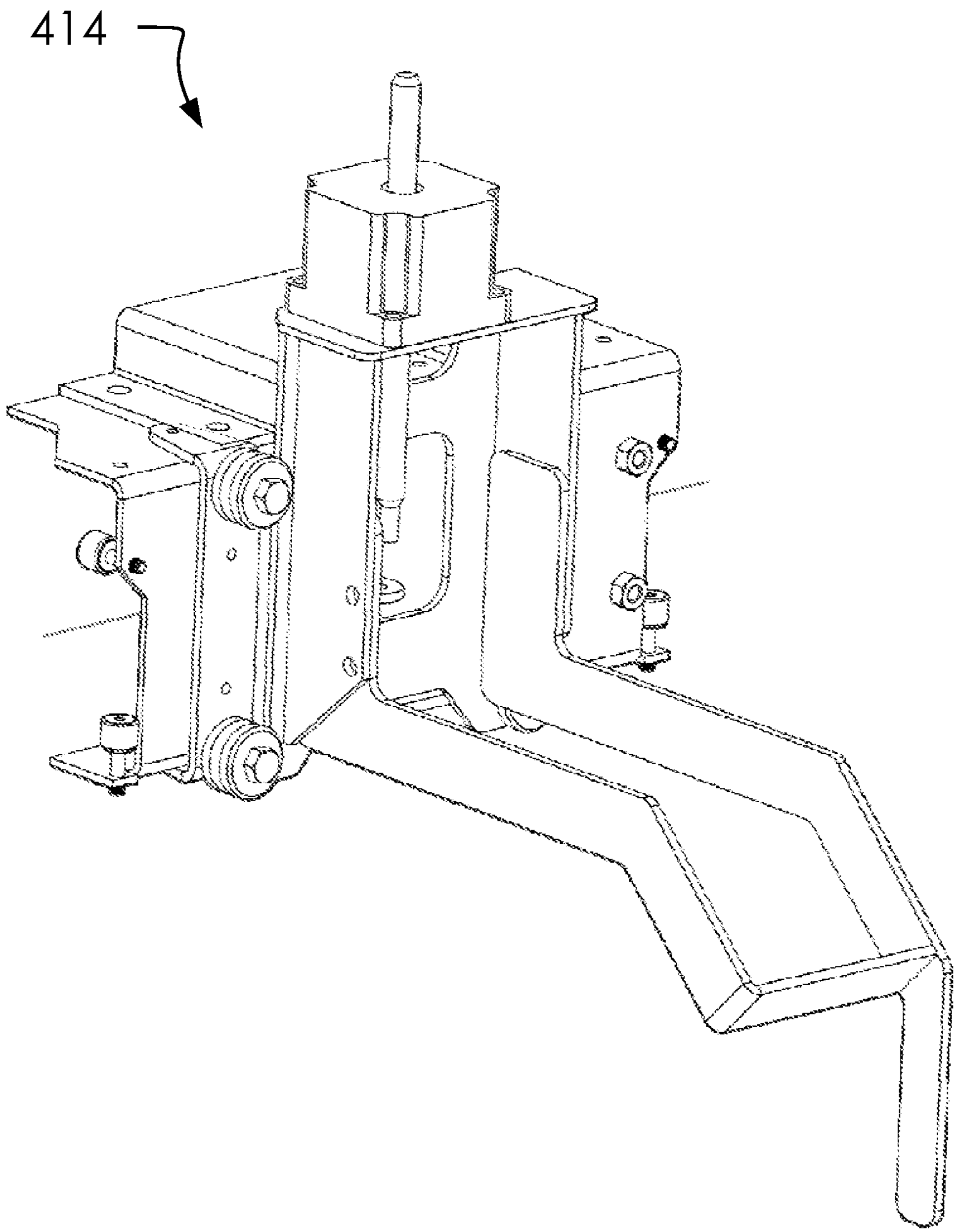

FIG. 15

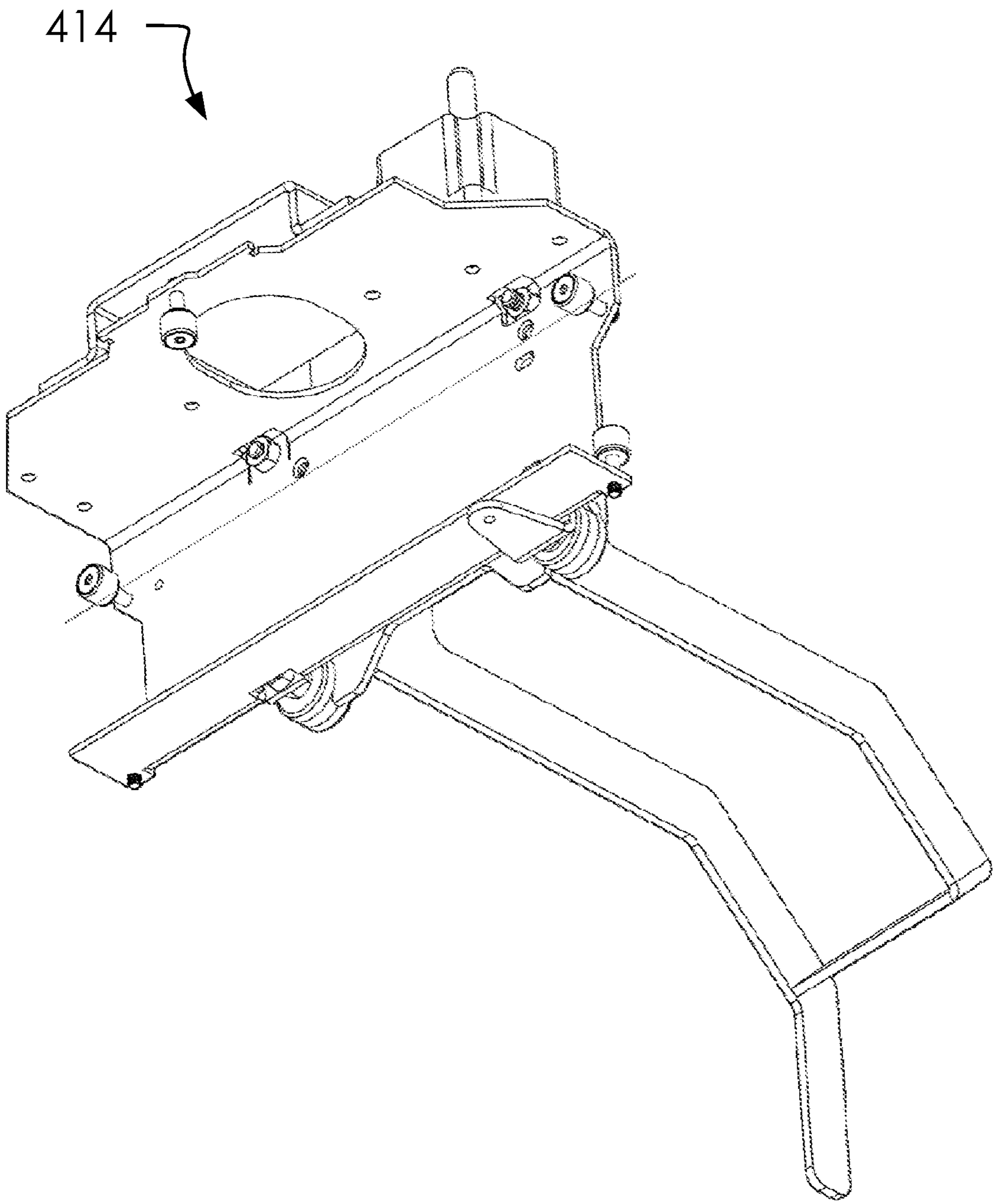

FIG. 16

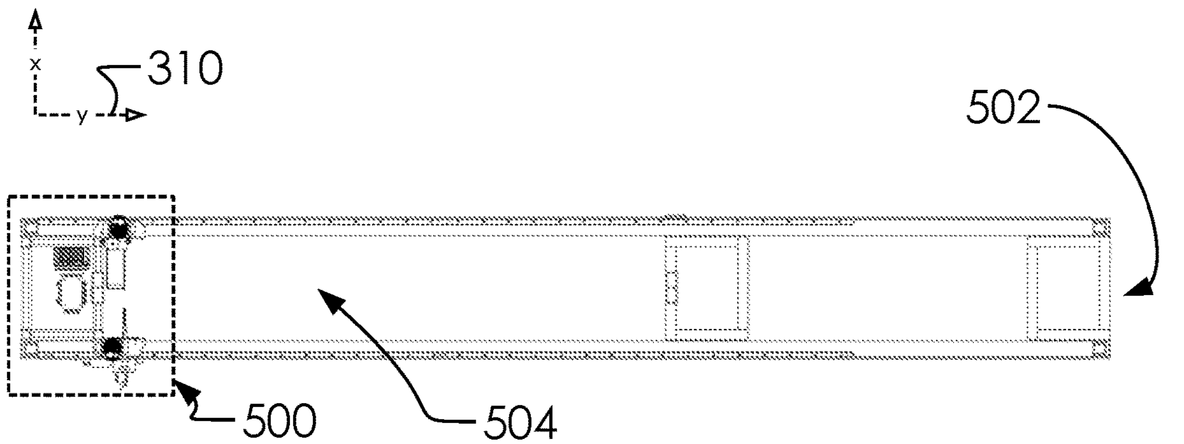

FIG. 17A

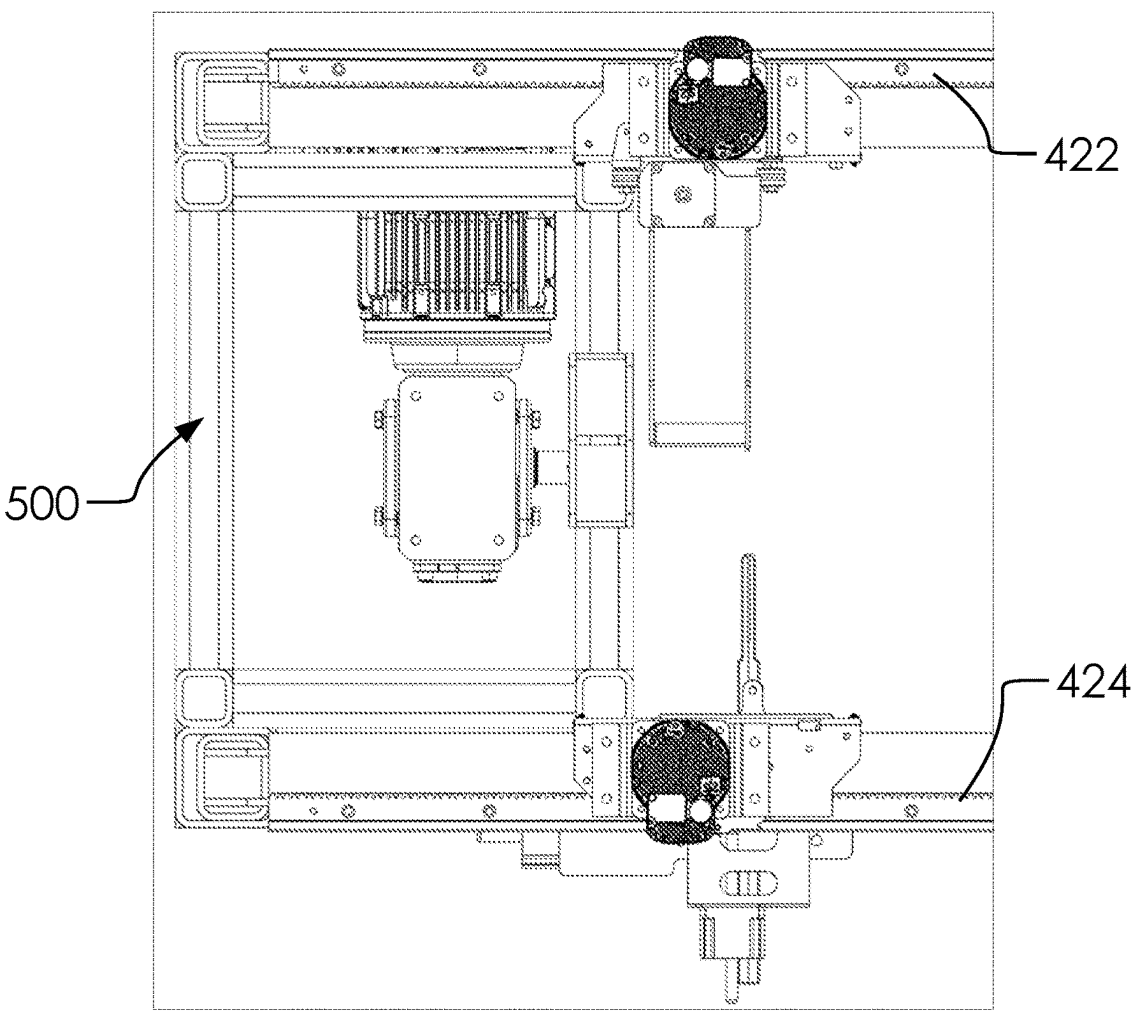

FIG. 17B

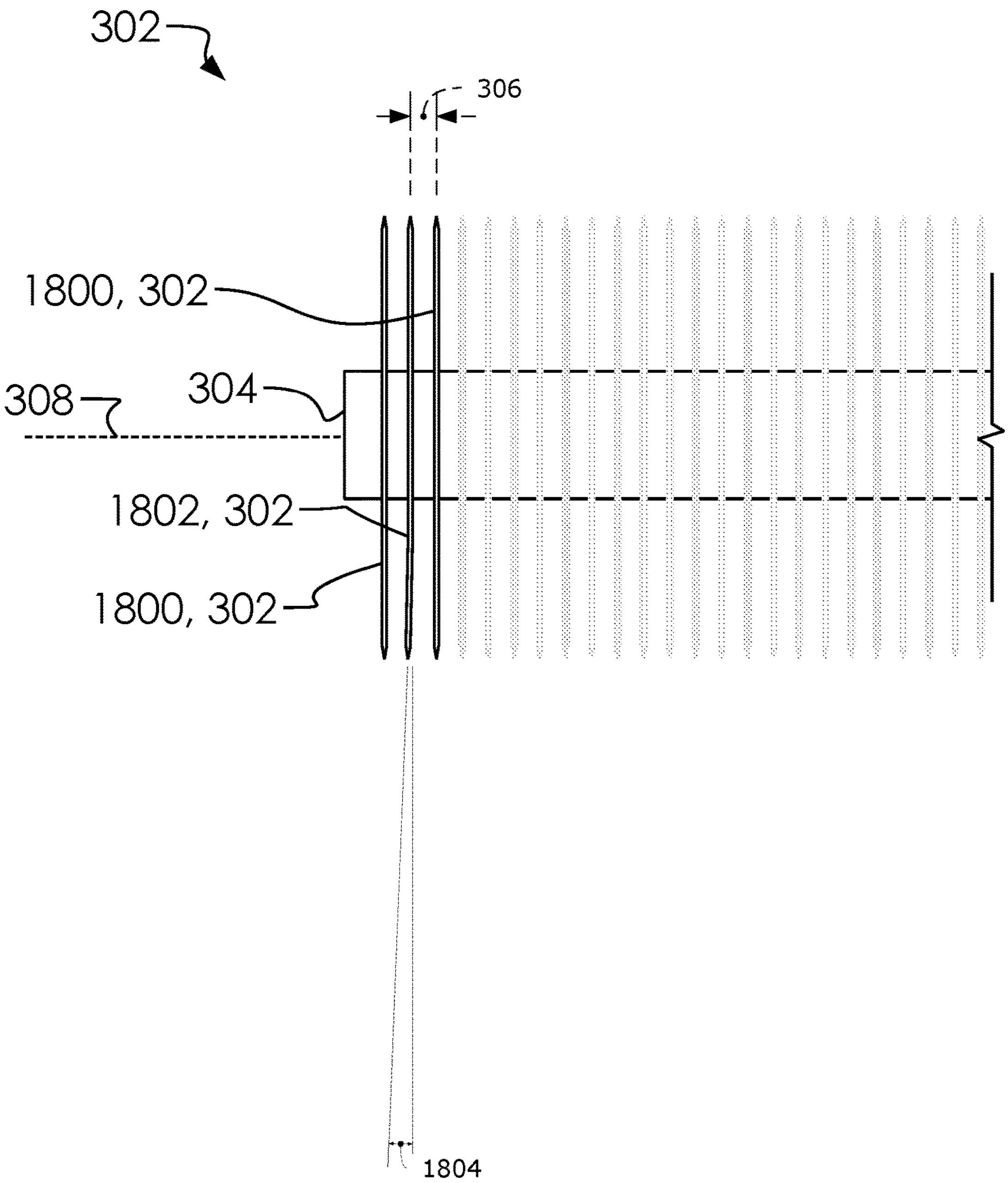

FIG. 18

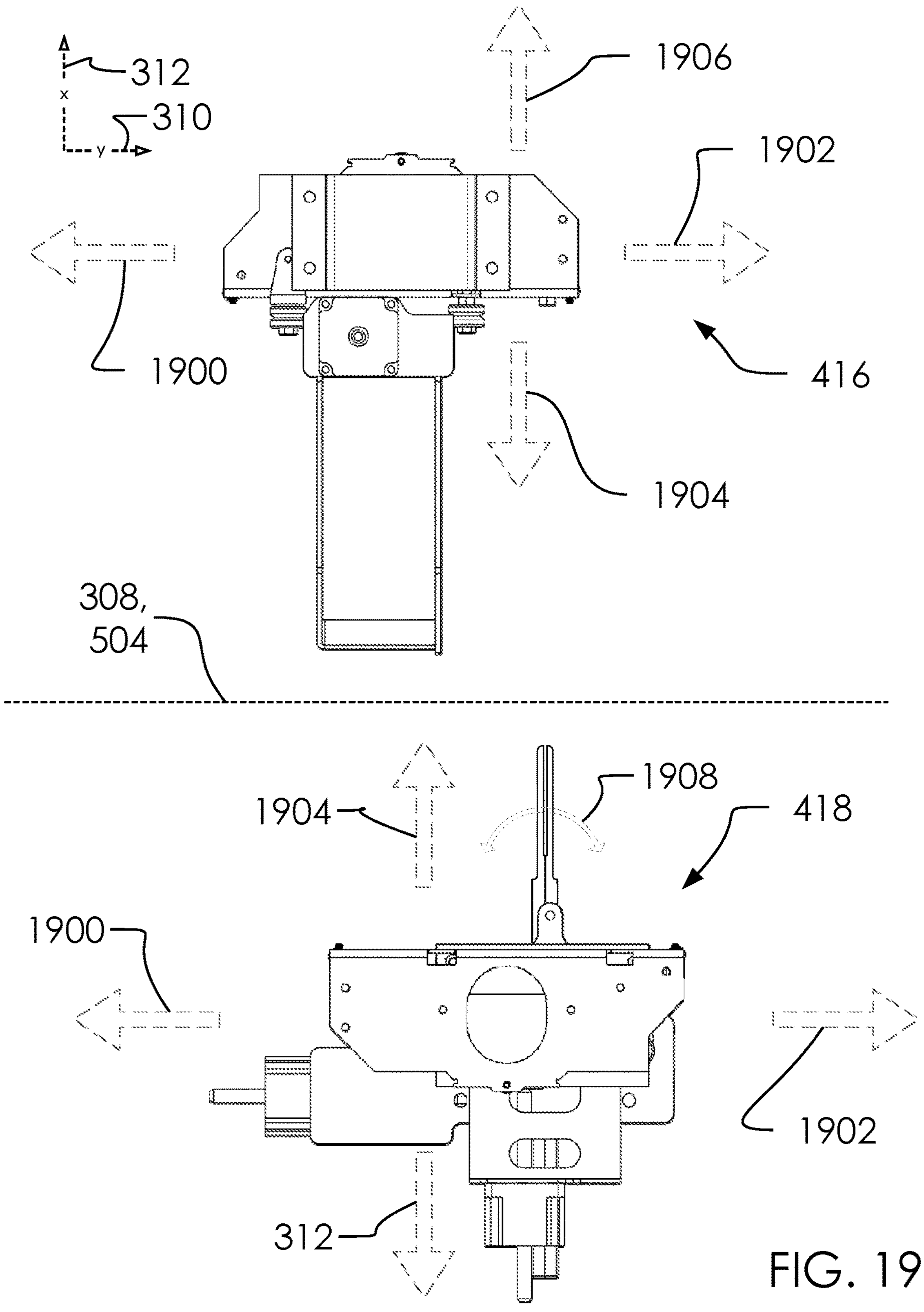
312
x
310
y
1906
1902
1900
416
1904
308,
504
1908
418
1904
1900
1902
312

FIG. 19

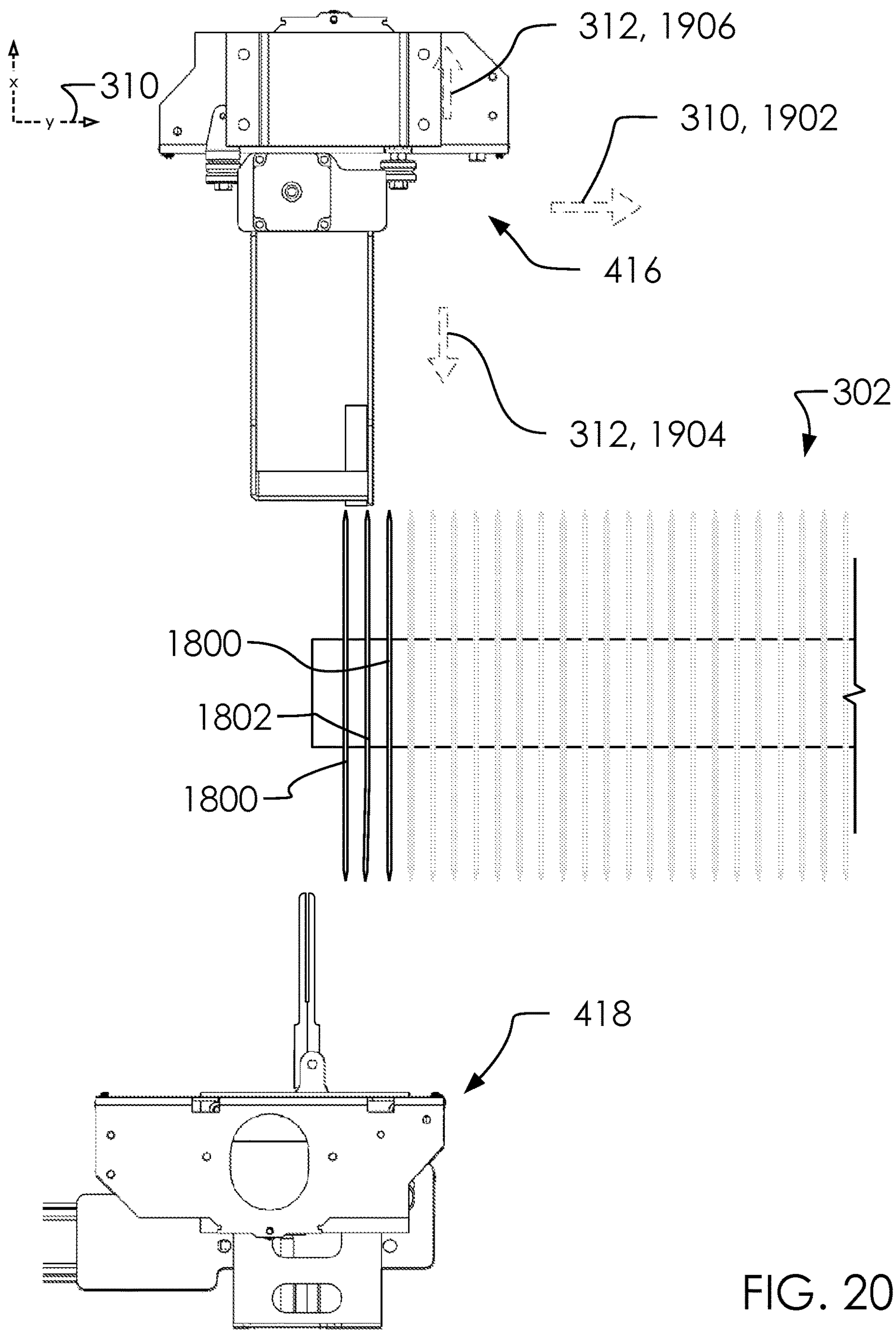

FIG. 20

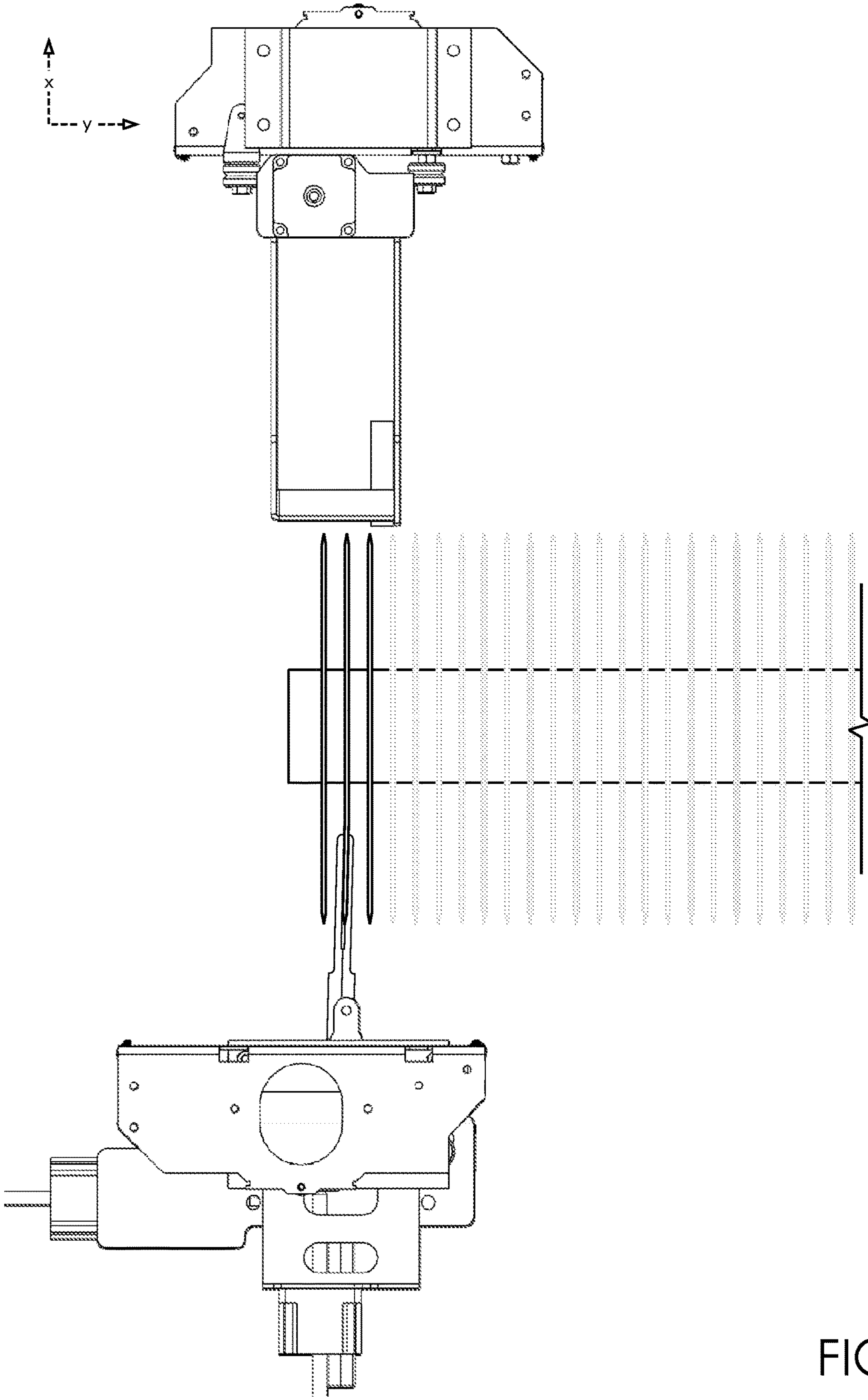

FIG. 21

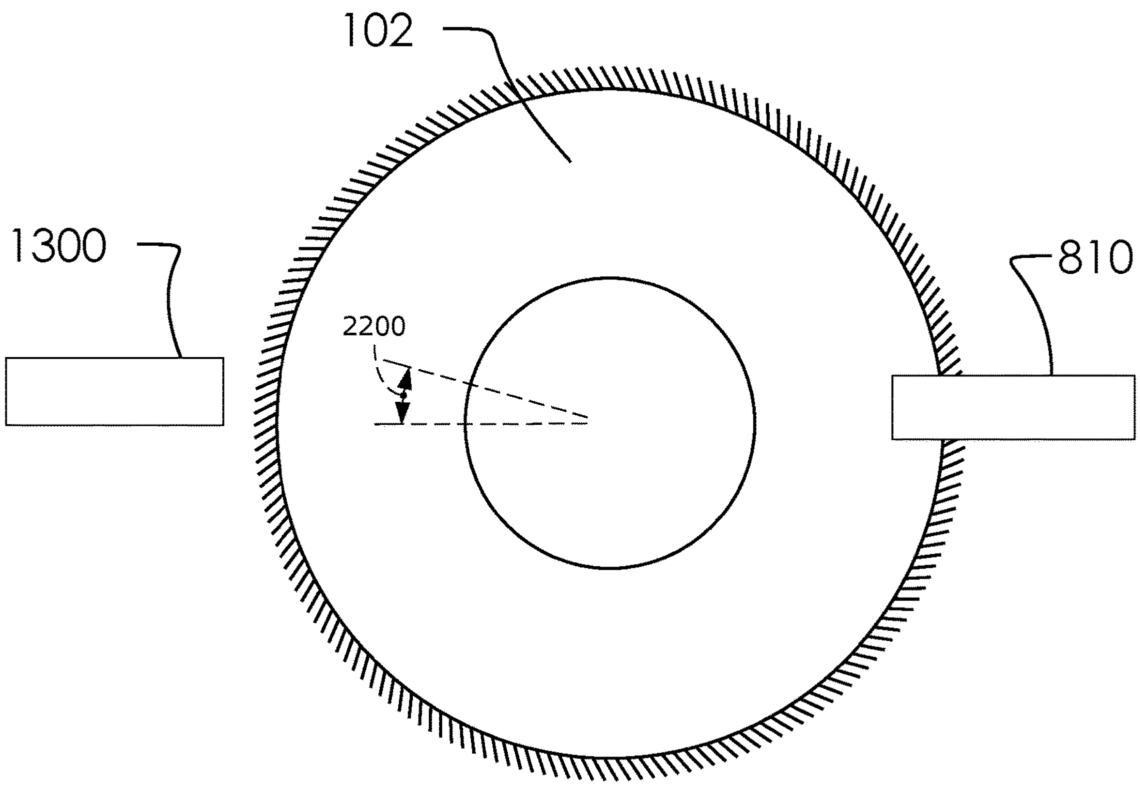

FIG. 22

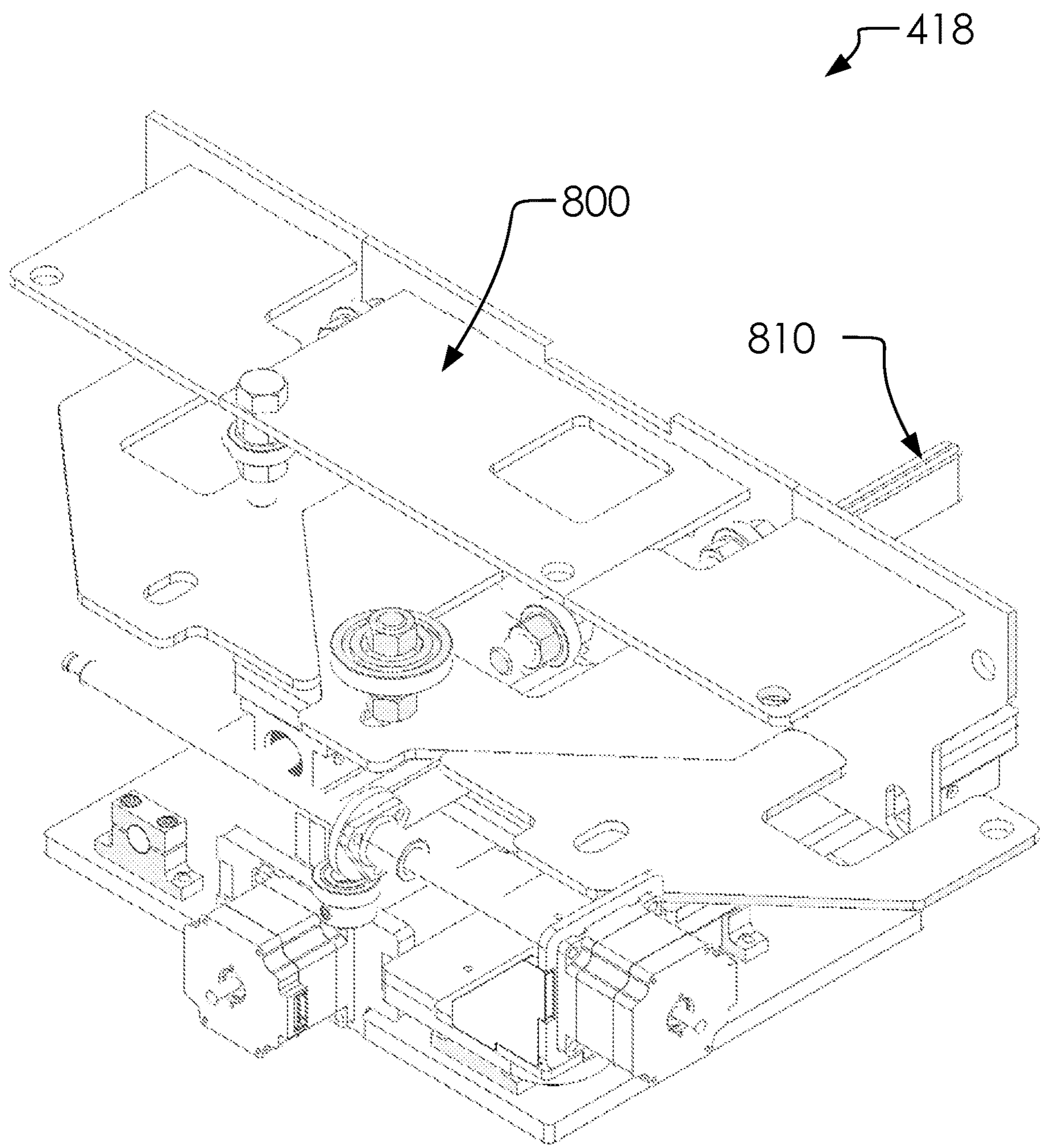

FIG. 23

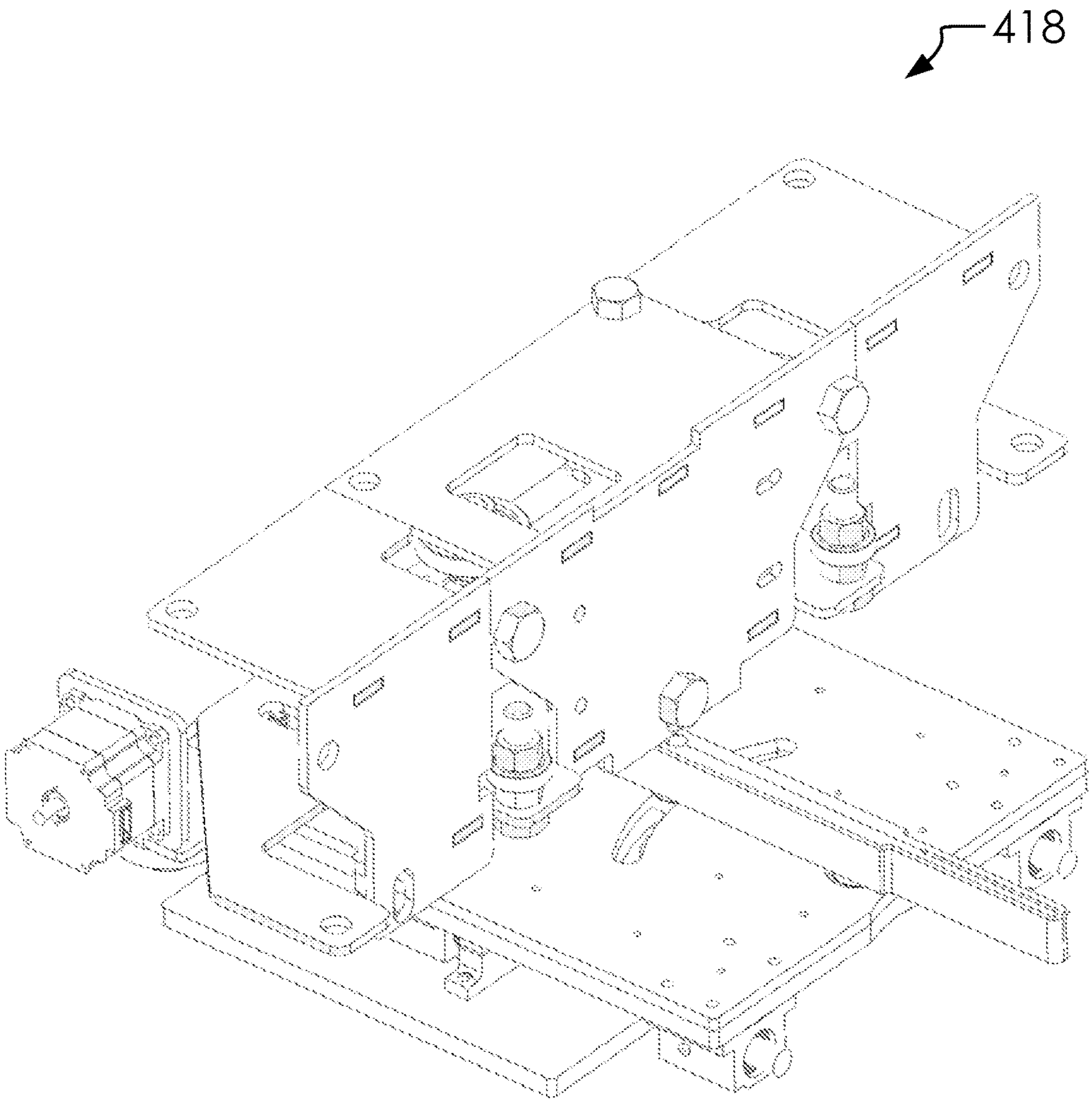

FIG. 24

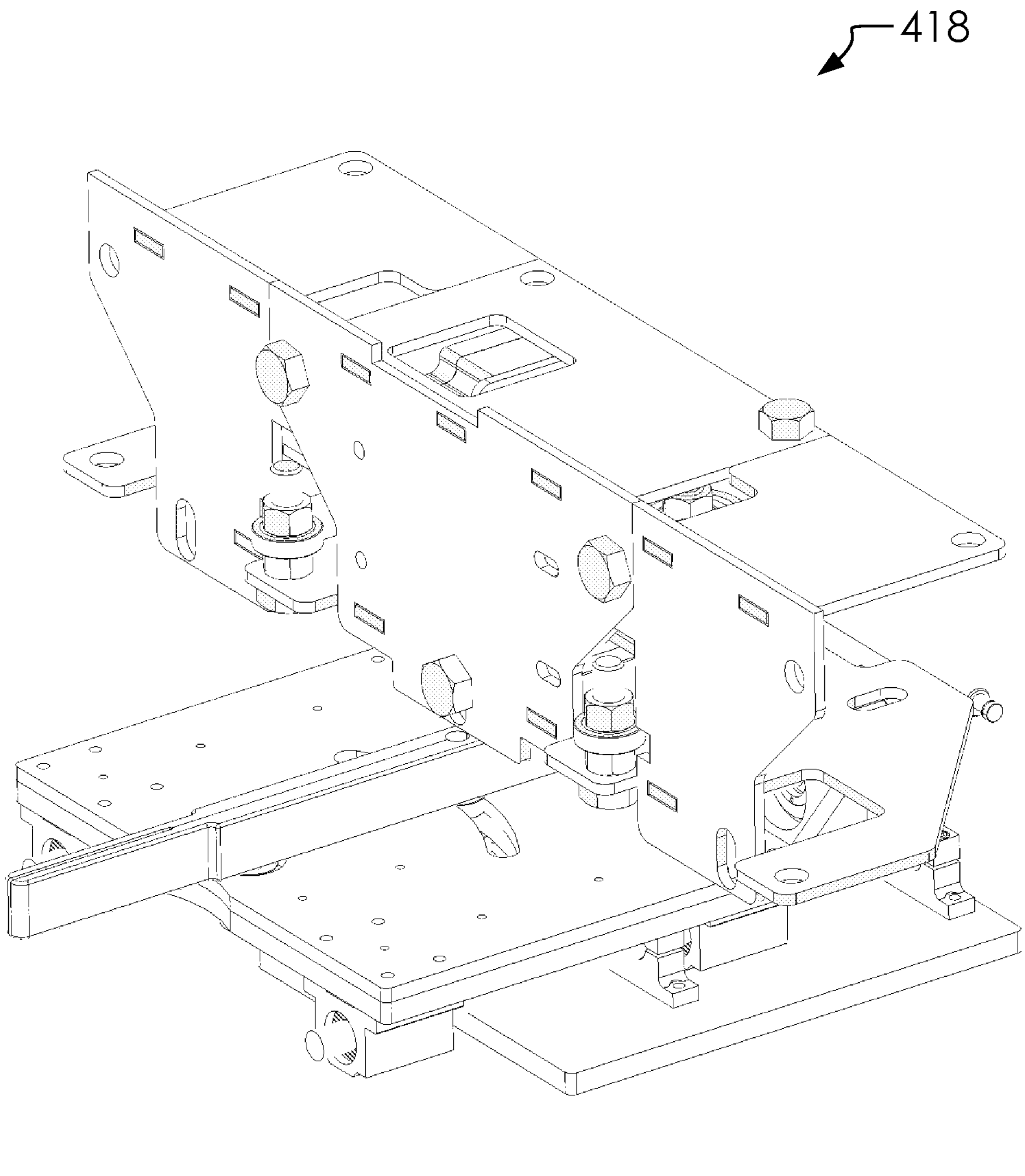

FIG. 25

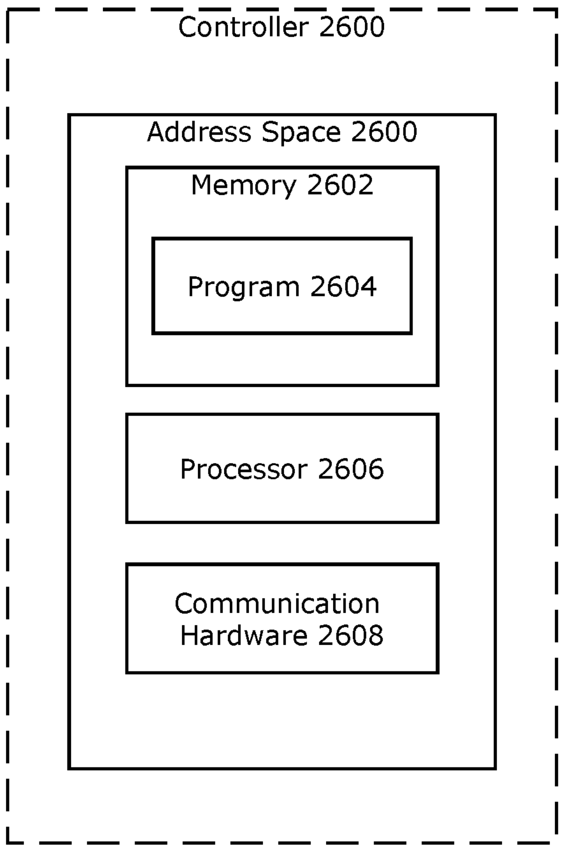
Controller 2600
Address Space 2600
Memory 2602
Program 2604
Processor 2606
Communication Hardware 2608

FIG. 26

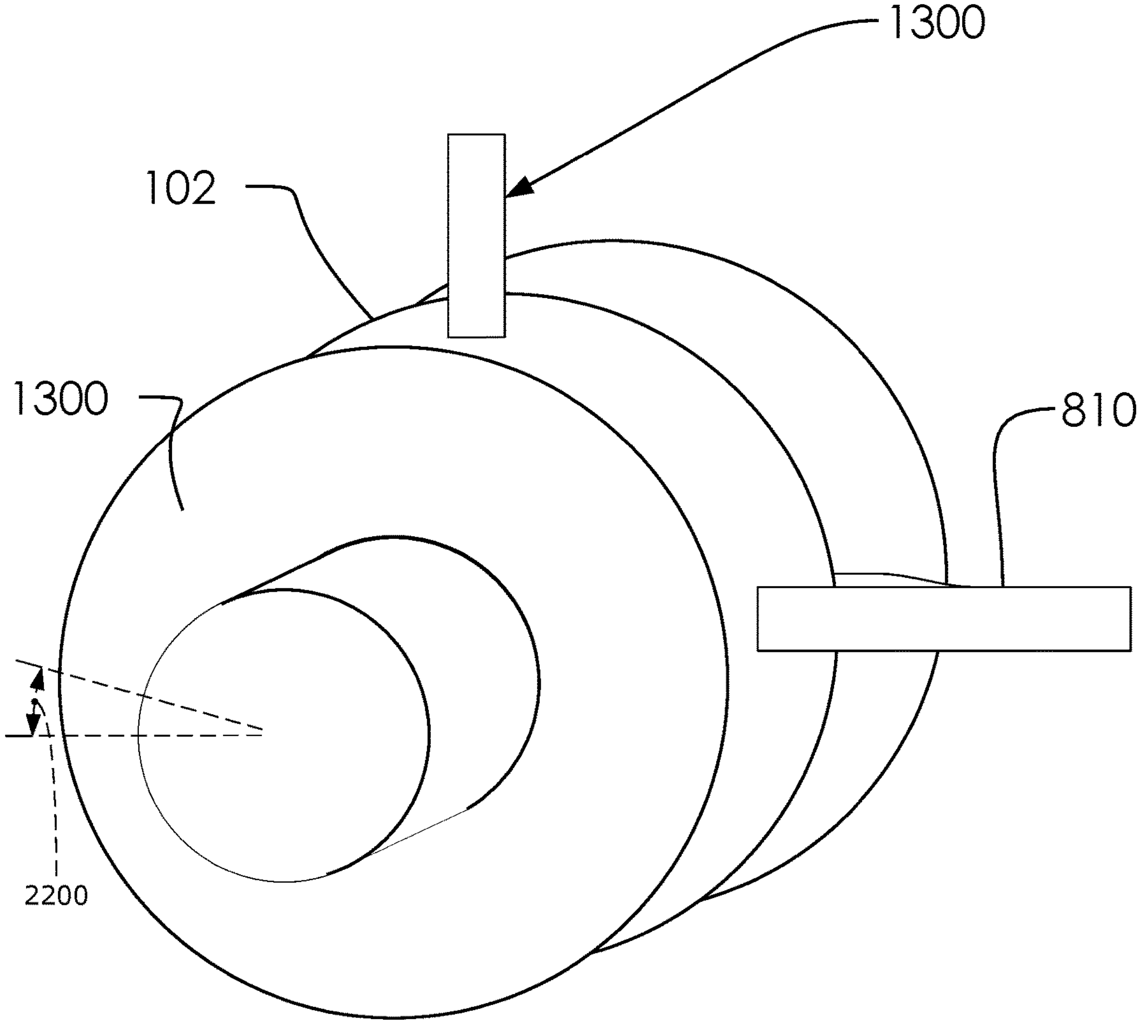

FIG. 27

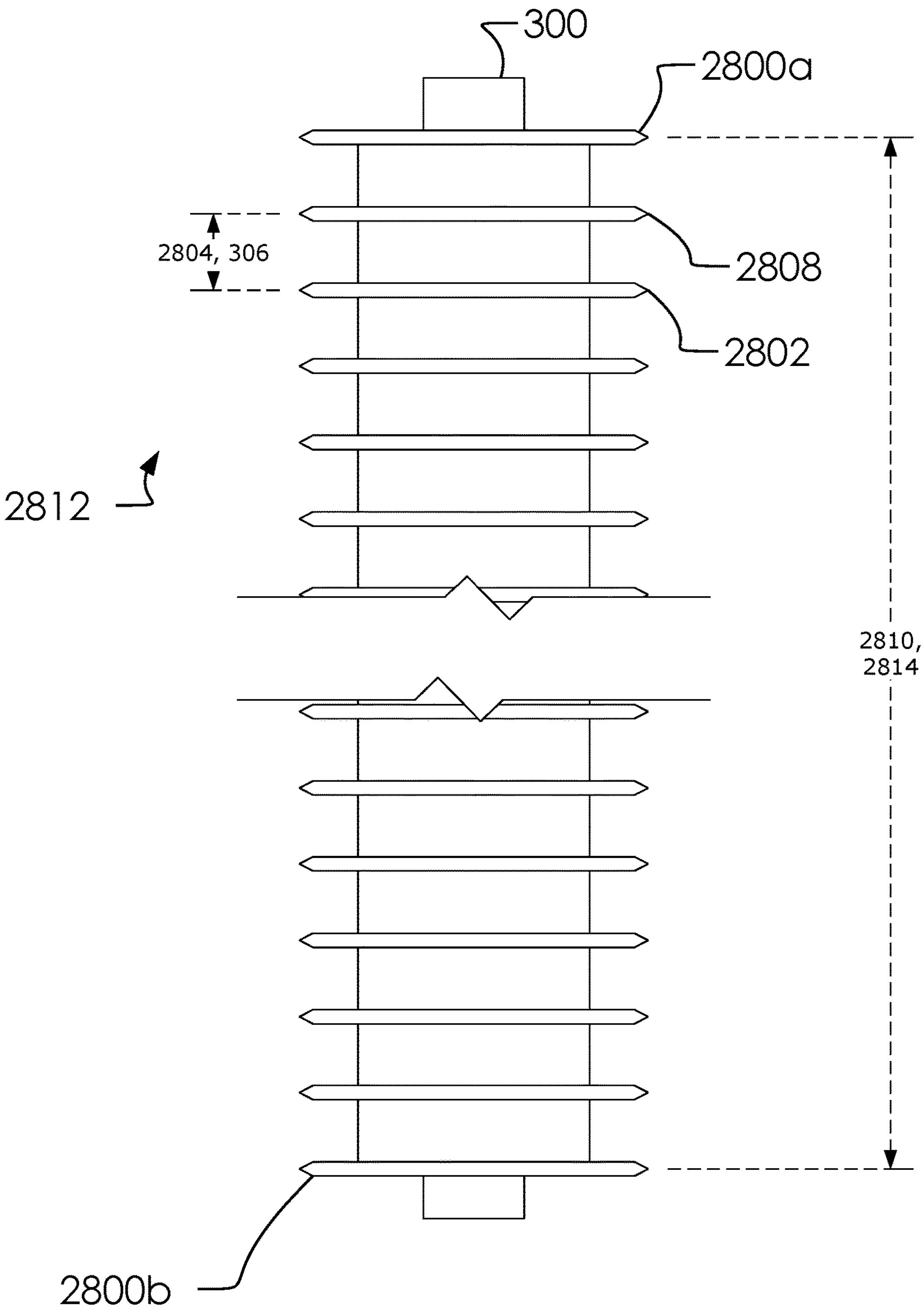

FIG. 28

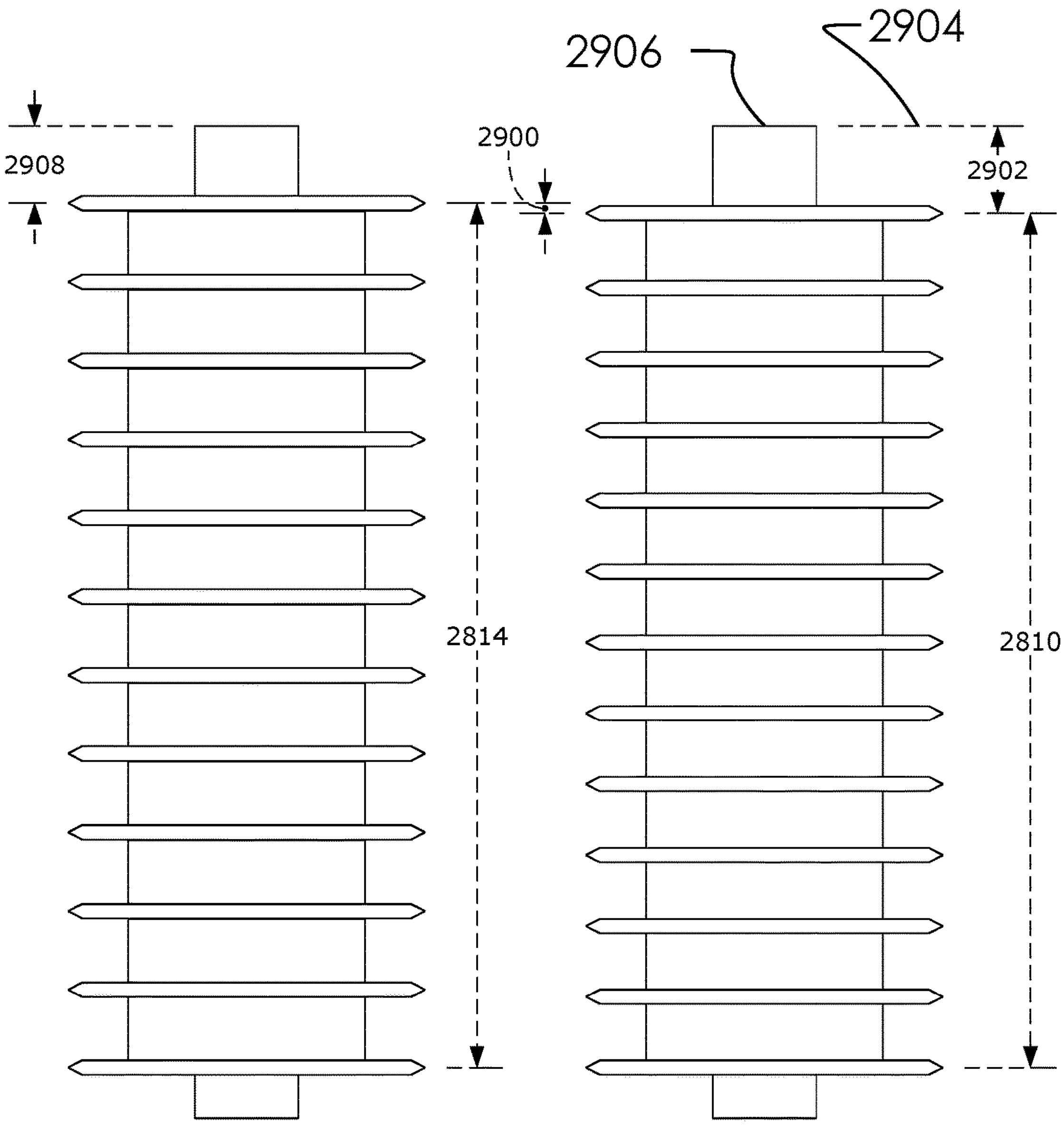

FIG. 29

AUTOMATIC GIN BLADE TRAINER AND METHOD OF USE

CROSS-REFERENCE TO RELATED APPLICATIONS

This application claims benefit to U.S. provisional patent application No. 63/212,442 filed on Jun. 18, 2021.

STATEMENT REGARDING FEDERALLY SPONSORED RESEARCH OR DEVELOPMENT (IF APPLICABLE

Not applicable.

REFERENCE TO SEQUENCE LISTING, A TABLE, OR A COMPUTER PROGRAM LISTING COMPACT DISC APPENDIX (IF APPLICABLE

Not applicable.

BACKGROUND OF THE INVENTION

No prior art is known to the Applicant.

BRIEF SUMMARY OF THE INVENTION

A training system for identifying one or more misaligned disks among a plurality of blade disks and straightening said one or more misaligned disks. Said training system comprises a training stand, a width, a length, a spacing measurement assembly, a training assembly, and a controller. each among said plurality of blade disks comprise a blade disk having a body portion, a center aperture, a diameter, a plurality of punched teeth, a sharpened edge, a center point, an outer edge and a center aperture diameter. portions of said plurality of blade disks comprises said one or more misaligned disks and one or more nominal disks. Said plurality of blade disks comprise at least a first disk and a last disk. each among said plurality of blade disks are attached to a mandrel along a center axis. Said one or more nominal disks conform to a blade spacing specification comprising a total saw width between said first disk and said last disk comprises a specified saw width, and said outer edge of each disk among said plurality of blade disks are spaced by a specified separation distance. Said training stand is configured to hold said mandrel having said plurality of blade disks. Said one or more nominal disks among said plurality of blade disks each comprise said outer edge being said specified separation distance from said outer edge of adjacent disks. Said one or more misaligned disks among said plurality of blade disks each comprise a portion of said outer edge not being said specified separation distance from said outer edge of adjacent disks. Said controller, for each among said plurality of blade disks, is configured for receiving a measurement of a current separation distance of said outer edge between a current disk and an adjacent disk from said spacing measurement assembly, specifying whether said current disk comprises one among said one or more nominal disks or said one or more misaligned disks. if said current disk is among said one or more nominal disks, said controller is further configured for calculating a bend angle to alter said current disk to match said current separation distance to said specified separation distance of said blade spacing specification controlling said training assembly to correct said one or more misaligned disks according to said bend angle.

BRIEF DESCRIPTION OF THE SEVERAL VIEWS OF THE DRAWING

FIGS. **1**A, and **1**B illustrate an elevated top view of a blank **100** and a detailed elevated top view of a blade disk **102**.

FIGS. **2**A, and **2**B illustrate an elevated cross-section side overview and detailed view of said blade disk **102**.

FIG. **3** illustrates a perspective overview of a mandrel **300**.

FIG. **4** illustrates a perspective overview of a training system **400**.

FIG. **5** illustrates a perspective overview of said training system **400**.

FIG. **6** illustrates a detailed perspective overview of a first end **500** of said training system **400**.

FIG. **7** illustrates a perspective overview of a training assembly **418**.

FIG. **8** illustrates a perspective overview of said training assembly **418**.

FIG. **9** illustrates a first perspective front side view of said training assembly **418**.

FIGS. **10**A, and **10**B illustrate a perspective bottom side view of said training assembly **418** and a elevated side view of a mounting plate **1002** with a training arm **810**.

FIG. **11** illustrates a first perspective overview of said training assembly **418** attached to a second track **424**.

FIG. **12** illustrates a perspective overview of a spacing measurement assembly **416** attached to a first track **422**.

FIG. **13** illustrates a second perspective overview of said spacing measurement assembly **416** attached to said first track **422**.

FIG. **13** illustrates a first front perspective overview of a second side height **414** without a motor **1200**.

FIG. **14** illustrates a second front perspective overview of said second side height **414** without said motor **1200**.

FIG. **15** illustrates a first front perspective overview of said second side height **414** without said motor **1200**.

FIG. **16** illustrates a rear perspective overview of said second side height **414** without said motor **1200**.

FIGS. **17**A, and **17**B illustrate an elevated top overview of said training system **400** and said first end **500** of said training system **400**.

FIG. **18** illustrates an elevated detailed top view of said mandrel **300**.

FIG. **19** illustrates an elevated top view of said spacing measurement assembly **416** and said training assembly **418**.

FIG. **20** illustrates an elevated top view of said spacing measurement assembly **416** and said training assembly **418** with a plurality of blade disks **302**.

FIG. **21** illustrates an elevated top view of said spacing measurement assembly **416** and said training assembly **418** with said plurality of blade disks **302**.

FIG. **22** illustrates an elevated side view of said blade disk **102** with a laser distance measurement system **1300** and said training arm **810**.

FIGS. **23-25** illustrates a perspective overview of said training assembly **418**.

FIG. **26** illustrates an address space **2600** of a controller **508**.

FIG. **27** illustrates an elevated view of a portion of said plurality of blade disks **302** on said mandrel **300** with said laser distance measurement system **1300** and said training arm **810**.

FIG. **28** illustrates an elevated side view of said mandrel **300** with said plurality of blade disks **302**.

FIG. **29** illustrates said plurality of blade disks **302** with a specified saw width **2814** and a total saw width **2810**.

DETAILED DESCRIPTION OF THE INVENTION

The following description is presented to enable any person skilled in the art to make and use the invention as claimed and is provided in the context of the particular examples discussed below, variations of which will be readily apparent to those skilled in the art. In the interest of clarity, not all features of an actual implementation are described in this specification. It will be appreciated that in the development of any such actual implementation (as in any development project), design decisions must be made to achieve the designers' specific goals (e.g., compliance with system- and business-related constraints), and that these goals will vary from one implementation to another. It will also be appreciated that such development effort might be complex and time-consuming, but would nevertheless be a routine undertaking for those of ordinary skill in the field of the appropriate art having the benefit of this disclosure. Accordingly, the claims appended hereto are not intended to be limited by the disclosed embodiments, but are to be accorded their widest scope consistent with the principles and features disclosed herein.

FIGS. **1**A, and **1**B illustrate an elevated top view of a blank **100** and a detailed elevated top view of a blade disk **102**.

Said blank **100** can comprise an unpunched and unsharpened version of said blade disk **102**, as described herein and known in the art.

Said blank **100** can comprise a round disc having a body portion **104**, a center aperture **106**, a diameter **108**, and a center aperture diameter **122**. Said body portion **104** can be a metal disk.

As shown in a detailed call-out **110** of said blade disk **102**, said blank **100** can be punched to create a plurality of punched teeth **112** and a sharpened edge **114** (illustrated below). In one embodiment, said plurality of punched teeth **112** can be aligned in a tooth orientation **116** being relative to a center point **118** of said body portion **104** and on an outer edge **120** of said body portion **104**.

Once punched said plurality of punched teeth **112** can be distributed evenly around said outer edge **120**, as is known in the art.

In one embodiment, said blank **100** can be punched to add said plurality of punched teeth **112** to form an unsharpened punched blank **124**, which needs to be sharpened as discussed below in order to create said blade disk **102**.

FIGS. **2**A, and **2**B illustrate an elevated cross-section side overview and detailed view of said blade disk **102**.

As shown in a call-out **200**, said outer edge **120** can be ground to said sharpened edge **114** at a grind angle **202**.

Said blank **100** and said blade disk **102** can comprise a top surface **204** and a bottom surface **206**.

FIG. **3** illustrates a perspective overview of a mandrel **300**.

In one embodiment, said mandrel **300** can comprise a plurality of blade disks **302** attached to a center shaft **304**. Each among said plurality of blade disks **302** can be separated by a specified separation distance **306** as measured along said center shaft **304**.

Said center shaft **304** and said plurality of blade disks **302** can be aligned along a center axis **308**. For reference, said center axis **308** is aligned along a y-axis **310**, and each among said plurality of blade disks **302** are designed to be flat and aligned with both an x-axis **312** and a z-axis **314**.

Said mandrel **300** comprising said plurality of blade disks **302** are a common feature of a cotton gin. Said mandrel **300** may be swapped in and out of a gin stand throughout the ginning process. As cotton is processed to separate lint from waste, said plurality of punched teeth **112** can become damaged, or one or more among said plurality of blade disks **302** can become bent such that said mandrel **300** will be removed and replaced. Process efficiency within a cotton gin is paramount to ensure profitability and safety in the industry.

During manufacturing, said mandrel **300** will need to be carefully constructed to ensure each among said plurality of blade disks **302** are planar within said x-axis **312** and said z-axis **314**, and evenly spaced according to said specified separation distance **306**.

Each said blade disk **102** among said plurality of blade disks **302** must fit within the ribs or gaps in the gin stand equipment, so care must be taken to ensure disks are straight and properly spaced to avoid jamming and equipment failure.

As is known in the industry, different equipment requires different specifications regarding said specified separation distance **306** and the quantity of said plurality of blade disks **302**.

Current approaches to training said plurality of blade disks **302** include a manual process of training said blade disk **102** overseen by human operators, one blade at a time. In some prior art settings, electronic sensors may be used for measuring said specified separation distance **306** and a flatness of each among said plurality of blade disks **302**. Accordingly, operators can bend disks to conform to expected standards.

FIG. **4** illustrates a perspective overview of a training system **400**.

In one embodiment, said training system **400** can comprise a training stand **402** comprising a first side **404** and a second side **406**. Said training system **400** can comprise a width **408**, and a length **410**. Said first side **404** can comprise a first side height **412**, and said second side **406** can comprise a second side height **414**. In one embodiment, said first side height **412** and said second side height **414** can be adjusted.

Said training system **400** can further comprise a spacing measurement assembly **416**, a training assembly **418**, a motor **420**, a first track **422** and a second track **424**. In one embodiment, said second side height **414** and said first track **422** can be attached to said second side **406**, and said second track **424** and said training assembly **418** can be attached to said first side **404**.

Said training system **400** can be configured to ensure each among said plurality of blade disks **302** are planar within said x-axis **312** and said z-axis **314**, and evenly spaced according to said specified separation distance **306** by holding said mandrel **300** on said training stand **402**, moving said spacing measurement assembly **416** and said training assembly **418** along said y-axis **310**, measuring said specified separation distance **306** between said plurality of blade disks **302**, and bending said plurality of blade disks **302** with said training assembly **418**.

FIG. **5** illustrates a perspective overview of said training system **400**.

Said training system **400** comprises a first end **500** and a second end **502**. Further, said training system **400** can comprise a central channel **504**. In one embodiment, said mandrel **300** can be mounted between said first end **500** and said second end **502** within said central channel **504**. Said central channel **504** can comprise a trainer rotating axis **506**.

With said mandrel **300** installed into said training system **400**, said center axis **308** and said center axis **506** can be aligned. Accordingly, said y-axis **310**, said x-axis **312** and said z-axis **314** are applied to FIGS. **4** and **5** for reference.

Said training system **400** can comprise a controller **508** configured to monitor a state of said mandrel **300** and apply force to fix portions of said plurality of blade disks **302** according to a specification.

One advantage of said training system **400** can comprise productivity gains in training said mandrel **300**. Initial testing shows a six fold productivity gain over human trainers. Said controller **508** can provide feedback and information during training.

FIG. **6** illustrates a detailed perspective overview of said first end **500** of said training system **400**.

In one embodiment, said spacing measurement assembly **416** can comprise double sensor configured to read both sides of said blade disk **102** among said plurality of blade disks **302**.

FIG. **7** illustrates a perspective overview of said training assembly **418**.

Said training assembly **418** can comprise a motor **700** and a linear slide assembly **702**. A portion of said linear slide assembly **702** can move said training assembly **418** along said y-axis **310** using said second track **424**.

FIG. **8** illustrates a perspective overview of said training assembly **418**.

In one embodiment, said training assembly **418** can comprise an upper portion **800** and a lower portion **802**. Said lower portion **802** and said upper portion **800** can move relative to one another in said x-axis **312** by applying pressure and rolling along a plurality of y-axis wheels **804**. Likewise, said training assembly **418** can move along portions of said second track **424** using a plurality of x-axis wheels **806** for guidance.

In one embodiment, said motor **700** can attach to said training assembly **418** on a motor mount **808**.

Said training assembly **418** further comprises a training arm **810**.

FIG. **9** illustrates a first perspective front side view of said training assembly **418**.

FIGS. **10**A, and **10**B illustrate a perspective bottom side view of said training assembly **418** and a elevated side view of a mounting plate **1002** with said training arm **810**.

Said lower portion **802** of said training assembly **418** can comprise a bender mounting assembly **1000**. Said bender mounting assembly **1000** can comprise said mounting plate **1002**, and a linear actuator **1004**. Said training arm **810** can comprise a fastener aperture **1006**, a first end **1008**, a second end **1010**, a pivoting axis **1012**, and a training adapter **1014**.

In one embodiment, said training adapter **1014** can be attached to or integrated with said training arm **810** at said first end **1008**. In one embodiment, said first end **1008** can be configured to point toward said central channel **504**. Said training adapter **1014** can comprise a slot **1016** between a first side **1018** and a second side **1020**.

In one embodiment, said slot **1016** can fit around a portion of said blade disk **102** of said plurality of blade disks **302**, said linear actuator **1004** can push or pull said training arm **810**, said training arm **810** can pivot around said pivoting axis **1012**, and said slot **1016** can bend a portion of said blade disk **102**.

Said linear actuator **1004** can comprise a rod **1022** configured to push and pull a portion of said training arm **810**. In one embodiment, said training arm **810** can be pivotably attached to said lower portion **802** with a fastener **1026** through said fastener aperture **1006** and an arched aperture **1024** in said mounting plate **1002**. In one embodiment, said fastener aperture **1006** can align with said pivoting axis **1012**. Accordingly, said training arm **810** can be positioned according to pressure put on said training arm **810** with said rod **1022** by said linear actuator **1004**, and pivoting about said pivoting axis **1012** through said fastener aperture **1006** and said arched aperture **1024**.

In one embodiment, said training assembly **418** can adjust a portion of said plurality of blade disks **302** by: calculating a proper alignment of said plurality of blade disks **302**, aligning said training adapter **1014** with one among said plurality of blade disks **302**, activating said linear actuator **1004**, moving said training arm **810** about said pivoting axis **1012**, and bending a portion of said plurality of blade disks **302** according to a desired disk configuration.

Said arched aperture **1024** can comprise a portion of a circular path arching away from said central channel **504**.

As illustrated in FIG. **10**B, said training arm **810** can further comprise a side mounting bracket **1028**. In one embodiment, a portion of said rod **1022** can attach to said side mounting bracket **1028** so as to allow said linear actuator **1004** to selectively push and pull said training arm **810** around said pivoting axis **1012**.

FIG. **11** illustrates a first perspective overview of said training assembly **418** attached to said second track **424**.

FIG. **12** illustrates a perspective overview of said spacing measurement assembly **416** attached to said first track **422**.

In one embodiment, said spacing measurement assembly **416** can comprise a motor **1200**, a lower portion **1202** and an upper portion **1204**.

In one embodiment, said lower portion **1202** can move in said z-axis **314** on a plurality of z-axis wheels **1206**; and said spacing measurement assembly **416** can move in said y-axis **310** on a plurality of y-axis wheels **1208**.

FIG. **13** illustrates a second perspective overview of said spacing measurement assembly **416** attached to said first track **422**.

In one embodiment, said spacing measurement assembly **416** can further comprise a laser distance measurement system **1300**.

FIG. **13** illustrates a first front perspective overview of said second side height **414** without said motor **1200**.

FIG. **14** illustrates a second front perspective overview of said second side height **414** without said motor **1200**.

FIG. **15** illustrates a first front perspective overview of said second side height **414** without said motor **1200**.

FIG. **16** illustrates a rear perspective overview of said second side height **414** without said motor **1200**.

FIGS. **17**A, and **17**B illustrate an elevated top overview of said training system **400** and said first end **500** of said training system **400**.

In one embodiment, said spacing measurement assembly **416** and said training assembly **418** move within said y-axis **310** along said first track **422** and said second track **424**, training of said plurality of blade disks **302** can begin at said first end **500** and proceed toward said second end **502**.

FIG. **18** illustrates an elevated detailed top view of said mandrel **300**.

Said plurality of blade disks **302** can comprise one or more nominal disks **1800** and one or more misaligned disks **1802**. One objective of said training system **400** is to locate and correct said one or more misaligned disks **1802** among said plurality of blade disks **302**, and to validate said one or more nominal disks **1800** among said plurality of blade disks **302**. For discussion purposes, said one or more misaligned disks **1802** can be out of alignment from nominal bent according to a bend angle **1804**.

Although said bend angle **1804** may be very small, any deviation from nominal, that is a 0 degree or planar disk, can cause damage when said mandrel **300** is installed and spinning in a gin stand (not illustrated).

FIG. **19** illustrates an elevated top view of said spacing measurement assembly **416** and said training assembly **418**.

Said spacing measurement assembly **416** and said training assembly **418** can move in a toward first end direction **1900** or a toward second end direction **1902** within said y-axis **310**; and in an inward direction **1904** or an outward direction **1906** in said x-axis **312** as related to said center axis **308**. Said inward direction **1904** can be toward said central channel **504** and said outward direction **1906** can be away from said central channel **504**. Said toward first end direction **1900** can be directed at said first end **500** and said toward second end direction **1902** can be toward said second end **502**.

As discussed above, said training arm **810** can rotate about said pivoting axis **1012**, which is illustrated as a training pivoting motion **1908**.

FIG. **20** illustrates an elevated top view of said spacing measurement assembly **416** and said training assembly **418** with said plurality of blade disks **302**.

In one embodiment, said training system **400** can comprise a method of training disks **2000** using said training system **400** comprising assessing said plurality of blade disks **302** as between said one or more nominal disks **1800** and said one or more misaligned disks **1802** by: measuring each among said plurality of blade disks **302** using said spacing measurement assembly **416** and bending said one or more misaligned disks **1802** to conform with a standard associated with said one or more nominal disks **1800**. In one embodiment, measuring each among said plurality of blade disks **302** can comprise: aligning said laser distance measurement system **1300** with each among said plurality of blade disks **302**, rotating said mandrel **300**, measuring characteristics of each said plurality of blade disks **302**.

FIG. **21** illustrates an elevated top view of said spacing measurement assembly **416** and said training assembly **418** with said plurality of blade disks **302**.

In one embodiment, bending said one or more misaligned disks **1802** can comprise sliding said training arm **810** around a portion of said one or more misaligned disks **1802** comprising said bend angle **1804**, pressing said training arm **810** to straighten each among said one or more misaligned disks **1802**. In one embodiment, said training system **400** can assess each among said plurality of blade disks **302** individually with said spacing measurement assembly **416** and said training assembly **418**. In one embodiment, said spacing measurement assembly **416** and said training assembly **418** can operate independently of one another to allow assessment and correction along said plurality of blade disks **302** with fewer bottlenecks.

FIG. **22** illustrates an elevated side view of said blade disk **102** with said laser distance measurement system **1300** and said training arm **810**.

In one embodiment, said training system **400** can be programmed to take measurements of said blade disk **102** at various points by taking a measurement, rotating a rotary step **2200** around said center point **118**, taking additional readings, and repeating at least one time around 360 degrees. In one embodiment, said training system **400** can rotate said blade disk **102** around 3 times to ensure a complete and accurate reading of defects in said blade disk **102**. In one embodiment, said rotary step **2200** can comprise 18 degrees.

In one embodiment, said training arm **810** can correct said blade disk **102** of defects while said laser distance measurement system **1300** measures the quality of corrections made to said blade disk **102**.

FIG. **23-25** illustrates a perspective overview of said training assembly **418**.

As illustrated, in one embodiment, said training assembly **418** can comprise a variation on said upper portion **800**, said lower portion **802**, said plurality of y-axis wheels **804**, said plurality of x-axis wheels **806**, said motor mount **808** and said training arm **810**. Wherein, said variations can be made to improve resiliency of said training assembly **418** and improve strength while bending said plurality of blade disks **302**, as discussed above.

FIG. **26** illustrates an address space **2600** of said controller **508**.

In one embodiment, said address space **2600** can comprise a memory **2602** having a program **2604**, one or more processors **2606**, and a communication hardware **2608**. In one embodiment, said program **2604** can control functions of said training system **400**, such as analysis and correction of said one or more misaligned disks **1802**.

FIG. **27** illustrates an elevated view of a portion of said plurality of blade disks **302** on said mandrel **300** with said laser distance measurement system **1300** and said training arm **810**.

In one embodiment, a portion of said laser distance measurement system **1300** can be arranged at a top center location relative to said center axis **308**, and said training arm **810** can be at a 90 degree clockwise location relative to said laser distance measurement system **1300**, as illustrated. For example, said rotary step **2200** can comprise 20 rotations per full rotation of said blade disk **102**, or 18 degrees per turn.

FIG. **28** illustrates an elevated side view of said mandrel **300** with said plurality of blade disks **302**.

In one embodiment, said plurality of blade disks **302** can comprise a first disk **2800*a*** and a last disk **2800*b***.

As said training system **400** is configured for measuring said outer edge **120** of a current disk **2802** at a plurality of rotary locations, and for calculating a correction delta **2806** of said specified separation distance **306** less a current separation distance **2804**. Further, said training system **400** can be configured to bend said current disk **2802** to eliminate said correction delta **2806** as between said current disk **2802** and an adjacent disk **2808**.

In one embodiment, said training system **400** is configured for measuring a total saw width **2810** comprising a distance between said first disk **2800*a*** and said last disk **2800*b***. In one embodiment, said training system **400** can confirm that said total saw width **2810** is equal to a nominal saw length equal to the desired location of said first disk **2800*a*** and said last disk **2800*b***.

In one embodiment, said training system **400** can confirm and alter said plurality of blade disks **302** according to a blade spacing specification **2812**. Wherein, said blade spacing specification **2812** can comprise said total saw width **2810** between said first disk **2800*a*** and said last disk **2800*b*** comprises a specified saw width **2814**, and each adjacent disk among said plurality of blade disks **302** being spaced by said specified separation distance **306**.

In one embodiment, said program **2604** can be configured for measuring said outer edge **120** in increments of said rotary step **2200**, recording said current separation distance **2804** at each among said rotary step **2200**, and bending said current disk **2802** at each said rotary step **2200** according to said bend angle **1804** for each among said rotary step **2200**.

In one embodiment, said training system **400** can be configured for measuring each among said plurality of blade disks **302** at each among said rotary step **2200**, and correcting any misalignments found according to said blade spacing specification **2812**.

FIG. **29** illustrates said plurality of blade disks **302** with said specified saw width **2814** and said total saw width **2810**.

In one embodiment, it can be advantageous to minimize bending on said plurality of blade disks **302** by ensuring that corrections according to said blade spacing specification **2812** are evenly distributed among said plurality of blade disks **302**. For example, if slight changes are applied to disks proximate to said first disk **2800***a*, it might be that large changes may need to be applied to disks proximate to said last disk **2800***b*. Accordingly, said training system **400** and said program **2604** can be configured to calculate a portion of said plurality of blade disks **302** to be bent outward toward said first disk **2800***a* and a second portion to bent outward toward said last disk **2800***b*.

Where said total saw width **2810** and said specified saw width **2814** do not match, said program **2604** can calculate a saw width distance error **2900** between said total saw width **2810** and said specified saw width **2814**, determine whether said saw width distance error **2900** exceeds said blade spacing specification **2812** and planning a correction for said plurality of blade disks **302**.

In one embodiment, said training system **400** can be configured for calculating a starting offset **2902** from a home position **2904** at a first end **2906** of said mandrel **300**. In one embodiment, said starting offset **2902** can comprise a default offset **2908** plus half of said saw width distance error **2900**. Wherein, bending said first disk **2800***a* outward will result in said last disk **2800***b* bent outward as well; and, conversely, if said first disk **2800***a* is bent inward, said last disk **2800***b* will be bent inward as well. Whereby, said bend angle **1804** on each among said plurality of blade disks **302** is minimized and distributed more evenly among said plurality of blade disks **302**.

Various changes in the details of the illustrated operational methods are possible without departing from the scope of the following claims. Some embodiments may combine the activities described herein as being separate steps. Similarly, one or more of the described steps may be omitted, depending upon the specific operational environment the method is being implemented in. It is to be understood that the above description is intended to be illustrative, and not restrictive. For example, the above-described embodiments may be used in combination with each other. Many other embodiments will be apparent to those of skill in the art upon reviewing the above description. The scope of the invention should, therefore, be determined with reference to the appended claims, along with the full scope of equivalents to which such claims are entitled. In the appended claims, the terms "including" and "in which" are used as the plain-English equivalents of the respective terms "comprising" and "wherein."

The following paragraphs are included with reference to the claims and can be interpreted as a preferred embodiment.

The following listing of the parts in the figures is included for the convenience of the reader.

said blank **100**,
Said blade disk **102**,
Said body portion **104**,
Said center aperture **106**,
Said diameter **108**,
Said center aperture diameter **122**,
Said detailed call-out **110**,
Said plurality of punched teeth **112**,
Said sharpened edge **114**,
Said tooth orientation **116**,
Said center point **118**,
Said outer edge **120**,
Said unsharpened punched blank **124**,
Said call-out **200**,
Said grind angle **202**,
Said top surface **204**,
Said bottom surface **206**,
Said mandrel **300**,
Said plurality of blade disks **302**,
Said center shaft **304**,
Said specified separation distance **306**,
Said center axis **308**,
Said y-axis **310**,
Said x-axis **312**,
Said z-axis **314**,
Said training system **400**,
Said training stand **402**,
Said first side **404**,
Said second side **406**,
Said width **408**,
Said length **410**,
Said first side height **412**,
Said second side height **414**,
Said spacing measurement assembly **416**,
Said training assembly **418**,
Said motor **420**,
Said first track **422**,
Said second track **424**,
Said first end **500**,
Said second end **502**,
Said central channel **504**,
Said trainer rotating axis **506**,
Said controller **508**,
Said motor **700**,
Said linear slide assembly **702**,
Said upper portion **800**,
Said lower portion **802**,
Said plurality of y-axis wheels **804**,
Said plurality of x-axis wheels **806**,
Said motor mount **808**,
Said training arm **810**,
Said mounting plate **1002**,
Said bender mounting assembly **1000**,
Said linear actuator **1004**,
Said fastener aperture **1006**,
Said first end **1008**,
Said second end **1010**,
Said pivoting axis **1012**,
Said training adapter **1014**,
Said slot **1016**,
Said first side **1018**,
Said second side **1020**,
Said rod **1022**,
Said fastener **1026**,
Said arched aperture **1024**,
Said side mounting bracket **1028**,
Said motor **1200**,
Said lower portion **1202**,
Said upper portion **1204**,
Said plurality of z-axis wheels **1206**,
Said plurality of y-axis wheels **1208**,
Said laser distance measurement system **1300**,
Said one or more nominal disks **1800**,
Said one or more misaligned disks **1802**,

Said bend angle **1804**,
Said toward first end direction **1900**,
Said toward second end direction **1902**,
Said inward direction **1904**,
Said outward direction **1906**,
Said training pivoting motion **1908**,
Said method of training disks **2000**,
Said rotary step **2200**,
Said address space **2600**,
Said memory **2602**,
Said program **2604**,
Said one or more processors **2606**,
Said communication hardware **2608**,
Said first disk **2800***a,*
Said last disk **2800***b,*
Said current disk **2802**,
Said correction delta **2806**,
Said current separation distance **2804**,
Said adjacent disk **2808**,
Said total saw width **2810**,
Said blade spacing specification **2812**,
Said specified saw width **2814**,
Said saw width distance error **2900**,
Said starting offset **2902**,
Said home position **2904**,
Said first end **2906**, and
Said default offset **2908**.

The invention claimed is:

1. A training system for identifying one or more misaligned disks among a plurality of blade disks and straightening said one or more misaligned disks, wherein:
- said training system comprises a training stand, a width, a length, a spacing measurement assembly, a training assembly, and a controller;
- each among said plurality of blade disks comprise a blade disk having a body portion, a center aperture, a diameter, a plurality of punched teeth, a sharpened edge, a center point, an outer edge and a center aperture diameter;
- portions of said plurality of blade disks comprise said one or more misaligned disks and one or more nominal disks;
- said plurality of blade disks comprise at least a first disk and a last disk;
- each among said plurality of blade disks is attached to a mandrel along a center axis;
- said one or more nominal disks conform to a blade spacing specification comprising
  - a total saw width between said first disk and said last disk,
  - a specified saw width, and
  - said outer edge of each disk among said plurality of blade disks spaced by a specified separation distance;
- said training stand is configured to hold said mandrel having said plurality of blade disks;
- said one or more nominal disks among said plurality of blade disks each comprise said outer edge being said specified separation distance from said outer edge of adjacent disks;
- said one or more misaligned disks among said plurality of blade disks each comprise a portion of said outer edge not being said specified separation distance from said outer edge of adjacent disks;
- said controller, for each among said plurality of blade disks, is configured for

  - receiving a measurement of a current separation distance of said outer edge between a current disk and an adjacent disk from said spacing measurement assembly, and
  - specifying whether said current disk comprises one among said one or more nominal disks or said one or more misaligned disks;
- if said current disk is among said one or more misaligned disks, said controller is further configured for
  - calculating a bend angle to alter said current disk to match said current separation distance to said specified separation distance of said blade spacing specification, and
  - controlling said training assembly to correct said one or more misaligned disks according to said bend angle;
- said training assembly comprises a motor, a linear slide assembly and a training arm;
- a portion of said linear slide assembly is configured to move said training assembly along a y-axis using a second track;
- said training assembly comprises an upper portion and a lower portion;
- said training assembly is configured to move along portions of said second track using a plurality of x-axis wheels for guidance; and
- said motor is configured to attach to said training assembly on a motor mount.

2. A training system for identifying one or more misaligned disks among a plurality of blade disks and straightening said one or more misaligned disks, wherein:
- said training system comprises a training stand, a width, a length, a spacing measurement assembly, a training assembly, and a controller;
- each among said plurality of blade disks comprise a blade disk having a body portion, a center aperture, a diameter, a plurality of punched teeth, a sharpened edge, a center point, an outer edge and a center aperture diameter;
- portions of said plurality of blade disks comprise said one or more misaligned disks and one or more nominal disks;
- said plurality of blade disks comprise at least a first disk and a last disk;
- each among said plurality of blade disks is attached to a mandrel along a center axis;
- said one or more nominal disks conform to a blade spacing specification comprising
  - a total saw width between said first disk and said last disk,
  - a specified saw width, and
  - said outer edge of each disk among said plurality of blade disks spaced by a specified separation distance;
- said training stand is configured to hold said mandrel having said plurality of blade disks;
- said one or more nominal disks among said plurality of blade disks each comprise said outer edge being said specified separation distance from said outer edge of adjacent disks;
- said one or more misaligned disks among said plurality of blade disks each comprise a portion of said outer edge not being said specified separation distance from said outer edge of adjacent disks;
- said controller, for each among said plurality of blade disks, is configured for

receiving a measurement of a current separation distance of said outer edge between a current disk and an adjacent disk from said spacing measurement assembly, and

specifying whether said current disk comprises one among said one or more nominal disks or said one or more misaligned disks; and

if said current disk is among said one or more misaligned disks, said controller is further configured for

calculating a bend angle to alter said current disk to match said current separation distance to said specified separation distance of said blade spacing specification, and

controlling said training assembly to correct said one or more misaligned disks according to said bend angle.

3. The training system of claim **2**, wherein:

it is advantageous to minimize bending on said plurality of blade disks by ensuring that corrections according to said blade spacing specification are evenly distributed among said plurality of blade disks;

said training system and a program is configured to calculate a portion of said plurality of blade disks to be bent outward toward said first disk and a second portion to bent outward toward said last disk;

where said total saw width and said specified saw width do not match, said program

calculates a saw width distance error between said total saw width and said specified saw width,

determines whether said saw width distance error exceeds said blade spacing specification and planning a correction for said plurality of blade disks;

said training system is configured for calculating a starting offset from a home position at a first end of said mandrel;

said starting offset comprises a default offset plus half of said saw width distance error;

wherein, bending said first disk outward will result in said last disk bent outward as well; and, conversely, if said first disk is bent inward, said last disk will be bent inward as well; and

whereby, said bend angle on each among said plurality of blade disks is minimized and distributed more evenly among said plurality of blade disks.

4. The training system of claim **2**, wherein:

said training system is configured for measuring, confirming and correcting each among said plurality of blade disks according to said blade spacing specification, comprising a substantially planar shape within an x-axis and a z-axis by

holding said mandrel on said training stand,

moving said spacing measurement assembly and said training assembly along a y-axis,

measuring said specified separation distance between said plurality of blade disks,

identifying a bent portion of a current blade disk among said plurality of blade disks, and

bending said current blade disk with said training assembly to conform to said desired disk configuration.

5. The training system of claim **2**, wherein:

a blank is punched to create said blade disk with said plurality of punched teeth and said sharpened edge; and

said plurality of punched teeth are aligned in a tooth orientation being relative to said center point of said body portion and on said outer edge of said body portion.

6. The training system of claim **2**, wherein:

said mandrel comprises said plurality of blade disks attached to a center shaft;

said training system comprises a central channel;

said mandrel is mounted between a first end and a second end within said central channel;

said central channel comprises a trainer rotating axis; and

with said mandrel installed into said training system, said center axis and said trainer rotating axis are aligned.

7. The training system of claim **2**, wherein:

said training assembly comprises a motor, a linear slide assembly and a training arm; and

a portion of said linear slide assembly is configured to move said training assembly along a y-axis using a second track.

8. The training system of claim **7**, wherein:

said training assembly comprises an upper portion and a lower portion;

said training assembly is configured to move along portions of said second track using a plurality of x-axis wheels for guidance; and

said motor is configured to attach to said training assembly on a motor mount.

9. The training system of claim **8**, wherein:

said lower portion and said upper portion are configured to move relative to one another in said x-axis by applying pressure and rolling along a plurality of y-axis wheels.

10. The training system of claim **2**, wherein:

said training assembly is configured to adjust a portion of said plurality of blade disks by:

calculating a proper alignment of said plurality of blade disks,

aligning a training adapter with one among said plurality of blade disks,

activating a linear actuator,

moving said training arm about a pivoting axis, and

bending a portion of said plurality of blade disks according to said desired disk configuration.

11. A method of training disks using a training system comprising:

with a controller having a program executed in one or more processors:

receiving a measurement of a current separation distance of an outer edge between a current disk and an adjacent disk from a spacing measurement assembly,

specifying whether said current disk comprises one among one or more nominal disks or one or more misaligned disks;

if said current disk is among said one or more misaligned disks, said controller is further configured for

calculating a bend angle to alter said current disk to match said current separation distance to a specified separation distance of a blade spacing specification

controlling a training assembly to correct said one or more misaligned disks according to said bend angle;

wherein, said training system comprises a training stand, a width, a length, said spacing measurement assembly, said training assembly, and said controller;

each among a plurality of blade disks comprise a blade disk having a body portion, a center aperture, a diameter, a plurality of punched teeth, a sharpened edge, a center point, said outer edge and a center aperture diameter;

portions of said plurality of blade disks comprises said one or more misaligned disks and said one or more nominal disks;

said plurality of blade disks comprise at least a first disk and a last disk;

each among said plurality of blade disks is attached to a mandrel along a center axis;

said one or more nominal disks conform to said blade spacing specification comprising

a total saw width between said first disk and said last disk,

a specified saw width, and

said outer edge of each disk among said plurality of blade disks spaced by said specified separation distance;

said training stand is configured to hold said mandrel having said plurality of blade disks;

said one or more nominal disks among said plurality of blade disks each comprise said outer edge being said specified separation distance from said outer edge of adjacent disks; and

said one or more misaligned disks among said plurality of blade disks each comprise a portion of said outer edge not being said specified separation distance from said outer edge of adjacent disks.

12. The method of training disks of claim **11**, wherein:

said program is configured for

measuring said outer edge in increments of a rotary step,

recording said current separation distance at each among said rotary step, and

bending said current disk at each said rotary step according to said bend angle for each among said rotary step.

13. The method of training disks of claim **11**, further comprising:

calculating a proper alignment of said plurality of blade disks,

aligning a training adapter with one among said plurality of blade disks,

activating a linear actuator,

moving a training arm about a pivoting axis, and

bending a portion of said plurality of blade disks according to said desired disk configuration.

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