



DEPARTMENT OF THE NAVY

OFFICE OF COUNSEL
NAVAL UNDERSEA WARFARE CENTER DIVISION
1176 HOWELL STREET NEWPORT RI 02841-1708

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TECHNOLOGY PARTNERSHIP OFFICE
NAVAL UNDERSEA WARFARE CENTER
1176 HOWELL ST.
CODE 00T2, BLDG. 102T
NEWPORT, RI 02841

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Inventor Michael J. Kroger

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SEWING MACHINE FOR CONTINUOUS STRENGTH MEMBERS

[0001] This patent application claims the priority of United States Provisional Patent Application Serial Number 62/424,669 filed on November 21, 2016 by the inventors Michael Kroger, Brian Amaral, Eric Lee, Robert Cutler, Michael Williams, Jason Bernier, Charles Holicker and Kathryn Best.

STATEMENT OF GOVERNMENT INTEREST

[0002] The invention described herein may be manufactured and used by or for the Government of the United States of America for governmental purposes without the payment of any royalties thereon or therefor.

CROSS REFERENCE TO OTHER PATENT APPLICATIONS

[0003] None.

BACKGROUND OF THE INVENTION

(1) Field of the Invention

[0004] The present invention is an assembly that automates the manufacture of an internal strength member of a towed array. The assembly attaches pieces of fabric using a multi-needle sewing machine to sew multiple linear pockets in a section of

the fabric in which cords are used to pull the strength members into the pockets.

(2) Description of the Prior Art

[0005] Towed arrays require an internal strength member to support the tension experienced while the towed array is deployed. Typically and especially for prototype arrays, strength members have been handmade. Handmade strength members generally require an exorbitant amount of labor to produce.

[0006] Production towed arrays use a manufactured sock where strength members are stitched on top of a nylon and fabric base. Electrical wires are also stitched into the production sock. However, a production sock is not desirable for research and development purposes because the production sock is too complex and expensive to use for prototype arrays built for these purposes.

[0007] A typical internal strength member is comprised of a fabric housing also known as a sock with individual high strength ropes known as strength members. The sock keeps the strength members from becoming entangled with each other as well as becoming entangled with the electronics inside the towed array. The positioning of the strength members is achieved by the sock having individual, open-ended, tubular, linear pockets for each strength member to pass through for the length of the array. The process of hand making socks involved manually

sewing each pocket down the length of the sock. Typical socks have more than a dozen pockets and are over one hundred feet long.

[0008] Each stitch line for each pocket is manually sewn with a sewing machine; however, maintaining exact dimensions between each stitch line is difficult as each stitch line is sewn down the length of the sock before an adjacent stitch line is sewn. Typically, stitch lines are not perfectly straight when sewn, so the resulting pockets are not straight and the internal space of each pocket varies. After the pockets are sewn, pull cords are manually fed through each pocket.

[0009] The strength members are pulled into the pockets using the pull cords. When the internal space of a pocket is too small, it is difficult and sometimes impossible, to pull the strength members through the pocket. If the internal space of a pocket is too small to pull a strength member through, then the portion of the pocket that is too small has to be cut out and re-stitched. Rework of non-straight stitch lines increases the risk of the sock failing from the fabric ripping or the stitch line being interrupted, breaking, or becoming untied.

[0010] As a result of the known labor intensive and complex methods of manufacturing towed array internal strength members, a need exists for an automated and efficient assembly for the manufacture of the strength members.

SUMMARY OF THE INVENTION

[0011] Accordingly, it is a general purpose and primary object of the present invention to provide an assembly for manufacturing an internal strength member of a towed array.

[0012] It is a further object of the present invention to automate the manufacture of an internal strength member of a towed array.

[0013] It is a still further object is provide an assembly of modular components for the manufacture of various types of internal strength members.

[0014] It is a still further object is provide an assembly for quick loading and unloading of material and components for easy and rapid manufacture of an internal strength member.

[0015] In order to obtain the objects described, an internal strength member sewing machine is provided in which the sewing machine comprises upper and lower feeder spools, a collection spool, and idlers - with all of the components positioned on a support structure. A cord supply, a fabric shaper, a speed control and a pressure foot lift are also provided and positioned on the support structure.

[0016] In operation, fabric from the upper spool and the lower spool is fed to be in contact with the idlers. The idlers maintain tension in the fabric moving toward the fabric shaper.

[0017] The fabric from the upper spool is crimped in the fabric shaper while the fabric from the lower spool remains flat and passes underneath the fabric shaper. Between the layers of fabric, pull cords are pulled through and guided from the cord supply thru the fabric shaper.

[0018] The fabric with crimps from the upper spool and with the pull cords inside the crimps is stitched to the fabric from the lower spool at the troughs of the crimps; thereby creating linear casings with a pull cord in the internal space of each casing. The joined fabrics with the pull cords in the casings are collected by the collection spool as a finished product.

[0019] The fabric in the feeder spools is configured to be easily change out or be replaced. A clamp top is attached to the clamp base of each feeder spool by a hinge. When the clamp top is closed, a quick-release pin locks the clamp top with the spool and fabric inserted to the clamp base. A clamp knob is rotated to increase or decrease the tension placed on the spool by the clamp top and the clamp base. A bearing reduces the wear on a spool shaft of the feeder spools; prevents wear of the clamp base; and allows for the smoother rotation of the spools.

[0020] An alignment tool is located between one of the flanges attached to the spool and the clamp base. The position of the alignment tool is adjustable so that the tool is placed in contact with one of the flanges. When the alignment tool is

in contact with the flange, the tool puts pressure on the flange to align the feeder spool so that the fabric leaves the feeder spool as flat and straight. The idlers maintain tension and dampen sudden jolts in the fabric to make the feed of fabric to the sewing machine more constant with less disruption.

[0021] The cord supply distributes pull cords in a controlled fashion to prevent the entanglement of the pull cords before the cords enter into the sewing machine. Each supply spool of the pull cords can be replaced individually with the tension on the pull cords being varied by applying weights on top of the spools.

[0022] The fabric shaper shapes the fabric from the upper spool into the crimps that are stitched into the casings for the longitudinal pull cords. Grooves in the fabric shaper guide the pull cords from the cord guide to the sewing machine. The sections of the fabric shaper can be easily changed to alter the pattern of what is fed to the sewing machine.

[0023] A lower section of the fabric shaper guides the fabric from the lower spool, which remains flat and unshaped, into the sewing machine. Magnets in the lower section attract to the metallic deck of the sewing machine to reduce the vibration of the deck and the fabric shaping while the sewing machine is running. This reduces independent movement of the deck and fabric shaping. A guide rail attached to each side of the

underside of the upper section base attaches to the support structure and allows a distance between the fabric shaper and the sewing machine to be adjusted.

[0024] The fabric from the upper spool that becomes crimped meets the pull cords and the flat fabric from the lower spool at the end of the fabric shaping. As the crimped fabric leaves the fabric shaping, the pull cords enter the crimps. The flat fabric from the lower spool slides along the deck of the sewing machine and is underneath the crimped fabric and the pull cords before entering the sewing machine. The sewing machine includes the deck and a thread stand with the stand supplying the thread used by the sewing machine to stitch the casings.

[0025] The collection spool collects a finished product of fabric as the product leaves the sewing machine. The collection spool may be adjusted to evenly collect the finished product. A speed control is used to regulate and maintain the speed of the sewing machine. The speed control can also be used to move the location from which the user operates the clutch to the side of the sewing machine.

BRIEF DESCRIPTION OF THE DRAWINGS

[0026] Other objects, features and advantages of the present invention will be better understood by means of a detailed

description of the drawings that illustrate the principals of the present invention in which:

[0027] FIG. 1 depicts a multi-needle sewing machine and fabric shaper of the present invention with the sewing machine having upper and lower spools, idlers, a cord supply, a multi-needle sewing machine, a collection spool, a speed control and a pressure foot lift, all attached to a support structure;

[0028] FIG. 2 is a sectional view of a completed sock with adjacent casings, pull cords inside the casings and stitching connecting upper and lower sections of fabric;

[0029] FIG. 3 depicts the upper spool with a clamp top shown hinged open to allow placement of a fabric spool;

[0030] FIG. 4 is a disassembled view of a spool shaft and associated assembly parts;

[0031] FIG. 5 is a side view of the clamp base, a feeder spool inserted into the clamp base, an alignment tool adjustment knob and an associated alignment tool;

[0032] FIG. 6 is a side view of the sewing machine of the present invention with the fabric shaper removed for clarity to show the operational path of the cords and fabric of the strength member;

[0033] FIG. 7 is an isometric view of the cord supply;

[0034] FIG. 8 is a disassembled view of the fabric shaper of the present invention with an upper section lid and a lower

section lid separated from an upper section base and a lower section base;

[0035] **FIG. 9** is a partial side view of the multi-needle sewing machine and fabric shaper of the present invention attached to the support structure;

[0036] **FIG. 10** is an isometric view of the collection spool of the present invention;

[0037] **FIG. 11** is an isometric view of the collection spool adapter; and

[0038] **FIG. 12** is an isometric view of the speed control and pressure tool of the sewing machine.

DETAILED DESCRIPTION OF THE INVENTION

[0039] An internal strength member sewing assembly **10** of the present invention is shown in **FIG. 1**. The sewing machine assembly **10** generally comprises a multi-needle sewing machine **12**, an upper spool **20**, a lower spool **30**, a collection spool **40**, idlers **60**, a support structure **66**, a cord supply **70** and a fabric shaper **80**. A speed control and a pressure foot lift **500** for the sewing machine assembly **10** is also depicted in the figure.

[0040] Generally, in operation, fabric **200** from the upper spool **20** and the lower spool **30** is fed to be in contact with the idlers **60**. The idlers **60** maintain tension in the fabric **200** as the fabric moves toward the fabric shaper **80**. The fabric **200**

from the upper spool **20** is crimped in the fabric shaper **80**, while the fabric from the lower spool **30** remains flat and passes underneath the fabric shaper.

[0041] As shown in conjunction with **FIG. 2**, between the layers of fabric **200**, a plurality of pull cords **300** are pulled through and guided from the cord supply **70** thru the fabric shaper **80**. The fabric **200** with crimps from the upper spool **20** and with the pull cords **300** inside the crimps is stitched to the fabric from the lower spool **30** at the troughs of the crimps, thus creating individual, linear casings **202** with a pull cord **300** in the internal space of each casing. The joined fabrics with the pull cords **300** in the casings **202** are collected by the collection spool **40** as a finished product **400** for future use.

[0042] The sewing assembly **10** can be automated with sensors and other devices, such as motors, sensors, or solenoids, for autonomous or automatic sock production. The sewing assembly **10** could be supplied with material and set up for production, set to run within certain parameters by the user using a computer interface, and left to run by the user until sock production is complete or a problem is detected that requires user attention.

[0043] Sensors can be placed at the upper spool **20**, the lower spool **30**, and the cord supply **70** to detect when the supply of fabric **200** or pull cord **300** is depleted or nearing depletion.

These sensors could also detect if the fabric **200** and pull cords **300** remain properly aligned and untangled. If the sensors in the upper spool **20** and the lower spool **30** detect that the fabric **200** being fed to the fabric shaper **80** is not properly leaving the spool then a motor can actuate an alignment tool to adjust the position of the spool and maintain the straightness of the fabric leaving the spool.

[0044] A similar system of sensors and motors could be used to maintain the straightness of finished product to the collection spool **40** or the alignment of the collection spool itself. Sensors could detect when collection at the collection spool **40** is complete. Additionally, the collection spool **40** could have a motor so that a user does not need to hand crank the spool to collect the finished product **400**. With the collection spool **40** driven by its own motor, a sensor could match the speed of the motor driving the sewing machine **12** to the speed of collection by the collection spool for an efficient production of socks.

[0045] Furthermore, a sensor could detect if the input of the sewing machine **12** is in contact with the fabric **200** entering the sewing machine. Contact between the input and the fabric **200** could be desirable or undesirable, depending on the type of sock produced, and could be set by the user. Also, sensors could be placed in the fabric shaper **80** to detect whether the fabric **200**

is being crimped properly and whether the sections of the fabric shaper are properly attached. Additional sensors could be placed on a guide rail **92** of the fabric shaper **80** and a motor could be used to change the position of the fabric shaper relative to the sewing machine **12**. Sensors placed on the underside of the fabric shaper **80** could detect if the pull cords **300** have become entangled or are out of position as the pull cords enter the sewing machine **12**.

[0046] As shown in various areas of **FIG .1**, the support structure **66** of the sewing machine assembly **10** is adjustable by the use of slotted extrusions or other mechanically modifiable attachment points with the material of the support structure preferably being aluminum. However, the material and adjustment mechanism of the support structure **12** is not limited to the material and structural limitations described herein.

[0047] The upper spool **20** and the lower spool **30** contain fabric or material that is being joined together. The upper spool **20** is wider than the lower spool **30** as the fabric **200** is shaped into the casings **202** before being stitched. This shaping action requires more fabric **200**. A detailed view of the upper spool **20** is shown in **FIG. 3**. The lower spool **30** is identical in mechanical configuration and basic operation. Also, the fabric **200** on the lower spool **30** remains flat as the fabric proceeds through the sewing machine **10**.

In order to maintain a high rate of sock production, a roll of fabric **200** each placed in the upper spool **20** and the lower spool **30** is easy to replace; however the fabric remains secure in the spools during operation of the sewing machine **12**.

[0048] As shown in **FIG. 3**, a roll of the fabric **200** is placed onto a spool shaft **22**. In the detailed view of **FIG. 4**, a plurality of wedge-driven spikes **24** orient outward and radially from the spool shaft **22**. The spikes **24** are equally spaced around the spool shaft **22** to create an interference fit between the roll of fabric **200** and the spool shaft.

[0049] Flanges **26** are positioned on the spool shaft **22** with one face of the flange in proximity but loosely fit at the base of a roll of the fabric **200** on both ends of the spool shaft. A tapered and circular wedge **28** is inserted into the open ends of the spool shaft **40**. Rotating the wedge **28** alters the protrusion of the wedge-driven spikes **24**.

[0050] Returning to **FIG. 3**, the feeder spool **20** is configured to be easily change out or replace the fabric **200**. Each end of the spool shaft **22** is positioned on a clamp base **110**. A bearing **112** is attached to the clamp base **110** and a clamp top **114** where the spool shaft **22** contacts the clamp base and the clamp top. The bearing **112** reduces the wear on the spool shaft **22**; prevents wear of the clamp base **110**; and allows for the smoother rotation of the upper spool **20** with respect to the clamp base.

[0051] The clamp top **114** is attached to the clamp base **110** by a hinge. When the clamp top **114** is closed, a quick-release pin locks the clamp top to the clamp base **110**. A clamp knob **116** is rotated to increase or decrease the tension placed on the upper spool **20** by the clamp top **114** and the clamp base **110** to secure the upper spool. An alignment tool **118** is located between one of the flanges **26** attached to the upper spool **20** and the clamp base **110** (See **FIG. 5** for additional details). The position of the alignment tool **118** is adjusted by rotating the alignment tool adjustment knob **120** so that the alignment tool is placed in contact with one of the flanges **26**.

[0052] When the alignment tool **118** is in contact with the flange **26**, the alignment tool puts pressure on the flange to align the feeder spool **20** so that the fabric **200** leaves the feeder spool as flat and straight. The clamp base **110** is attached to a flat base **122** and the flat base is attached to the support structure **66** (See **FIG. 1** and **FIG. 6**).

[0053] As shown in **FIG. 6**, the idlers **60** in proximity to the upper spool **20** and the lower spool **30** maintain tension and dampens sudden jolts in the fabric **200** to make the feed of fabric to the sewing machine **12** more constant with less disruption. Each idler **60** comprises a weighted, vertically sliding, horizontal roller **61** with a vertical bar **62** attached to

the horizontal roller, and a plurality of slides mounted to the support structure **66**.

[0054] The vertical bar **62** constrains the motion of the horizontal roller **61** in a horizontal plane. A plurality of weights **63** are placed on top of the vertical bar **62**. The number of the weights **63** can be varied to produce less or more tension in the fabric **200**. A pull pin **64** at the top of the vertical bar **62** secures the weights **63** to the idler **60**. The horizontal roller **61** contacts the fabric **200** to ensure the fabric remains flat as the fabric is fed into the sewing machine **12**. The horizontal roller **61** then applies the tension to the fabric **200**.

[0055] As shown in **FIG. 7**, the cord supply **70** houses and distributes pull cords **300** in a controlled fashion to prevent the entanglement of the pull cords before the pull cords enter into the sewing machine **12**. Each supply spool **72** of the pull cords **300** can be replaced individually. The tension on the pull cords **300** can be varied by applying weights **74** on top of the spools **72**.

[0056] A cord guide **76** includes handles on a top section to easily remove the section so that replacement pull cords **300** can be loaded with minimal down time and disassembly of the cord guide. Each half of the cord guide **76** has corresponding grooves on one side so that when the halves are combined with the grooves of the bottom half facing the grooves of the top half; a

plurality of channels is then formed. The pull cords **300** enter into a cord feeder **78** through the channels.

[0057] In use, the pull cords **300** could wear at the cord guide **76** where feeding of the pull cords changes angles. To minimize this wear, a plurality of wear resistant channel reinforcements **79** are inserted into the cord guide **76** at the inside corners of the channels. When the sections of the cord guide **76** are assembled with each other; the pull cords **300** can be seen moving through the cord guide through viewing windows in the cord guide. The cord guide **76** and the cord feeder **78** are attached to a base which attaches to the support structure **66**.

[0058] As shown in **FIG. 8**, the fabric shaper **80** is comprised of a lower section **81** and an upper section **82** with each section having a lid and base. The upper section **82** is furthest from the sewing machine **12** while the lower section **81** contacts a deck **14** of the sewing machine. The upper section **82** shapes the fabric **200** from the upper spool **20** into the crimps that will get stitched into the casings **202**. The lower section **81** maintains and supports the newly formed crimps. Grooves **83** on the lower section **81** guide the pull cords **300** from the cord guide **76** to the sewing machine **12**. As the fabric **200** from the upper spool **20** enters the upper section **82** and the lower section **81**, the weight of an upper section lid **84** shapes the fabric.

[0059] The upper section lid **84** can be locked to the upper section base **85** with a plurality of sliding magnetic locks **86**. The sliding magnetic locks **86** attract to magnets or metal in the upper section base **85** to lock the upper section lid **84** to the upper section base.

[0060] Ridges **87** on the upper section base **85** and a lower section base **88** respectively match cavities in the upper section lid **84** and a lower section lid **89**. The ridges **87** are sized smaller than the cavities to create a small thickness gap to allow the fabric **200** to conform to shape and to slide through the fabric shaper **80**. A pattern of the upper section lid **84** is a shallow "V" formation of the ridges **87** running linear with feeding direction "A" of the fabric **200** with the tip of the "V" starting in the middle of a width of the fabric. This pattern is needed so that the extra fabric **200** that is required to be crimped to make the casings **202** is slowly taken up by width - starting from the center and working outward as the fabric advances onto the "V" pattern. The upper section lid **84**, the lower section lid **89**, the upper section base **85**, and the lower section base **88** can be easily changed to alter the pattern.

[0061] The lower section lid **89** magnetically attaches to the lower section base **88**, with magnets in the lower section lid attracting to magnets or metal in the lower section base. If needed, additional magnets can be put into a plurality of magnet

slots in the lower section base **88**. Also, a sliding lock locks the lower section lid **89** to the lower section base **88**.

[0062] As shown in **FIG. 9**, a lower section guide **90** guides the fabric **200** from the lower spool **30**, which remains flat and unshaped, into the sewing machine **12**. Magnets in the lower section base **88** attract to the metallic deck **14** of the sewing machine **12** to reduce the vibration of the deck and the fabric shaping while the sewing machine is running, which reduces independent movement of the deck and fabric shaping. The guide rail **92** attached to each side of the underside of the upper section base **85** attaches to the support structure **66** and allows the distance between the fabric shaper **80** and the sewing machine **12** to be adjusted.

[0063] In this configuration, the fabric shaper **80** is positioned so that the side of the lower section **81** that faces the sewing machine **12** is close to the needles of the sewing machine. The fabric **200** from the upper spool **20** that becomes crimped meets the pull cords **300** and the flat fabric from the lower spool **30** at the end of the fabric shaping. As the crimped fabric **200** leaves the fabric shaping, the pull cords **300** enter the crimps. The flat fabric **200** from the lower spool **30** slides along the deck **14** of the sewing machine **12** and is underneath the crimped fabric and the pull cords **300** before entering the sewing machine.

[0064] The sewing machine **12** includes the deck **14** and a thread stand **16** (See **FIG. 1** and **FIG. 6**). The sewing machine **12** performs a chain stitch of the fabric **200** to form the casings **202** by sewing the edges of the crimps in the fabric from the upper spool **20** to the flat fabric from the lower spool **30**. The thread stand **16** supplies the thread used by the sewing machine **12** to stitch the casings **202**.

[0065] As shown in **FIG. 10**, the collection spool **40** collects a finished product **400** as the finished product leaves the sewing machine **12**. A Y-shaped clamp base **41** with a wearable surface on each inside face of the Y-shape supports both ends of a spool shaft **42**. A clamp top **43** is attached to the clamp base **41** with a hinge so the clamp top can rotate with respect to the clamp base to open and close. When closed, the clamp top **43** is secured to the clamp base **41** with a quick release pin **44**. When the clamp top **43** is closed and secured to the clamp base **41**, the bearing on the inside of the clamp top contacts the spool shaft **42**. A clamp knob **45** is able to adjust pressure between the clamp top **43** and the spool shaft **42**.

[0066] An alignment tool **46** is attached to the section of the clamp base **41** that faces a flange **47** attached to either side of the spool shaft **42**. A position of the alignment tool **46** can be adjusted so that the alignment tool contacts the flange **47** to adjust the position of the collection spool **40**. Adjusting the

position of the collection spool **40** allows the collection spool to evenly collect the finished product **400** of fabric.

[0067] As shown in **FIG. 11**, the spool shaft **42** has a slot for an adapter **140**. The adapter **140** has a fabric clamp **142** on either side of a main body **144** and a plurality of pull cords holes **146**. The fabric clamps **142** rotate with respect to the main body **144** to expose the inside of the main body. The end of the pull cords **300** are pulled through pull cords holes **146** and secured with a pull cord clamp **148**. The pull cords **300** are placed underneath the pull cord clamp **148**. A set screw on either side of the pull cord clamp **148** is rotated to tighten the pull cord clamp to secure the pull cords **300** to the adapter **140**.

[0068] Before the sewing machine **12** is operated, the fabric **200** from the upper spool **20** and lower spool **30** and the pull cords **300** are pulled through the fabric shaper **80** and the sewing machine, secured in the adapter **140**. The adapter **140** is put into a slot in the collection spool **40**. The collection spool **40** is attached to one end of a crank shaft **48** with a shaft coupler **49** that allows the collection spool to be quickly detached from the crank shaft. The crank shaft **48** is supported by a plurality of crank shaft supports **50**. The other end of the crank shaft **48** is attached to a crank wheel **51**. In operation, the user of the sewing machine **10** rotates the crank wheel **51** at a rate similar to the rate that the sewing machine **12** sews the fabric **200**. The

crank shaft supports **50** are attached at a flat base **52**, which attaches to the support structure **66**.

[0069] **FIG. 12** depicts a pressure foot lift **500** comprised of a lever **502**, a fulcrum **504**, and a chain **506**. The pressure foot lift **500** moves the location from which the multi-needle sewing machine **12** is actuated because of the location of the collection spool **40** and the support structure **66**. The pressure foot lift **500** moves the actuation motion to the side of the sewing machine **10** and close to the other controls. The fulcrum **504** is attached to the support structure **66** and to the lever **502** between the two ends of the lever. One end of the lever **502** faces the user and is used by the user to set the position of the pressure foot lift **500**. Raising or lowering the lever **502** changes the position of the foot pressure foot lift **500**. A set screw is used to lock the position of the lever **502** and the pressure foot lift **500**, into a desired position so the user does not need to hold the lever in position while using the sewing machine **12**.

[0070] A speed control **600** is used to regulate and maintain the speed of the sewing machine **12**. Use of variable speed multi-needle sewing machine **12** normally operates at top speed so a clutch **602** is used to slow down the sewing machine. The clutch **602** actuates to slow down a motor of the sewing machine **12**. The support structure **66** and the location of the collection

spool **40** requires the user to operate the clutch **602** from the side of the sewing machine **12**.

[0071] The speed control **600** moves the location from which the user operates the clutch **602** to the side of the sewing machine **12**. A cable **604** is attached to the clutch **602** and is routed through a plurality of pulleys attached to the support structure **66** to a cam operator **606**. The cam operator **606** is attached by a shaft to a hard wheel **608** and slotted wheel **610**. A plurality of shaft supports **612** support the shaft and allow the shaft to rotate. The shaft supports **612** are attached to a flat base and the support structure **66**.

[0072] The hard wheel **608** is rotated by the user to change the position of the clutch **602** and thus the speed of the sewing machine **12**. The slotted wheel **610** rotates with the shaft as the user rotates the hard wheel **608**. The slot in the slotted wheel **610** allows the slotted wheel to rotate around a knob **614**. The knob **614** is attached to a flange **616**, which is attached to the support structure **66**. The knob **614** can be rotated to lock the position of the slotted wheel **610** to set the desired speed of the sewing machine **12** without the user having to hold the hard wheel **608** in position while operating the sewing machine.

[0073] It will be understood that many additional changes in the details, materials, steps and arrangement of parts, which have been herein described and illustrated in order to explain

the nature of the invention, may be made by those skilled in the art within the principle and scope of the invention as expressed in the appended claims.

[0074] The foregoing description of the preferred embodiments of the invention has been presented for purposes of illustration and description only. It is not intended to be exhaustive nor to limit the invention to the precise form disclosed; and obviously many modifications and variations are possible in light of the above teaching. Such modifications and variations that may be apparent to a person skilled in the art are intended to be included within the scope of this invention as defined by the accompanying claims.

SEWING MACHINE FOR CONTINUOUS STRENGTH MEMBERS

ABSTRACT OF THE DISCLOSURE

A strength member sewing machine is provided which comprises upper and lower feeder spools, a collection spool and idlers positioned on a support structure. A cord supply, a fabric shaper, a speed control and a pressure foot lift are positioned on the structure. Fabric from the spools is kept in tension with the idlers while moving toward the fabric shaper. The fabric from the upper spool is crimped while the fabric from the lower spool remains flat underneath the shaper. Between the fabric layers, pull cords are pulled through from the cord supply thru the fabric shaper. The fabric with crimps and with the pull cords inside the crimps is sewn to the fabric from the lower spool to create casings with a pull cord in the internal space of each casing. The joined fabrics with the pull cords are collected by the collection spool as a finished product.

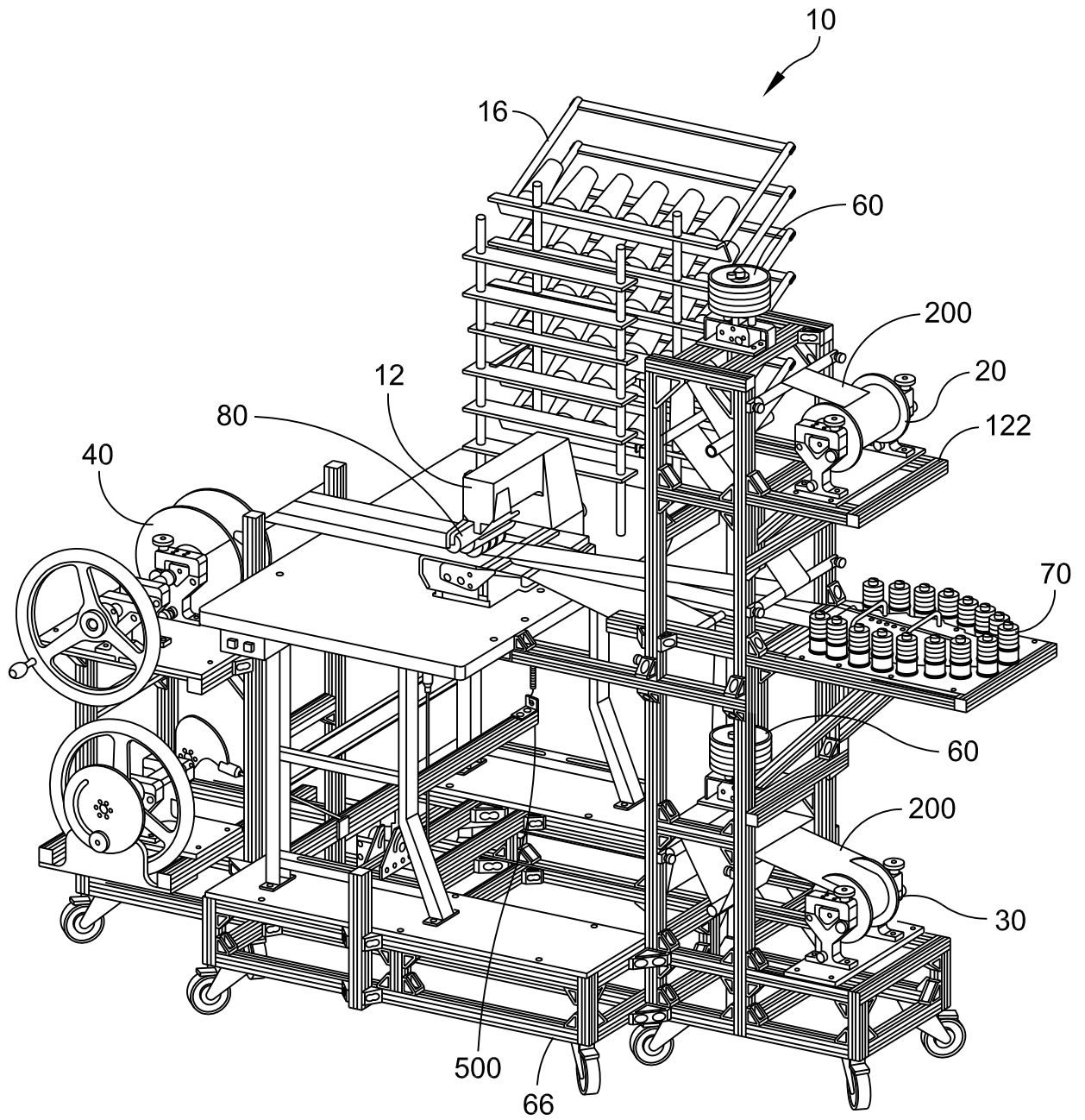


FIG. 1

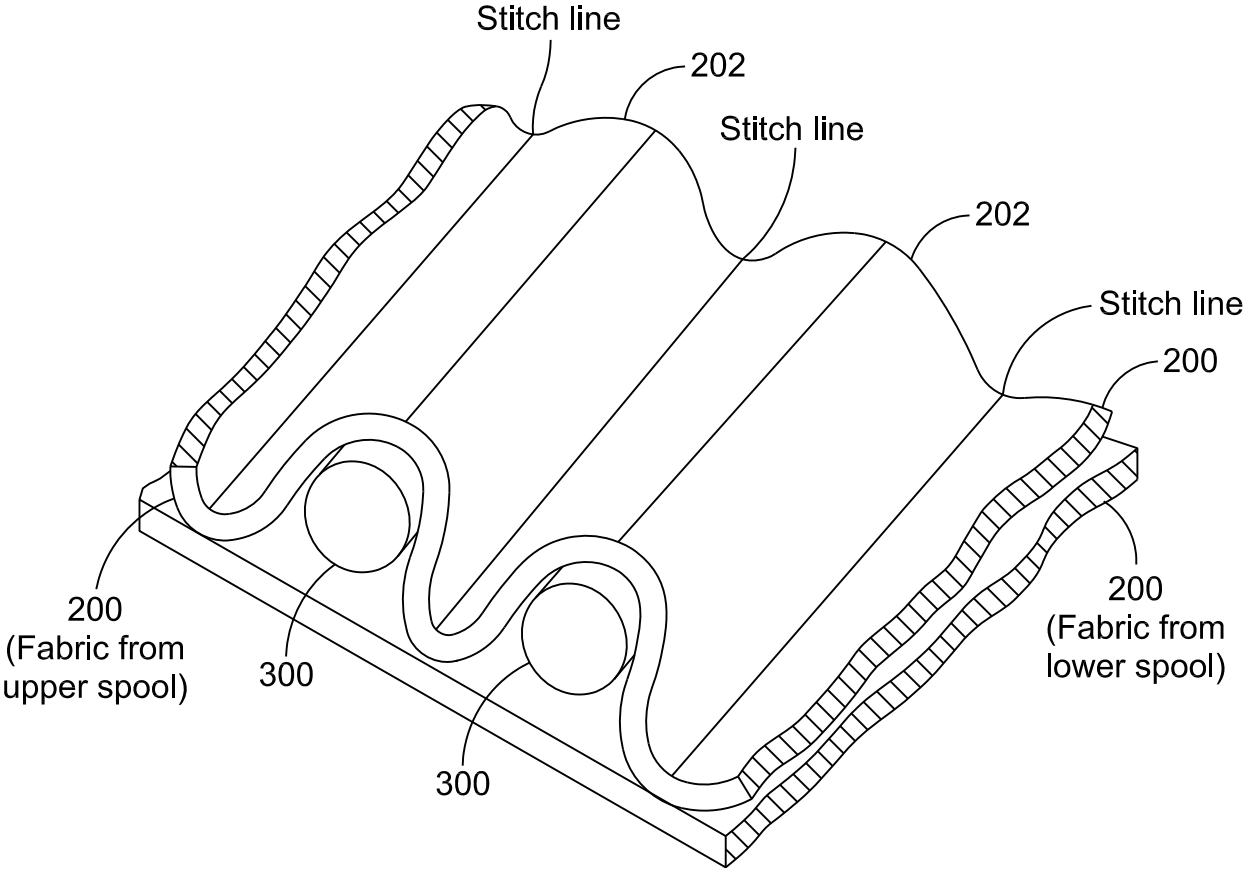


FIG. 2

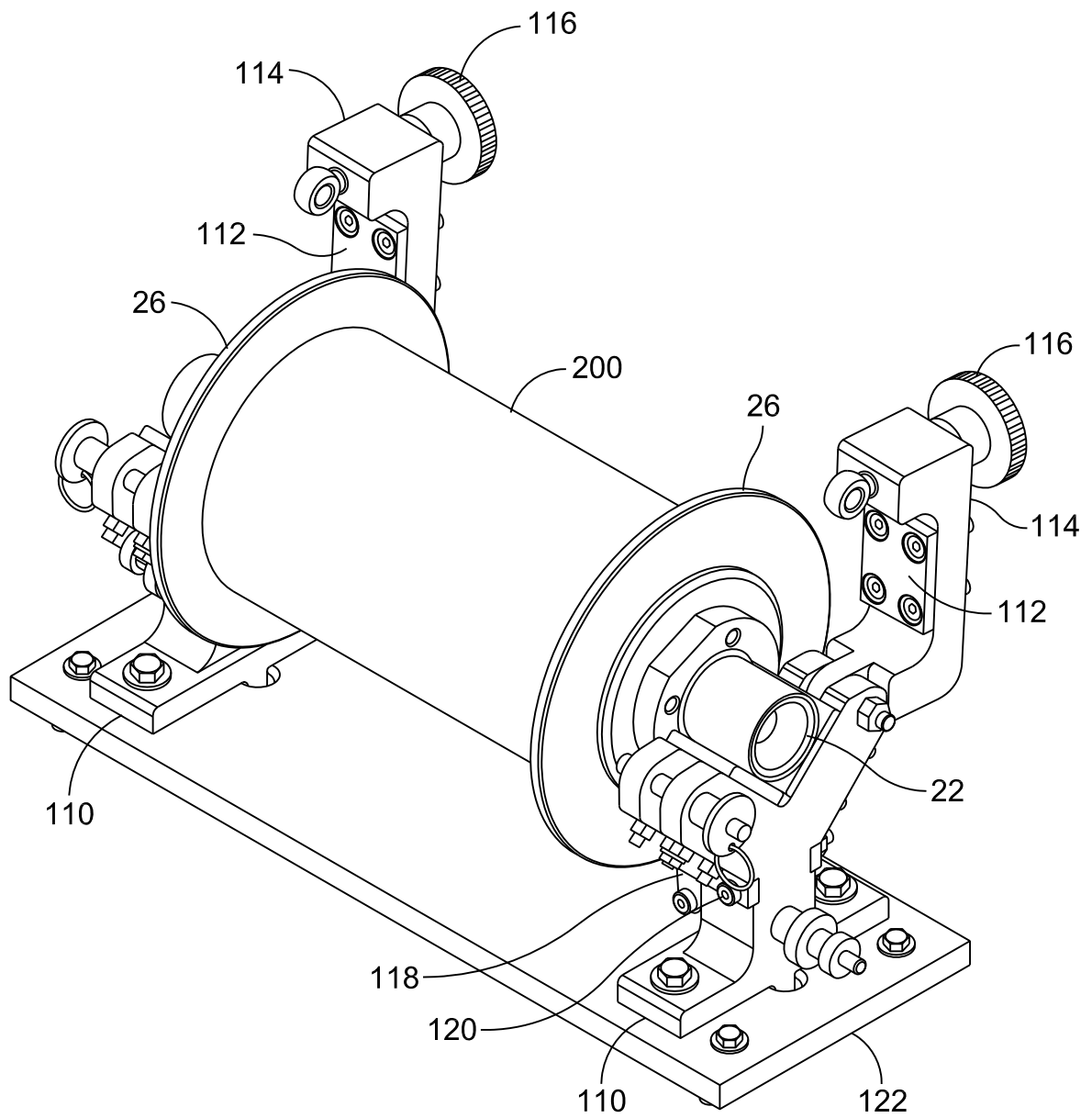


FIG. 3

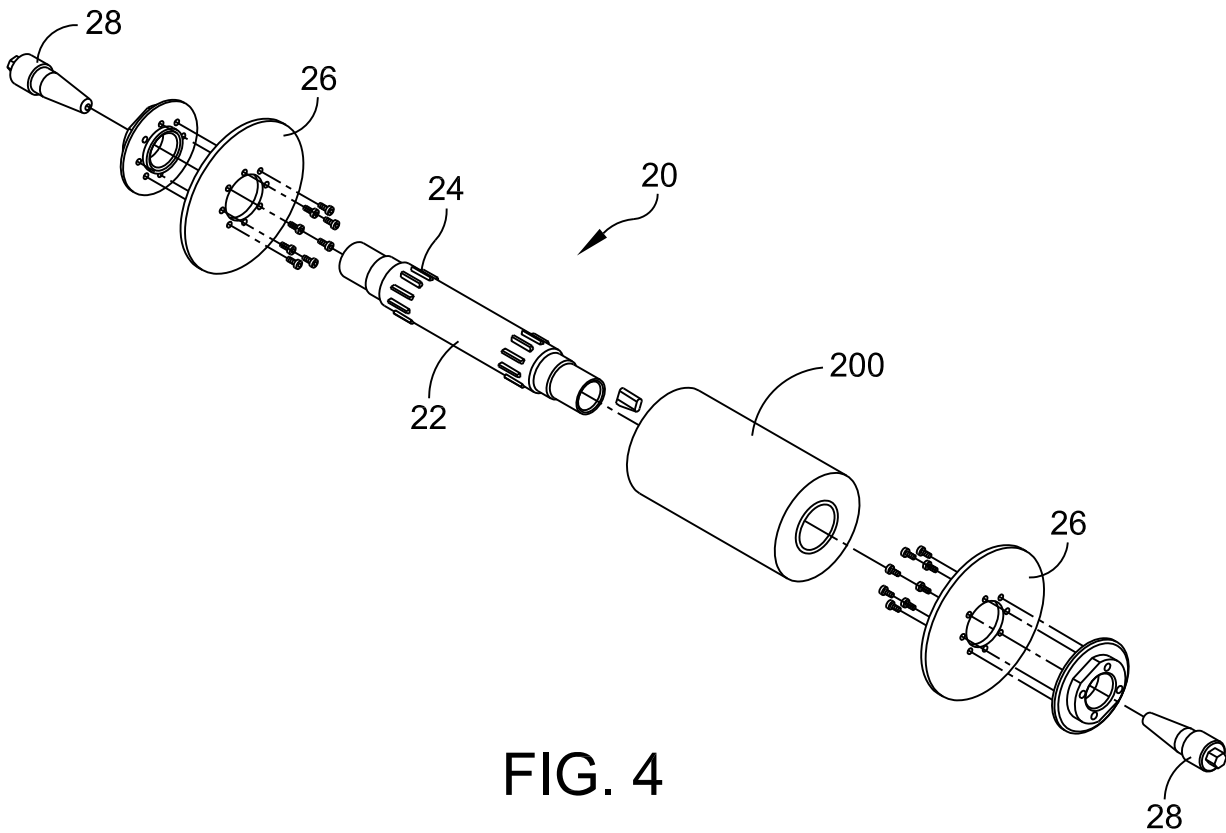


FIG. 4

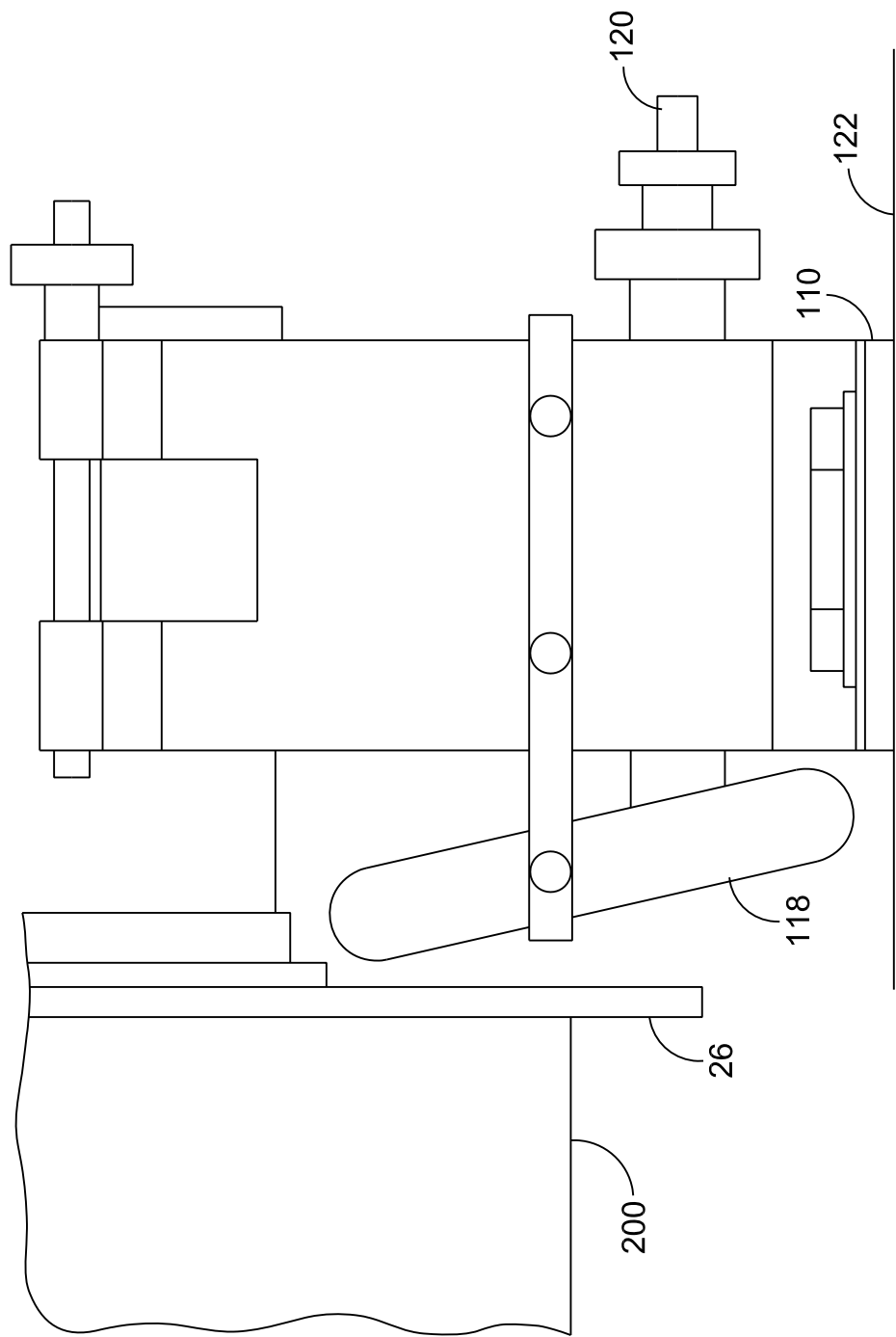


FIG. 5

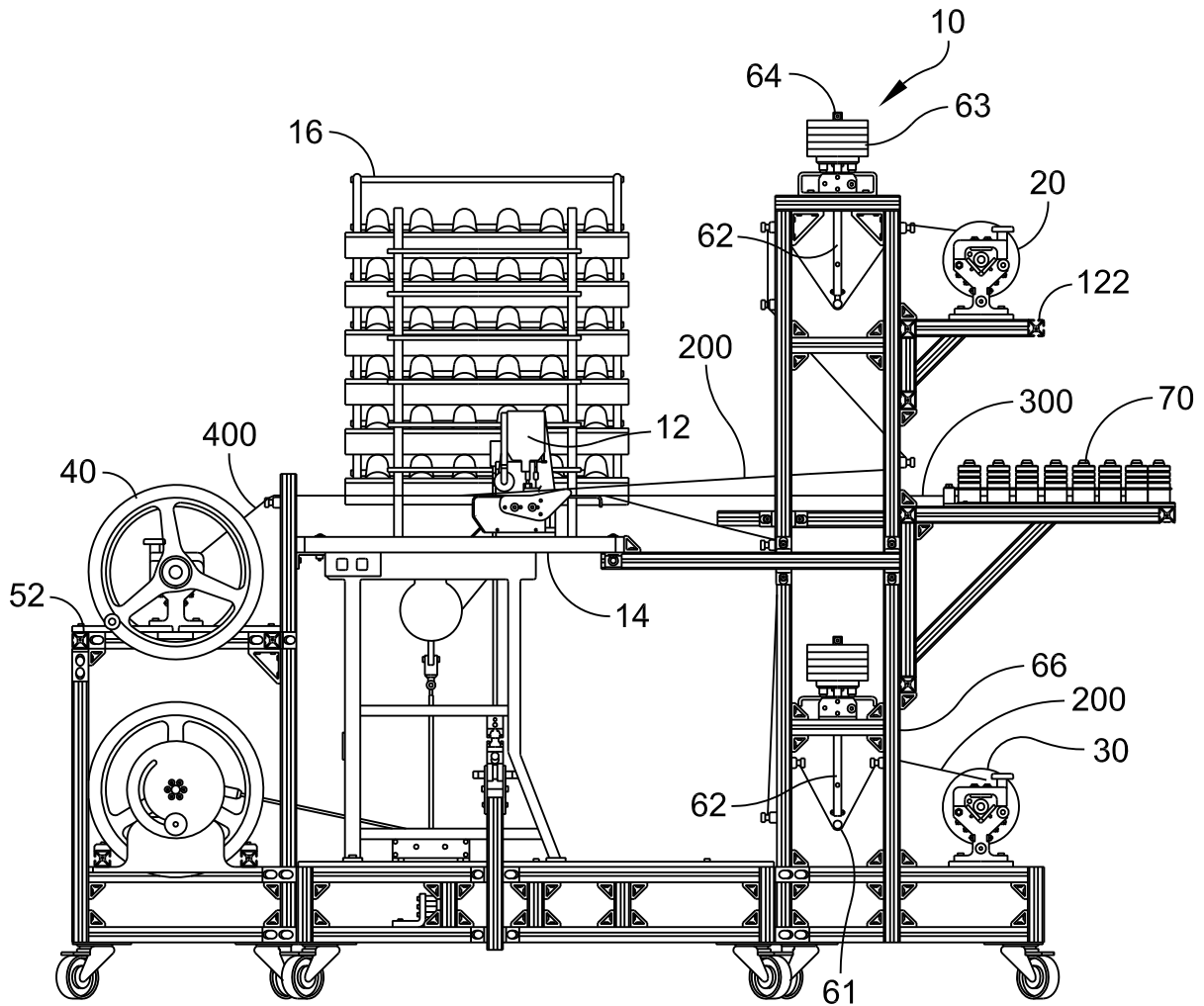


FIG. 6

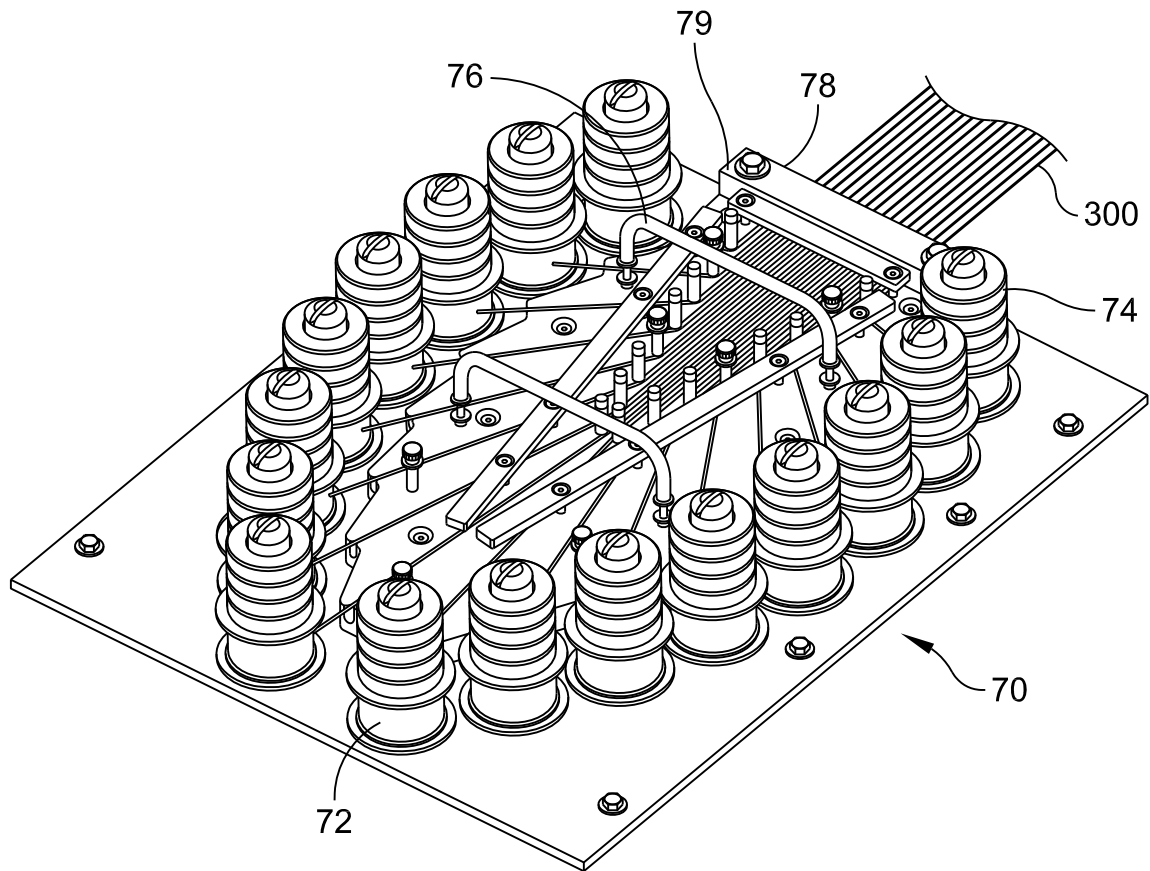


FIG. 7

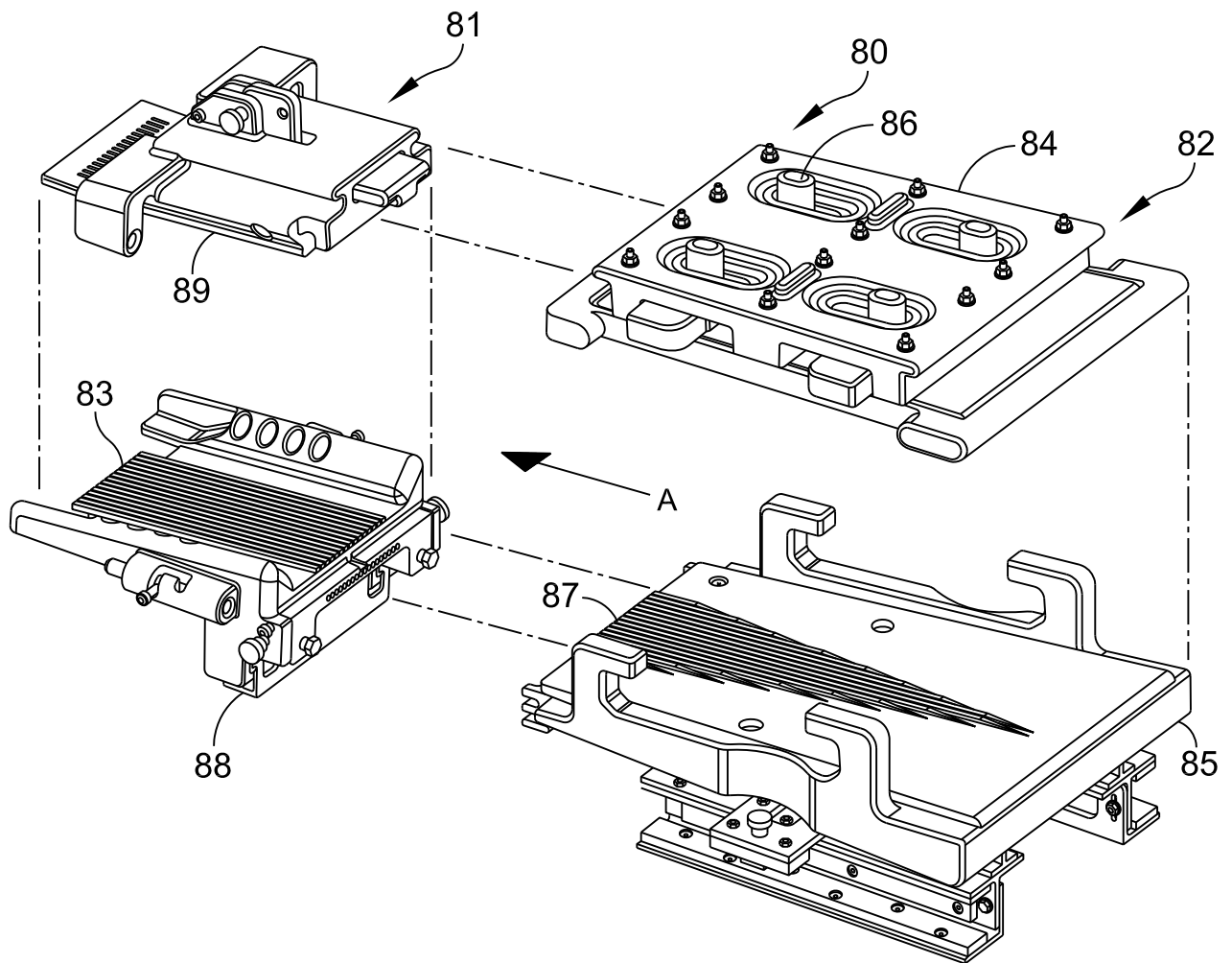


FIG. 8

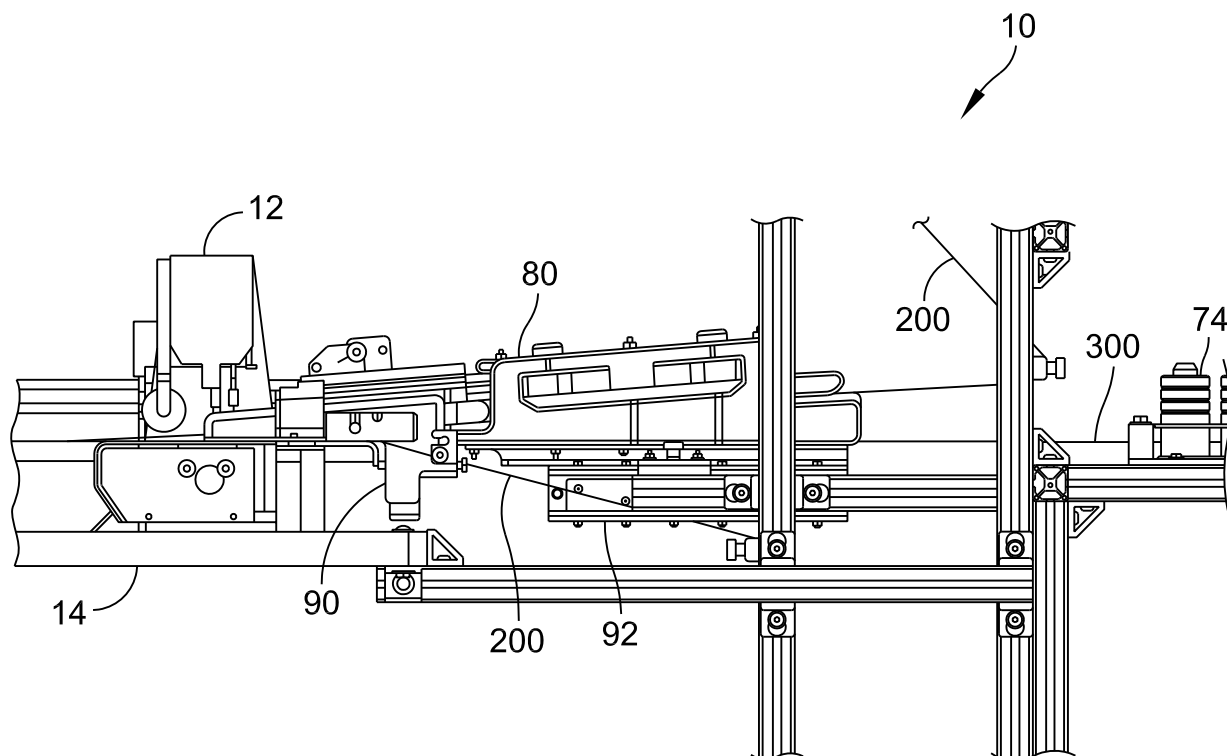


FIG. 9

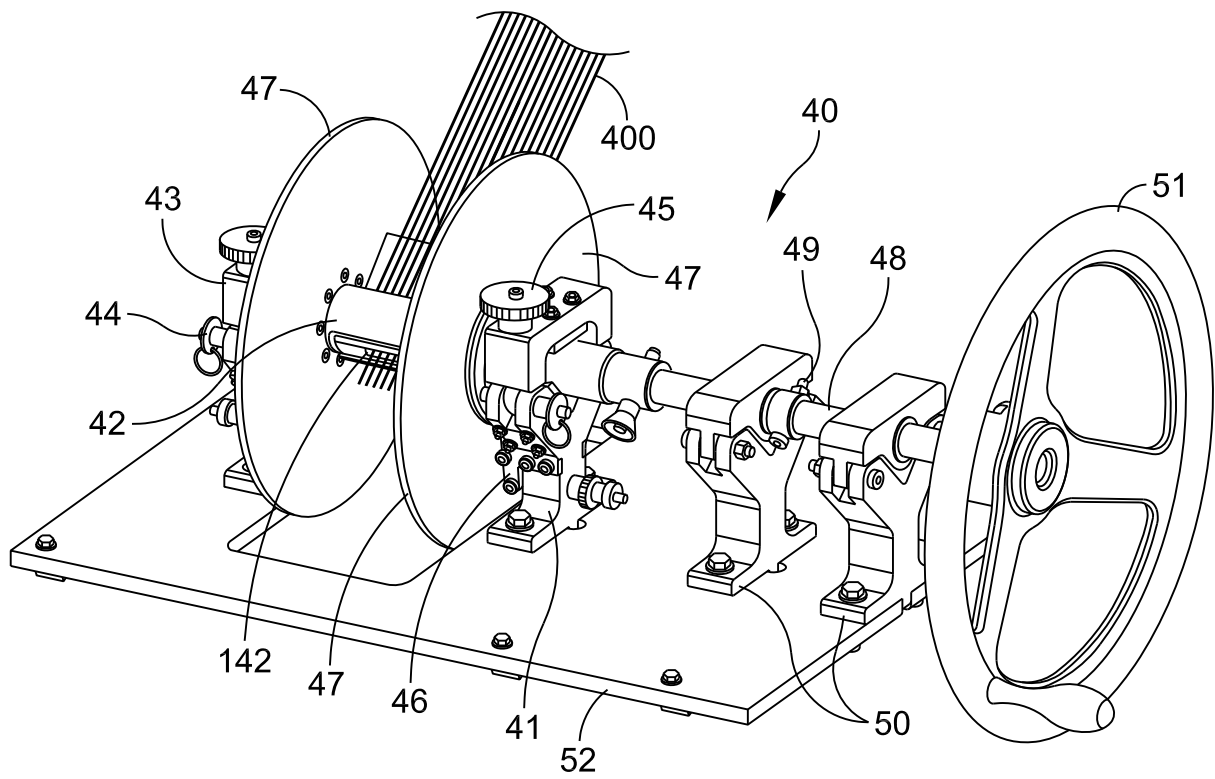


FIG. 10

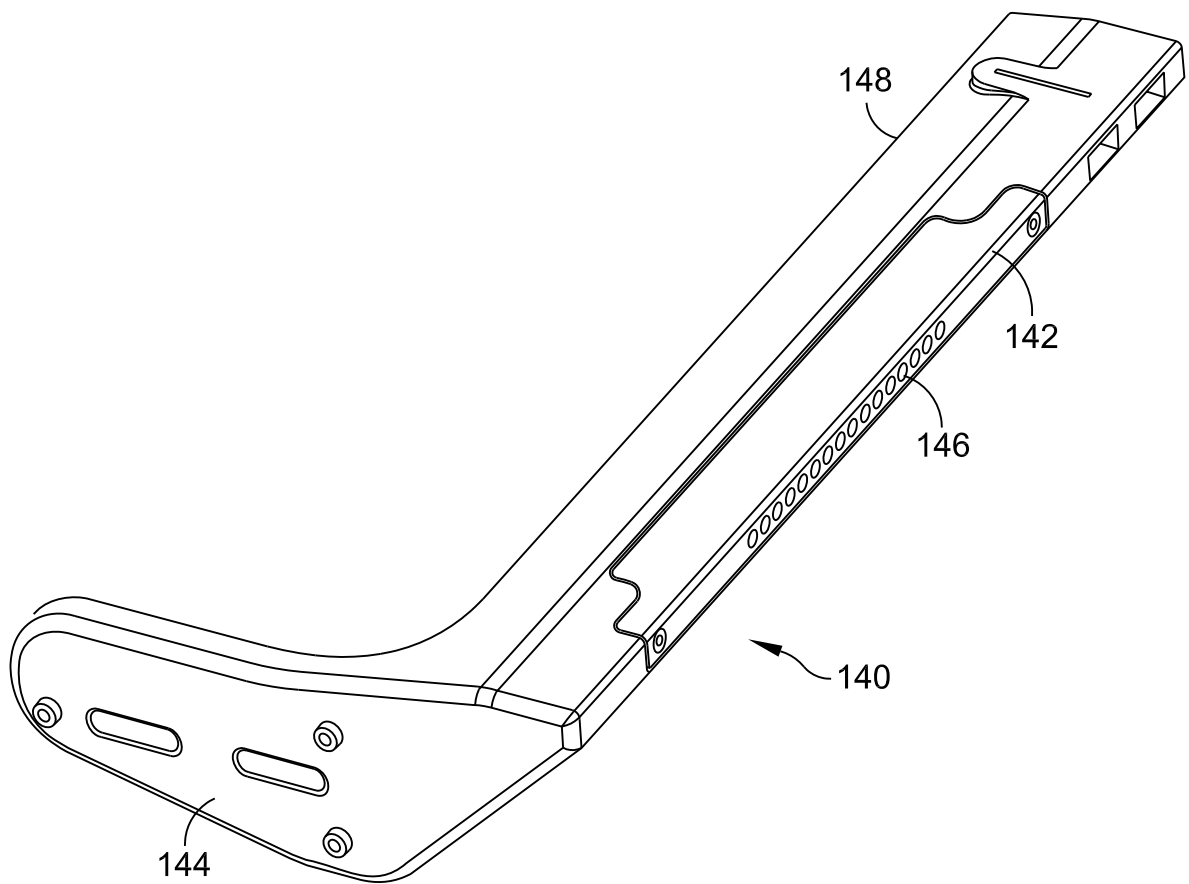


FIG. 11

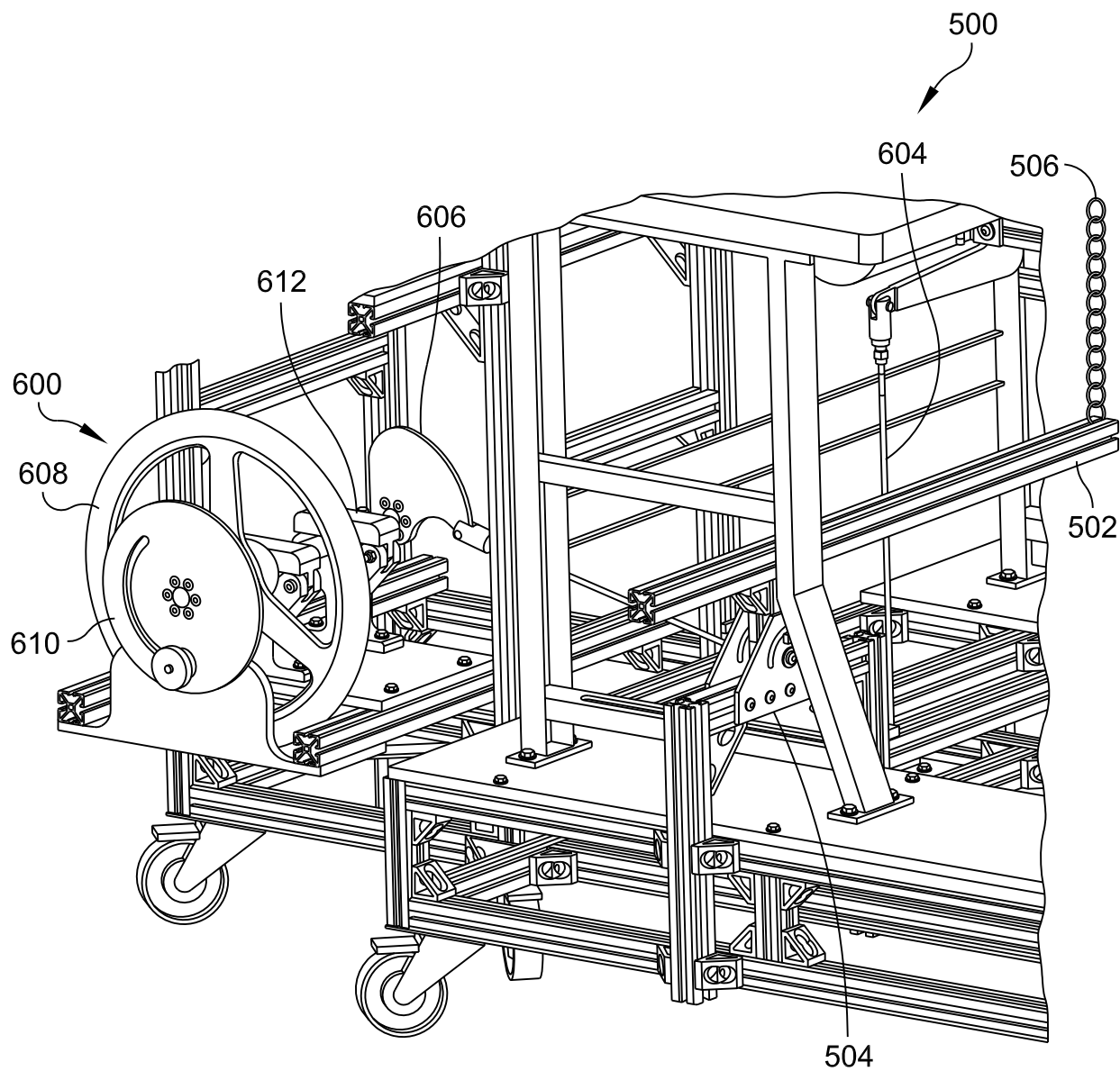


FIG. 12