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(54) Benævnelse: **MODULÆR GREBSENHED TIL ET STYRBART KATETER**

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DESCRIPTION

BACKGROUND OF THE INVENTION

1. Field of the Invention

[0001] The present invention relates to steerable catheters, and more particularly to a modular handle assembly for supporting and controlling a steerable catheter.

2. Description of the Prior Art

[0002] This section provides background information related to the present disclosure which is not necessarily prior art.

[0003] Catheters (i.e., catheters or sheaths) that have flexible tubular bodies with deflectable distal ends and control handles for controlling distal end deflection are used for many non-invasive medical producers. The distal portion of the catheter body is selectively deformed into a variety of curved configurations using an actuator on the control handle which remains outside the patient's body. The actuator is commonly internally linked to the distal portion of the catheter body by at least one deflection wire. Some catheter bodies employ a single deflection wire, which is pulled (i.e., placed in tension) by the actuator in order to cause the distal portion of the catheter body to deform. Other catheter bodies have at least two deflection wires, where the displacement of one wire (i.e., placing one wire in tension) results in the other wire going slack (i.e., the wire does not carry a compressive load). In such catheters, where the deflection wires are not adapted to carry compressive loads (i.e., the deflection wires are only meant to be placed in tension), the deflection wires are commonly called pull or tension wires.

[0004] Although the prior art control handles are capable of controlling distal end deflection of catheter bodies, they have several drawbacks. For example, the prior art control handles are often excessively bulky and oftentimes expensive. Additionally, the prior art control handles often have a mechanical component that requires a significant effort to operate on the part of the user, and once a desired distal end deflection has been reached, the control handles typically require the operator to take a conscious step to maintain the catheter at the desired deflection. Further, the prior art control handles cannot be easily modified, and thus are only designed to work with a specific steerable catheter design.

[0005] A steerable catheter of the prior art is disclosed in EP 2 397 108 A2. This steerable catheter comprises a handle having a lever for steering the catheter. The lever is connected to a pulley and can be rotated in order to pull a flexible tension member and a pull wire and to thereby steer a distal tip of the catheter. Further steerable catheters of the prior art are

disclosed in US 2008/0103520 A1, US 2006/0100640 A1 and WO 98/33429.

[0006] Accordingly, there remains a need in the art for an improved control handle for use with a steerable catheter.

SUMMARY OF THE DISCLOSURE

[0007] This section provides a general summary of the disclosure and is not intended to be a comprehensive disclosure of its full scope, aspects, objectives, and/or all of its features.

[0008] A modular handle assembly for supporting and controlling a steerable catheter includes a handle extending along an axis for being secured about a portion of the steerable catheter. The modular handle assembly includes at least one barrel rotatably connected to the handle for rotation about the axis and at least one spindle disposed in and connected with the barrel for rotation about the axis with the barrel. The modular handle assembly further includes at least one guide cable extending from an anchored end being anchored to the spindle to a distant end for connection with one of the deflection wires of the steerable catheter. The guide cable is wrapped about the spindle for axially moving the deflection wires in response to rotation of the first spindle about the axis by way of the barrel to curl the distal tip of the elongated body of the steerable catheter.

[0009] As will be described in more detail below, the subject modular handle assembly provides for equal or better steering performance of steerable catheters using less overall parts and a simpler design than the prior art handle assemblies. Accordingly, the subject modular handle assembly provides for a lower cost solution to steering a catheter. Additionally, the subject modular handle assembly is easily customizable to achieve two or four direction deflection of the distal end of the steerable catheter, and even customizable for use with a variety of different steerable catheter designs. Thus, the subject modular handle provides for increased flexibility and modularity over the prior art handle assemblies.

[0010] Further areas of applicability will become apparent from the description provided herein. The description and specific examples in this summary are intended for purposes of illustration only and are not intended to limit the scope of the present disclosure.

BRIEF DESCRIPTION OF THE DRAWINGS

[0011] Other advantages of the present invention will be readily appreciated, as the same becomes better understood by reference to the following detailed description when considered in connection with the accompanying drawings wherein:

Figure 1 is perspective assembled view of a modular handle assembly constructed in accordance with the principles of the present disclosure;

Figure 2 is a perspective view of a frame, spindle, torsion spring, and guide cables of the modular handle assembly;

Figure 2A is a side perspective view of the frame, spindle, torsion spring, and guide cables connected to deflection wires of a steerable catheter;

Figure 3 is an exploded view of the assembled modular handle assembly illustrated in Figure 1;

Figure 3A is a magnified side view of a frame of Figure 3;

Figure 3B is a magnified end view of a spindle of Figure 3;

Figure 4 is a perspective assembled view of a second embodiment of the modular handle assembled constructed in accordance with the principles of the present disclosure;

Figure 5 is an exploded view of the assembled modular handle assembly illustrated in Figure 5; and

Figure 6 is a side magnified view of a first spindle and second spindle of Figure 5.

DETAILED DESCRIPTION OF THE ENABLING EMBODIMENTS

[0012] Example embodiments will now be described more fully with reference to the accompanying drawings. The example embodiments are provided so that this disclosure will be thorough and fully convey the scope to those skilled in the art. Numerous specific details are set forth such as examples of specific components, devices, mechanisms, assemblies and methods to provide a thorough understanding of various embodiments of the present disclosure. It will be apparent to those skilled in the art that specific details need not be employed, that example embodiments may be embodied in many different forms, and that neither should be construed to limit the scope of the disclosure. With this in mind, the present disclosure is generally directed to a modular handle assembly for supporting a controlling a steerable catheter.

[0013] Referring to the Figures, wherein like numerals indicate corresponding parts throughout the several views, a modular handle assembly **20, 120** is generally shown for supporting and controlling a steerable catheter **26** that has a tubular, flexible elongated body **28** that extends to a distal tip **30**. At least one deflection wire **32** extends from the distal tip **30** of the steerable catheter **26** and through the body **28** for curling the distal tip **30** in response to movement of the deflection wire **32**.

[0014] The modular handle assembly **20, 120** includes a handle **24** that has a ring shaped cross-section and which defines an inside surface **34** surrounding a hollow. However, the rear

handle **24** could have a cross-section having another shape without departing from scope of the subject disclosure including, but not limited to, a square shape or rectangular shape. The handle **24** extends along an axis **A** from a proximal end **36** to a distal end **38** for being disposed about the body **28** of the steerable catheter **26**.

[0015] The handle **24** includes a pair of halves **40** being mirror images with one another and mating along a plane **P** extending diametrically across the handle **24** though the axis **A**. A mechanical attachment **42,** such as tabs, slots, nuts, bolts, or the like, removeably attach the halves **40** to one another at the plane **P.** The construction of the modular handle assembly **20**, **120** having two halves **40** advantageously provides for ease in manufacturing and assembly of the modular handle **24** as the handle halves **40** can be molded separately. In addition, the two halves **40** provide for increased flexibility and modularity of the handle **24** assembly as components internal to the handle **24** can easily be installed while the halves **40** are disconnected from one another.

[0016] A plurality of flanges **44** extend inwardly in spaced and parallel relationship with one another from the inside surface **34** of each of the halves **40** of the handle **24** in the hollow for providing structural rigidity to the handle **24.** It should be appreciated that any number of flanges **44** could be used to meet specific design needs and they could be oriented in other directions than shown in the Figures.

[0017] The handle **24** defines a proximal opening **46** about the axis **A** at the proximal end **36** and a distal opening **48** about the axis **A** at the distal end **38**. A distal cap **50** is received by the distal opening **48**. The distal cap **50** has a generally funnel shape and includes a mouth **52** that is disposed outside of the distal opening **48** of the handle **24.** The distal cap **50** also includes a cylinder **54** that extends axially into the hollow of the handle **24** for receiving and engaging the body **28** of the steerable catheter **26** for tightening the handle **24** portion about the body **28** of the steerable catheter **26**. The cylinder **54** has a thickness that can vary based on the diameter of the body **24** of the steerable catheter **22** to ensure that the front handle portion **32** is tightened about the body **24** of the steerable catheter **22**. Put another way, the size of the cylinder **54** can be adjusted to accommodate a wide range of differently sized catheters **22**, and thus provides for improved modularity of the subject handle assembly **20**. It should be appreciated that the cylinder **54** could extend axially to various lengths to advantageously hold the body **24** of the steerable catheter **22** in place along different lengths based on operational needs.

[0018] As best shown in Figures 2 through 3A, the modular handle assembly **20**, **120** further includes a first frame **56** that includes a base **58** which has a disc shape and presents a perimeter **60** disposed about the axis **A**. The first frame **56** further includes a conduit **62** that has a tube shape and which extends through the base **58** along the axis **A** between a first termination **64** disposed outside of the handle **24** and a second termination **66** disposed in the hollow of the handle **24**.

[0019] The first frame **56** further includes a plurality of support plates **68** that have a triangular

shape and extend from the second termination **66** of the conduit **62** to the perimeter **60** of the base **58** for providing for structural rigidity of the first frame **56**. The first frame **56** also includes a pair of arms **70** that extend axially from diametrically opposite sides of the perimeter **60** of the base **58** away from the hollow of the handle **24** and extending to an edge **72**. Each of the arms **70** defines a groove **74** that extends axially from the edge **72** toward the base **58** of the first frame **56.**

[0020] As best presented in Figures 2, 2A and 3B, the modular handle assembly **20** further includes a first spindle **76** that is rotatably disposed about the conduit **62** of the first frame **56**. The first spindle **76** includes a platform **78** that has a washer shape and presents an outer periphery **80**. The outer periphery **80** of the first spindle **76** defines a channel **82** that extends radially inwardly and about the periphery of the platform **78**. The platform **78** of the first spindle **76** further defines a cavity **84** that extends radially inwardly from the channel **82**.

[0021] A pair of first guide cables **86** each extend from an anchored end that is anchored in the cavity **84** of the platform **78** of the first spindle **76** to a distant end **88.** Each of the first guide cables **86** are wrapped about the channel **82** of the platform **78** between the anchored and distant ends **88** and extend through one of the grooves **74** of the arms **70** to the distant end **88** in the hollow of the handle **24.** The distant ends **88** of the first guide cables **86** connect with one of the deflection wires **32** of the steerable catheter **26** for axially moving the deflection wires **32** in response to rotation of the first spindle **76** about the conduit **62** of the first frame **56** to curl the distal tip **30** of the elongated body **28** of the steerable catheter **26** horizontally. The grooves **74** advantageously align the guide cables and space the guide cables from the first spindle **76**. In a preferred arrangement, each of the first guide cables **86** of the first spindle **76** include a loop **90** at the distant end **88** for establishing the connection with one of the deflection wires **32**. A crimp **92** is fixed partially about the loop **90** for securing the loop **90** in place.

[0022] The first guide cables **86** are wrapped around the channel **82** in opposite directions from one another for moving the first guide cables **86** in opposite directions from one another during rotation of the first spindle **76** about the first frame **56**. Movement in this regard moves the deflection wires **32** in opposite directions from one another to allow the steerable catheter **26** to be curled in two horizontal or directly opposing directions. Thus, as can be understood from the aforementioned disclosure in connection with the Figures, as the first spindle **76** is rotated clockwise relative to the axis **A**, the wrapped first guide cables **86** cause simultaneous opposed displacement of the deflection wires **38**. Specifically, because of opposing threaded relationship of the first guide cables **86** about the first spindle **76**, one of the deflection wires **38** moves distally within the handle assembly **20** and the other of the deflection wires **38** moves proximally within the handle assembly **20** when the first spindle **76** is rotated clockwise relative to the handle **24**. Conversely, when the first spindle **76** is rotated in a counterclockwise manner relative to the handle **24**, each of the deflection wires **38** reverse or alternate their axial direction. Accordingly, the first spindle **76** of the first embodiment the modular handle assembly **20** provides for two (2) direction deflection of the distal end **26** of the catheter body **24**.

[0023] A pair of projections **94** that have an arc shaped cross-section extend axially from the

platform **78** of the first spindle **76** away from the handle **24** and radially adjacent to the conduit **62** of the first frame **56**. Further, a torsion spring **96** is disposed about the conduit **62** of the first frame **56**. The torsion spring **96** has a pair of fingers **98** that extend radially outwardly therefrom, with each of the fingers **98** of the torsion spring **96** engaging one of the projections **94** for biasing the first spindle **76** in a fixed position. Therefore, the first spindle **76** is naturally biased in the fixed position after rotation of the first spindle **76** about the conduit **62** of the frame.

[0024] A first barrel **100** that has a generally tube shape extends along the axis **A** between a lower rim **102** and an upper rim **104** and includes a wall **106** that extends between the lower rim **102** and the upper rim **104**. The first barrel **100** is disposed about and is connected to the first spindle **76** for rotating the first spindle **76** about the conduit **62** in response to rotation of the first barrel **100** by a user of the modular handle assembly **20**. The first barrel **100** further includes a step **108** that extends radially inwardly from the wall **106**, as well as a duct **110** that extends along the axis **A** through the step **108**. The duct **110** receives the body **28** of the steerable catheter **26**. The first barrel **100** also defines a pair of indentations **112** that extend axially into the step **108** and which are disposed in axial alignment with one of the projections **94** of the first spindle **76.** The indentations **112** receive the projections **94** of the first spindle **76** for connecting the first barrel **100** and the first spindle **76** and effectuating rotation of the first spindle **76** in response to rotation of the first barrel **100** about the axis **A**. The first barrel **100** further includes a cone **114** that extends radially inwardly from the upper rim **104** and axially toward the lower rim **102** to the duct **110.** A first sleeve **115** that has a tube shape can be disposed about the wall **106** of the first barrel **100** for providing a gripping surface for operators of the steerable catheter **26**. The first sleeve **115** includes an outside surface that could be made of various materials and could have different patterns or textures to provide for a satisfactory gripping surface for operators based on operational needs.

[0025] In the first enabling embodiment, as best presented in Figures 1 through 3B, the first frame **56** is removeably coupled with the proximal opening **46** of the handle **24** to close the proximal opening **46**. Further, the first termination **64** of the first frame **56** is disposed outside of the handle **24** and the second termination **66** of the first frame **56** is disposed in the hollow of the handle **24**. A proximal cap **116** that has a generally hemispherical shape is rotatably connected with the upper rim **104** and cone **114** of the first barrel **100**. The proximal cap **116** defines a passageway **118** that extends therethrough along the axis **A** and is in fluid communication with the channel **82** for receiving and engaging the body **28** of the steerable catheter **26** for tightening the proximal cap **116** about the body **28** of the steerable catheter **26.** The proximal cap **116** further defines an orifice **120** that extends radially inwardly therethrough for receiving a hose **122** of a stopcock assembly **22** of the steerable catheter **26**.

[0026] In a second enabling embodiment, as best presented in Figures 4-6, the modular handle assembly **120** further includes a second frame **124** that includes a base **58** that has a disc shape and which defines a perimeter **60** disposed about the axis **A**. The second frame **124** is removeably coupled with the proximal opening **46** of the handle **24** to close the proximal opening **46**. The second frame **124** further includes a conduit **62** that has a tube shape that

extends through the base **58** along the axis **A**. The conduit **62** of the second frame **124** extends between a first termination **64** disposed outside of the handle **24** and a second termination **66** that is disposed in the hollow of the handle **24**. A mechanical connector fixedly connects the first termination **64** of the conduit **62** of the first frame **56** with the second termination **66** of the conduit **62** of the second frame **124** such that the conduits **62** of the first and second frames **56, 124** extend coaxially and in axial abutment with one another. The mechanical connector is comprised of a plurality of slot and legs that mate with one another, however other connections could be used like screws, nuts and bolts or the like.

[0027] The second frame **124** further includes a plurality of support plates **68** that have a triangular shape and which extend from the second termination **66** of the conduit **62** of the second frame **124** to the perimeter **60** of the base **58** for providing for structural rigidity of the second frame **124**. The second frame **124** also includes a pair of arms **70** that extend axially from diametrically opposite sides of the perimeter **60** of the base **58** away from the hollow of the handle **24** and extend to an edge **72**. Each of the arms **70** of the second frame **124** define a groove **74** that extends axially from the edge **72** toward the base **58** of the second frame **124.**

[0028] As best shown in Figure 5, in the second embodiment, a second spindle **126** is rotatably disposed about the conduit **62** of the second frame **124**. The second spindle **126** includes a platform **78** that has a washer shape and presents an outer periphery **80.** The outer periphery **80** of the second spindle **126** defines a channel **82** that extends radially inwardly and about the outer periphery **80** of the platform **78**. The platform **78** of the second spindle **126** further defines a cavity **84** that extends radially inwardly from the channel **82.**

[0029] A pair of second guide cables **87** each extend from an anchored end anchored in the cavity **84** of the platform **78** of the second spindle **126** to a distant end **88**. The second guide cables **87** are wrapped about the channel **82** of the platform **78** between the anchored and distant ends **88** and extend through one of the grooves **74** of the arms **70** to the distant end **88** in the hollow of the handle **24**. The distant ends **88** of the second guide cables **87** connect with one of the deflection wires **32** of the steerable catheter **26** for axially moving the deflection wires **32** in response to rotation of the second spindle **126** about the conduit **62** of the first frame **56** to curl the distal tip **30** of the elongated body **28** of the steerable catheter **26** in a direction that is transverse to the direction effectuated by the first spindle **76.** The grooves **74** advantageously align the second guide cables **87** and space the second guide cables **87** from the second spindle **126.** In a preferred arrangement, each of the second guide cables **87** of the second spindle **126** have a loop **90** at the distant end **88** for connecting with one of the deflection wires **32**. A crimp **92** is fixed partially about the loop **90** for securing the loop **90** in place.

[0030] The second guide cables **87** are wrapped around the channel **82** in opposite directions from one another for moving the second guide cables **87** in opposite directions from one another during rotation of the second spindle **126** about the second frame **124.** Comparably to the second guide cables **87** of the first spindle **76**, movement in this regard moves the

deflection wires **32** in opposite axial directions from one another to allow the steerable catheter **26** to be curled in two vertically or directly opposing directions. Thus, as can be understood from the aforementioned disclosure in connection with the Figures, as the second spindle **76** is rotated clockwise relative to the axis **A**, the wrapped second guide cables **87** cause simultaneous opposed displacement of the deflection wires **38** to which they are connected Specifically, because of opposing threaded relationship of the second guide cables **87** about the second spindle **126,** one of the deflection wires **38** moves distally within the handle assembly **20** and the other of the deflection wires **38** moves proximally within the handle assembly **20** when the second spindle **126** is rotated clockwise relative to the handle **24**. Conversely, when the first spindle **76** is rotated in a counterclockwise manner relative to the handle **24**, each of the deflection wires **38** reverse or alternate their axial direction. Accordingly, the second spindle **126**, in combination with the first spindle **76**, provides for four (4) direction deflection of the distal end **26** of the catheter body **24**. In addition, as can be understood from the aforementioned disclosure, the subject handle assembly **20** can be easily modified to incorporate the second spindle **126** to provide the four (4) direction deflection, and thus provides for more flexibility and modularity over the prior art handle assemblies. Further, the subject modular handle assembly **20** achieves the four (4) direction deflection of the distal end **26** of the catheter body **24** using less overall parts and a simpler design than the prior art handle assemblies.

[0031] A pair of projections **94** that have an arc shaped cross-section extend axially from the platform **78** of the second spindle **126** away from the handle **24** and radially adjacent to the conduit **62** of the second frame **124.** Further, a torsion spring **96** is disposed about the conduit **62** of the second frame **124.** The torsion spring **96** has a pair of fingers **98** that extend radially outwardly therefrom. Each of the fingers **98** of the torsion spring **96** engage one of the projections **94** for biasing the second spindle **126** in a fixed position for returning the second spindle **126** to the fixed position after rotation of the second spindle **126** about the conduit **62** of the second frame **124.**

[0032] A second barrel **128** that has a generally tube shape extends along the axis **A** between a lower rim **102** and an upper rim **104** and includes a wall **106** that extends between the lower rim **102** and the upper rim **104.** The second barrel **128** is disposed about and is connected to the second spindle **126** for rotating the second spindle **126** about the conduit **62** in response to rotation of the second barrel **128**. The second barrel **128** further includes a step **108** that extends radially inwardly from the wall **106**, and a duct **110** that extends along the axis **A** through the step **108.** The second barrel **128** also defines a pair of indentations **112** that each extend axially into the step **108** in axial alignment with one of the projections **94** of the second spindle **126** and receive the projections **94** of the second spindle **126** for connecting the second barrel **128** and the second spindle **126.** The second barrel **128** further includes a cone **114** that extends radially inwardly from the upper rim **104** and axially toward the lower rim **102** to the duct **110**.

[0033] A second sleeve **130** that has a tube shape is disposed about the wall **106** of the second barrel **128** for providing a gripping surface for operators of the steerable catheter **26**.

Like the first sleeve **115**, the second sleeve **130** includes an outside surface that could be made of various materials and could have different patterns or textures to provide for a satisfactory gripping surface for operators based on operational needs. A proximal cap **116** that has a generally hemispherical shape is rotatably connected with the upper rim **104** and the cone **114** of the second barrel **128**. The proximal cap **116** defines a passageway **118** that extends therethrough along the axis **A** in fluid communication with the channel **82** for receiving and engaging the body **28** of the steerable catheter **26** for tightening the proximal cap **116** about the body **28** of the steerable catheter **26.** The proximal cap **116** defines an orifice **120** that extends radially inwardly therethrough for receiving a hose **122** of a stopcock assembly **22** of the steerable catheter **26**.

[0034] Due to the modular construction of modular handle assembly **20**, additional spindles **76**, **126**, barrels **100**, **126**, and other aforementioned components could be added to the assembly **20** in the same fashion as the second enabling embodiment to provide for movement of the steerable catheter **22** in a wide variety other directions or along different lengths along the body **24** of the steerable catheter **22.**

[0035] The foregoing description of the embodiments has been provided for purposes of illustration and description. It is not intended to be exhaustive or to limit the disclosure. Individual elements or features of a particular embodiment are generally not limited to that particular embodiment, but, where applicable, are interchangeable and can be used in a selected embodiment, even if not specifically shown or described. The same may also be varied in many ways. Such variations are not to be regarded as a departure from the disclosure, and all such modifications are intended to be included within the scope of the disclosure.

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- EP2397108A2 **[0005]**
- US20080103520A1 **[0005]**
- US20060100640A1 **[0005]**
- WO9833429A **[0005]**

Patentkrav

1. Modulær grebsenhed (20, 120) til at holde og styre et styrbart kateter (26) med mindst én afbøjningstråd (32), hvilken modulær grebsenhed (20, 120) omfatter;

et greb (24), der strækker sig langs en akse (A) for at blive fastgjort omkring en del af det styrbare kateter (26),

mindst én cylinder (100, 128), der er roterbart forbundet med grebet (24) for rotation omkring aksen (A),

mindst én spindel (76, 126), der er placeret i og forbundet med cylinderen (100, 128) for rotation omkring aksen (A) med cylinderen (100, 128),

mindst ét styrekabel (86, 87), der strækker sig fra en forankret ende, der er ankret til spindlen (76, 126), til en fjern ende (88) for forbindelse med én af det styrbare kateters (26) afbøjningstråder (32),

hvor styrekablet (86, 87) er viklet omkring spindlen (76, 126) for aksial bevægelse af afbøjningstrådene (32) som reaktion på rotation af spindlen (76, 126) omkring aksen (A) med cylinderen (100, 128) for oprulning af den distale spids (30) af styrbare kateters (26) aflange legeme (28).

2. Modulær grebsenhed (120) ifølge krav 1, der endvidere omfatter:

hvor den mindst ene spindel indbefatter en første spindel (76) og en anden spindel (126) aksialt justeret i forhold til hinanden,

det mindst ene styrekabel indbefatter et første par styrekabler (86) og et andet par styrekabler (87),

hvor det første par styrekabler (86) er viklet omkring den første spindel (76) i modsatte aksiale retninger i forhold til hinanden for at bevæge styrekablerne (86) i modsatte retninger i forhold til hinanden under rotation af den første spindel (76), og

hvor det andet par styrekabler (87) er viklet omkring den anden spindel (126) i modsatte retninger i forhold til hinanden for at bevæge styrekablerne (87) i modsatte aksiale retninger i forhold til hinanden under rotation af den anden spindel (126).

3. Modulær grebsenhed (20, 120) ifølge krav 1, hvor det mindst ene styrekabel (86, 87) er et par styrekabler viklet omkring spindlen (76, 126) i modsatte retninger til at bevæge styrekablerne (86, 87) i modsatte aksiale retninger i forhold til hinanden under rotation af spindlen (76, 126).

4. Modulær grebsenhed (20, 120) ifølge krav 3, der endvidere indbefatter:

en ramme (56, 124), der indbefatter en base (58), der er placeret omkring aksen (A) og har en perimeter (60) forbundet med grebet (24), og en ledning (62), der strækker sig gennem basen (58) langs aksen (A), og

hvor spindlen (76, 126) er roterbart placeret omkring rammens (56, 124) ledning (62).

5. Modulær grebsenhed (20, 120) ifølge krav 4, hvor rammen (56, 124) endvidere indbefatter et par arme (70), der strækker sig aksialt fra basen (58) og strækker sig til en kant (72), og hvor hver arm (70) definerer en rille (74), der strækker sig aksialt fra kanten (72) mod rammens (56, 124) base (58) for modtagelse af ét af styrekablerne (86, 87) for at justere styrekablet (86, 87) og anbringe styrekablet (86, 87) i afstand fra spindlen (76, 126).

6. Modulær grebsenhed (20, 120) ifølge krav 5; hvor spindlen (76, 126) indbefatter en platform (78) med en skiveform, der er placeret omkring rammens (56, 124) ledning (62) og har en ydre periferi (80), og hvor spindlens (76, 126) ydre periferi (80) definerer en kanal (82), der strækker sig radialt indefter og i ring omkring platformens (78) periferi (80).

7. Modulær grebsenhed (20, 120) ifølge krav 6, hvor spindlens (76, 126) platform (78) endvidere definerer et hulrum (84), der strækker sig radialt indefter fra kanalen (82), og hvor hvert styrekabel (86, 87) strækker sig fra en forankret ende, der er forankret i hulrummet (84) i spindlens (76, 126) platform (78), til en fjern ende (88).

8. Modulær grebsenhed (20, 120) ifølge krav 7, hvor hvert styrekabel (86, 87) er viklet omkring platformens (78) kanal (82) mellem de forankrede og fjerne ender og strækker sig

gennem én af armenes (70) riller (74) til den fjerne ende (88) for forbindelse med ét af det styrbare kateters (26) afbøjningstråde (32).

9. Modulær grebsenhed (20, 120) ifølge krav 6, hvor mindst ét fremspring (94) strækker sig aksialt fra spindlens (76, 126) platform (78).

10. Modulær grebsenhed (20, 120) ifølge krav 9, hvor det mindst ene fremspring indbefatter et par fremspring (94) med en bueform.

11. Modulær grebsenhed (20, 120) ifølge krav 10, der endvidere indbefatter en torsionsfjeder (96), der er placeret omkring rammens (56) ledning (62) og har et par fingre (98), der strækker sig radialt udefter derfra hver i indgreb med ét af fremspringene (94) for forspænding af spindlen (76, 126) i en fast position for returnering af spindlen (76, 126) til den faste position efter rotation af spindlen (76, 126) omkring rammens (56) ledning (62).

12. Modulær grebsenhed (20, 120) ifølge krav 11, hvor cylinderen (100, 128) har en generelt rørform og har en væg (106), der er placeret omkring og forbundet med spindlen (76, 126) til rotation af spindlen (76, 126) omkring ledningen (62) som reaktion på rotation af cylinderen (100, 128).

13. Modulær grebsenhed (20, 120) ifølge krav 12, hvor cylinderen (100, 128) endvidere indbefatter et trin (108), der strækker sig radialt indefter fra væggen (106), og hvor cylinderen (100, 128) indbefatter en gang (110), der er defineret af trinnet (108) og strækker sig langs aksen (A) til modtagelse af kateterets (26) legeme (28).

14. Modulær grebsenhed (20, 120) ifølge krav 13, hvor cylinderen (100, 128) definerer et par indsnit (112), der hvert strækker sig aksialt ind i trinnet (108) og er placeret i aksialt justering efter ét af spindlens (76, 126) fremspring (94) og modtager spindlens (76, 126) fremspring (94) for at forbinde cylinderen (100, 128) og spindlen (76, 126).

15. Modulær grebsenhed (20, 120) ifølge krav 14 og som endvidere indbefatter et hylster (115, 130), der er placeret omkring væggen cylinderens (100, 128) væg (106) og er

forbundet med cylinderen (100, 128) for at tilvejebringe en gribeoverflade for operatører af det styrbare kateter (26).

DRAWINGS

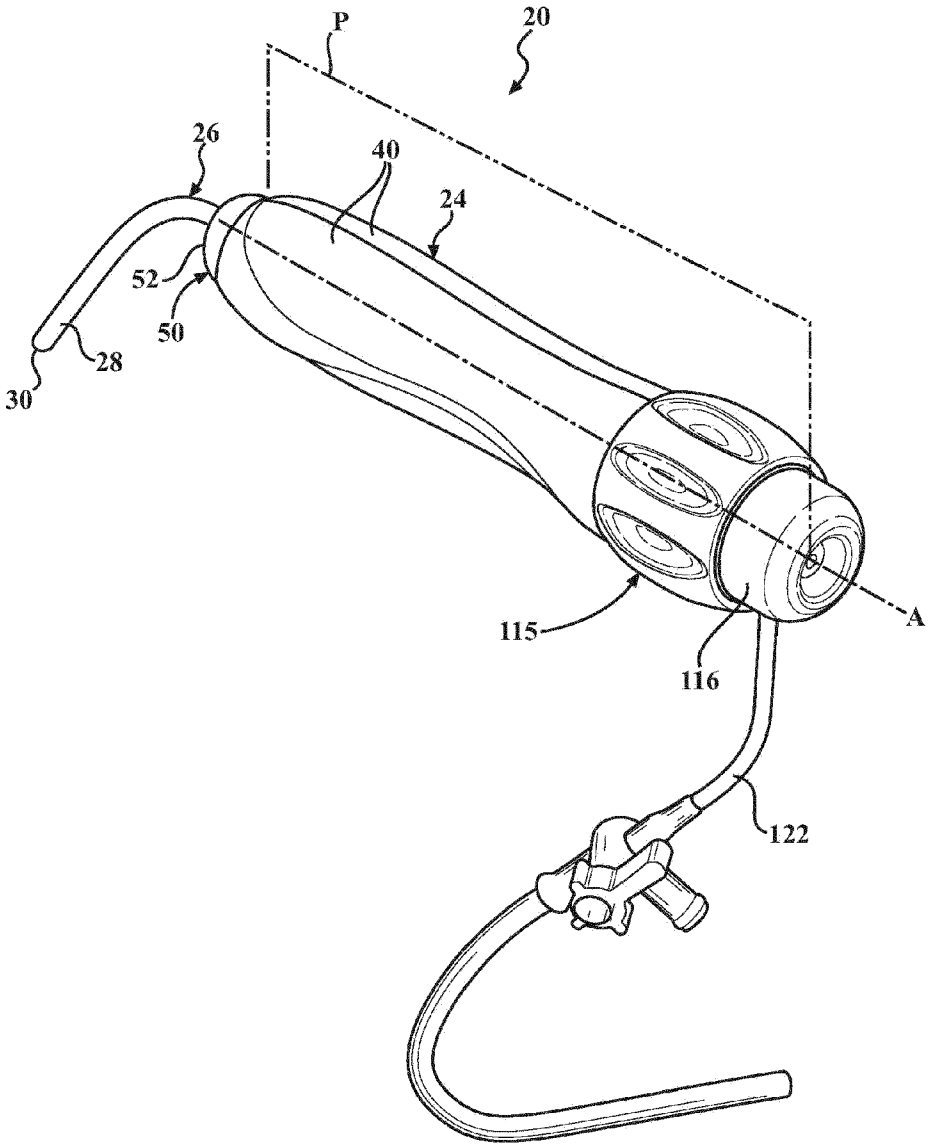

FIG. 1

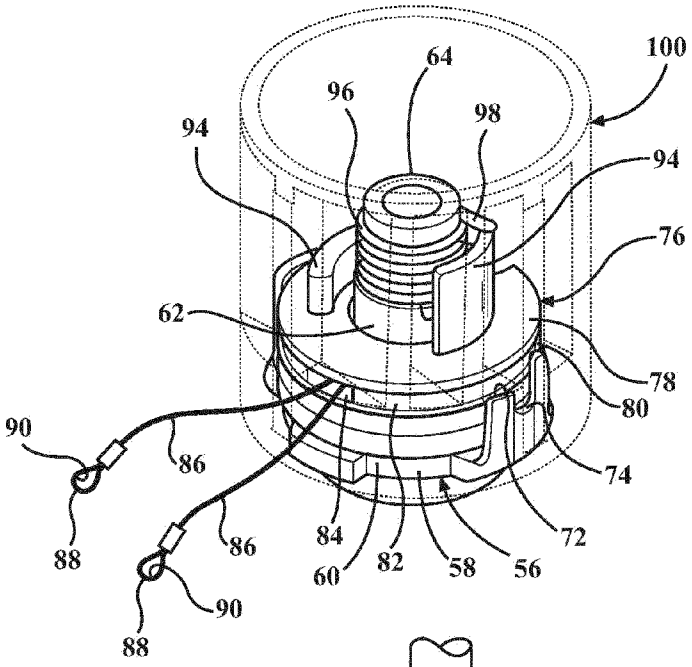
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FIG. 2

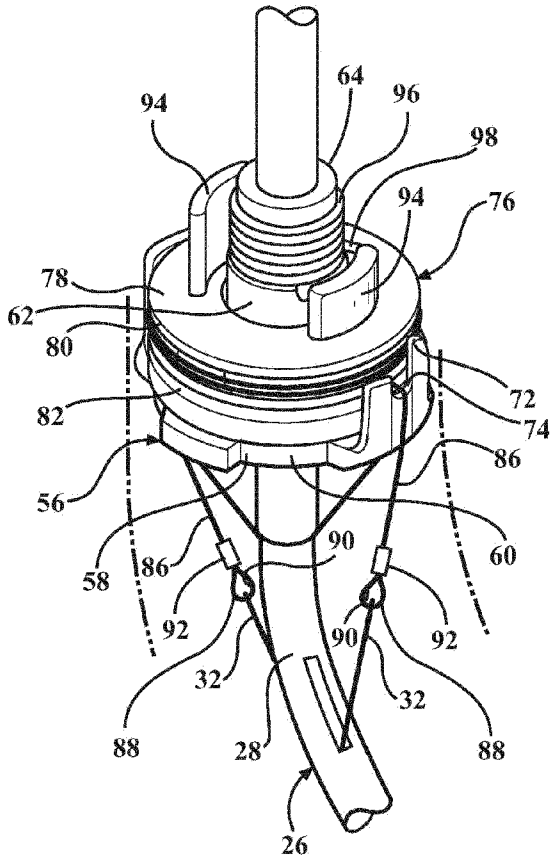
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FIG. 2A

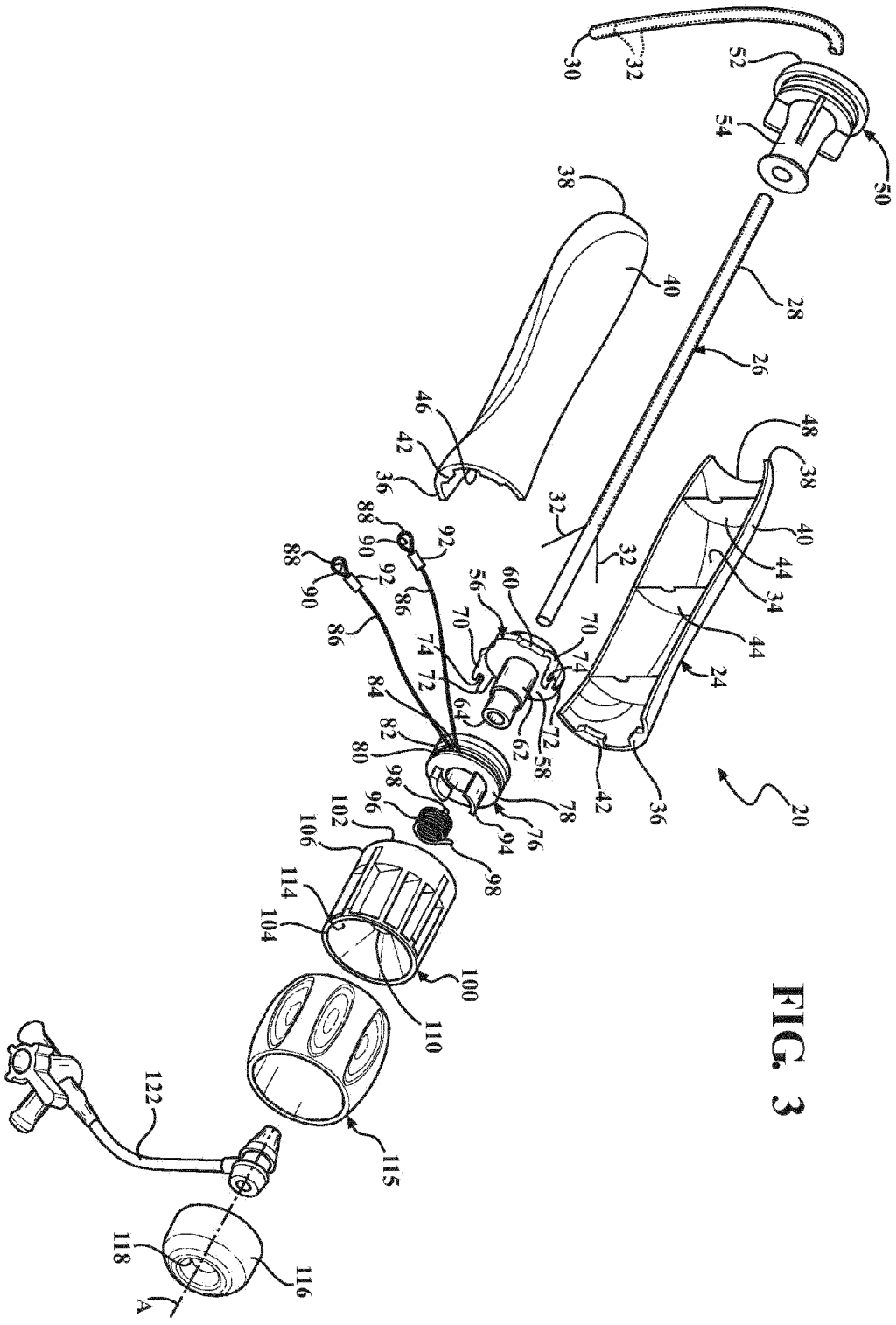
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FIG. 3

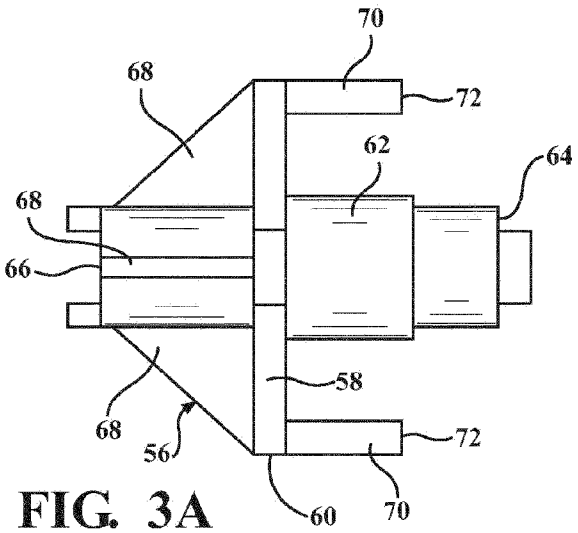

FIG. 3A

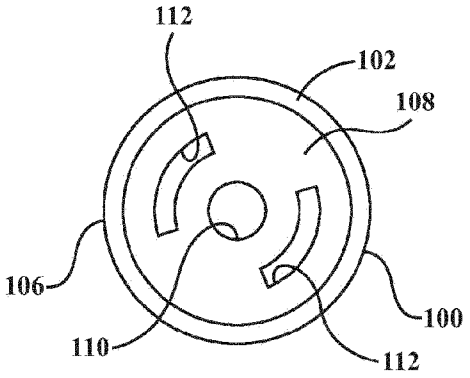

FIG. 3B

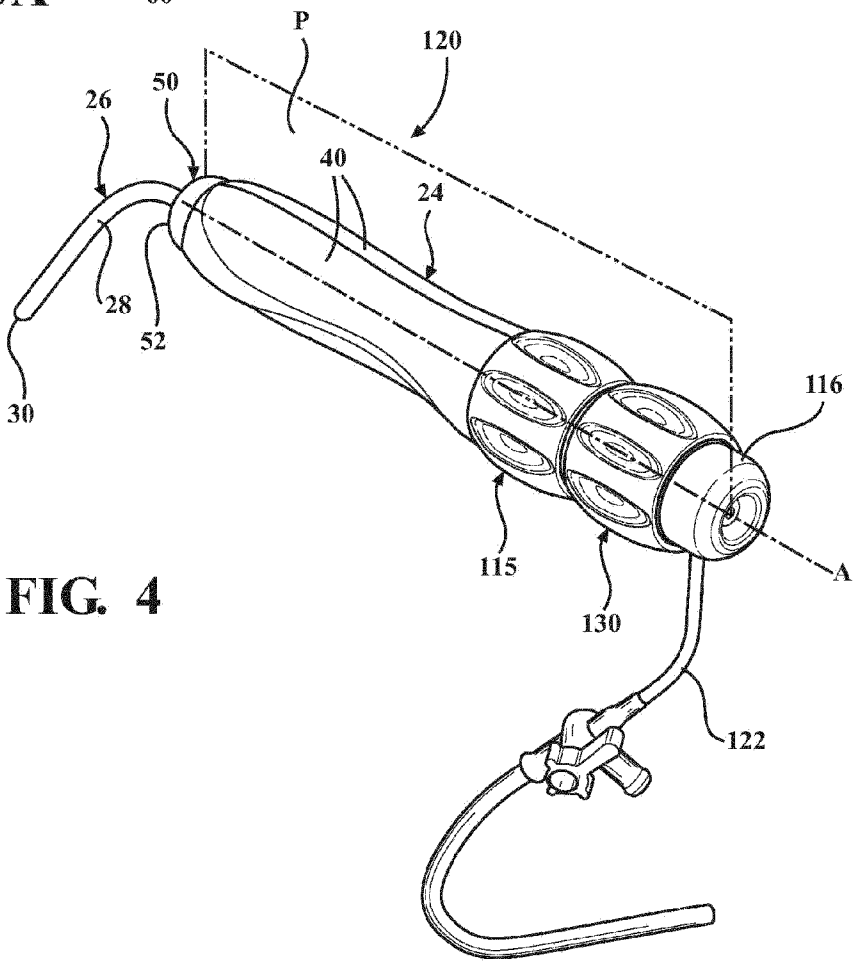

FIG. 4

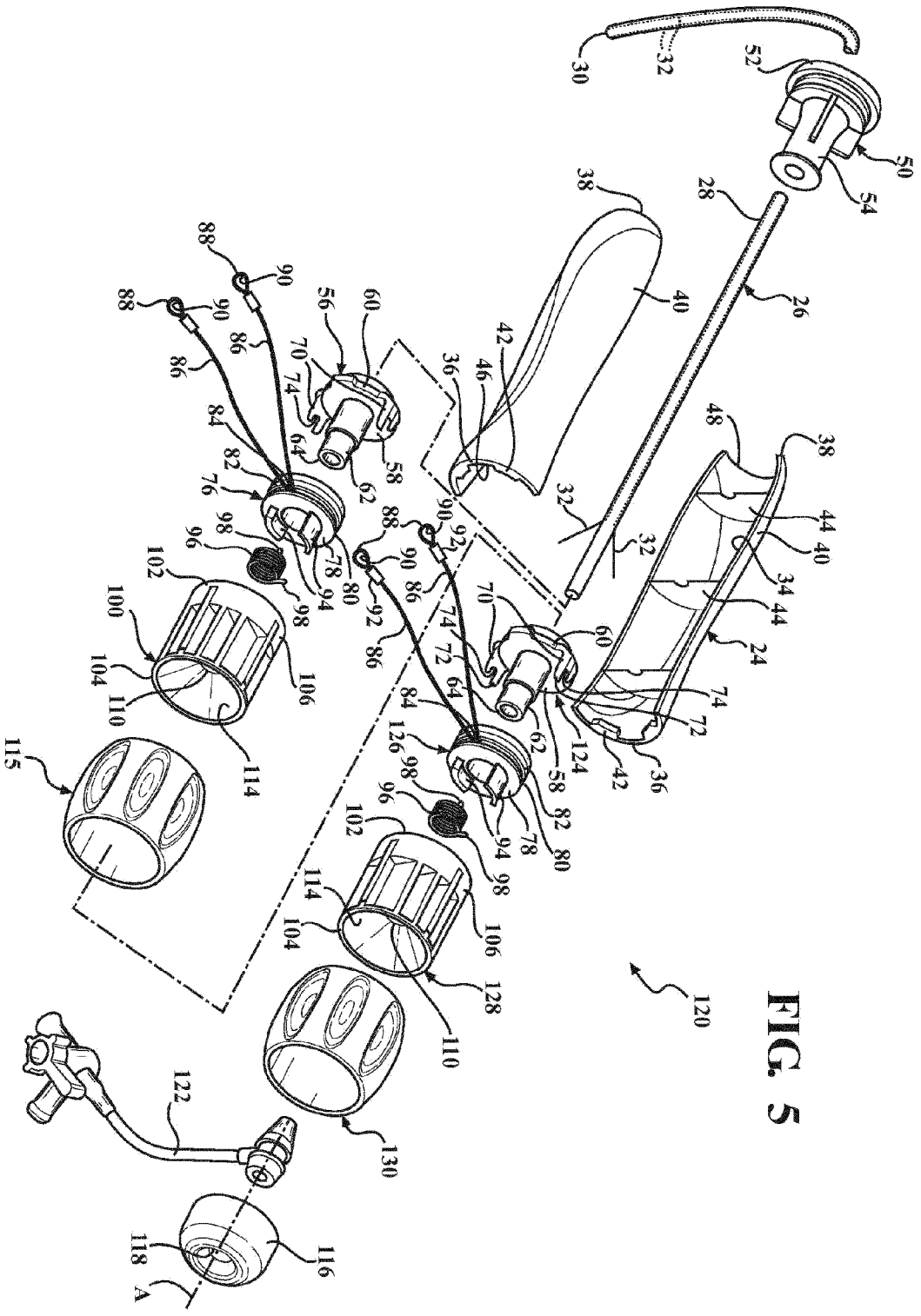
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FIG. 5

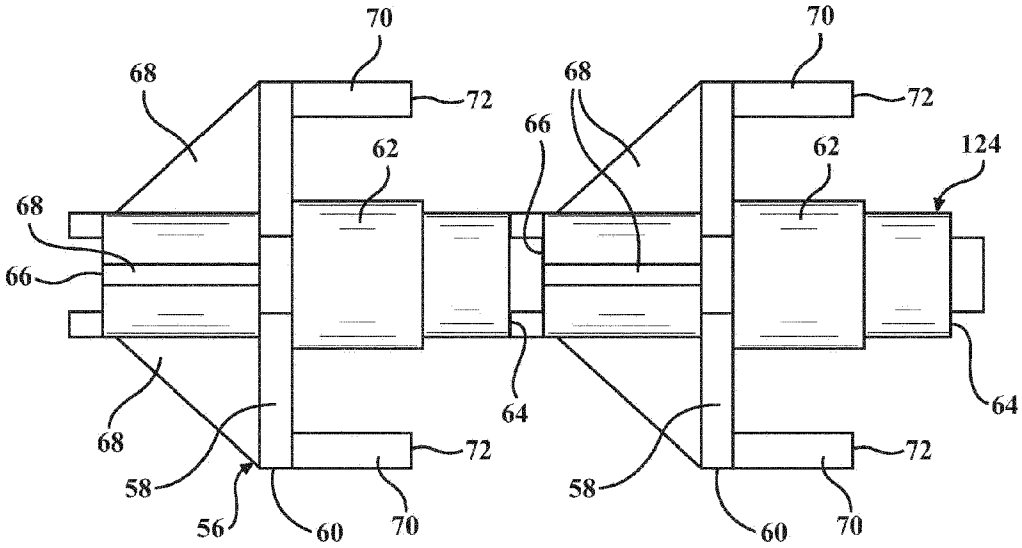

FIG. 6