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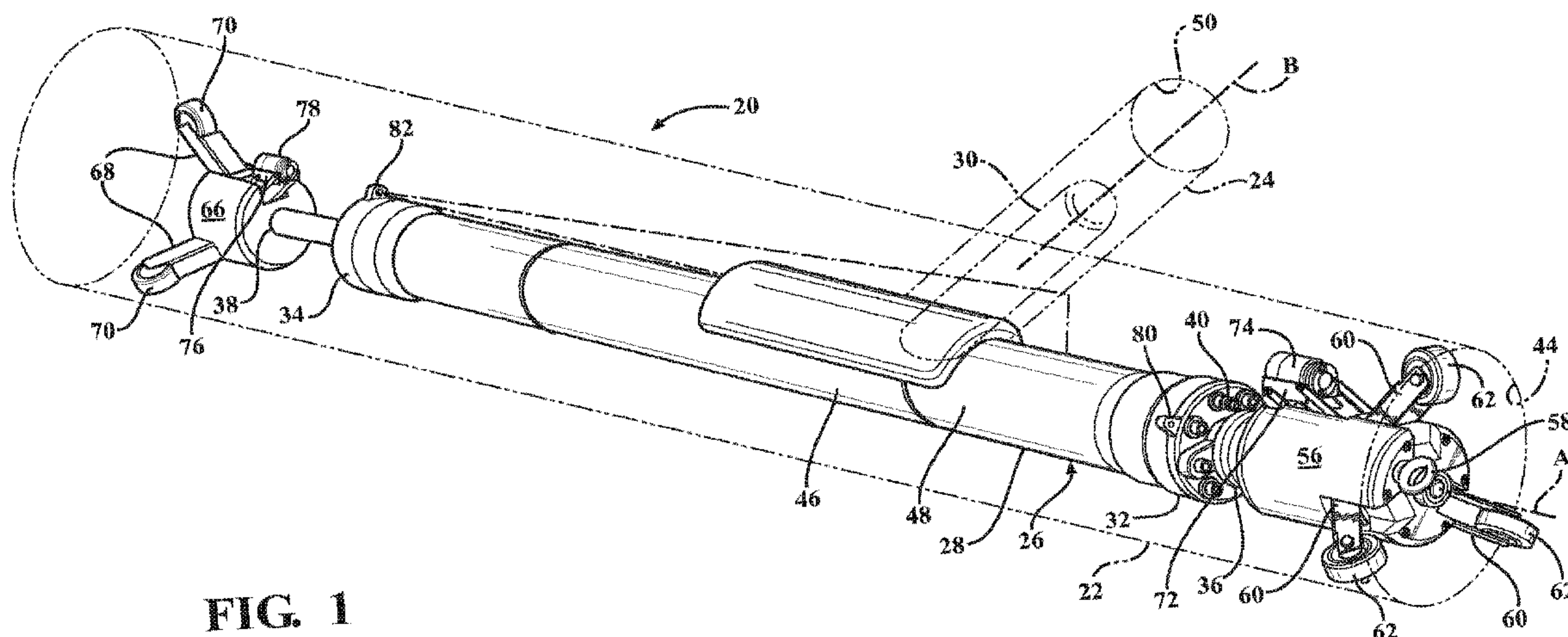


FIG. 1

(57) **Abrégé/Abstract:**

A pipe repair apparatus and method of repairing a main pipe and a lateral pipe is provided. The apparatus includes a packer assembly having a main bladder body with a cylindrical shape extending radially from and along the first axis for inflating in the main pipe. The packer assembly also has a lateral bladder body with a cylindrical shape extending radially from and along a second axis transverse to the first axis for inflating in the lateral pipe. A main liner is disposed about the main bladder body for adhering to the inner surface of the main pipe to repair the main pipe in response to the main bladder body being inflated. Similarly, a lateral liner is disposed about the lateral bladder body for adhering to the inside surface of the lateral pipe to repair the lateral pipe in response to the lateral bladder body being inflated.

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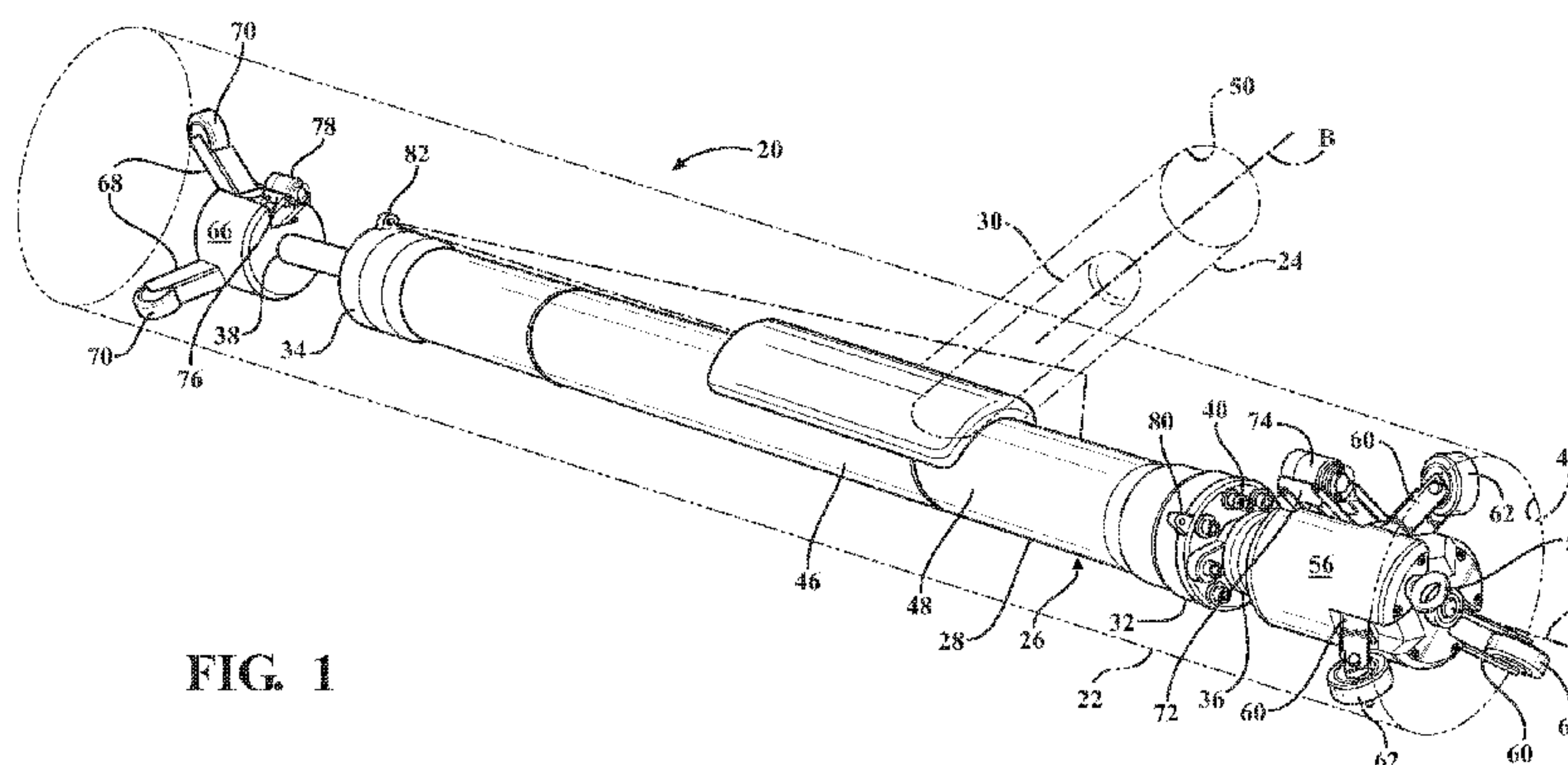
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(54) Title: PIPE REPAIR APPARATUS AND METHOD



(57) Abstract: A pipe repair apparatus and method of repairing a main pipe and a lateral pipe is provided. The apparatus includes a packer assembly having a main bladder body with a cylindrical shape extending radially from and along the first axis for inflating in the main pipe. The packer assembly also has a lateral bladder body with a cylindrical shape extending radially from and along a second axis transverse to the first axis for inflating in the lateral pipe. A main liner is disposed about the main bladder body for adhering to the inner surface of the main pipe to repair the main pipe in response to the main bladder body being inflated. Similarly, a lateral liner is disposed about the lateral bladder body for adhering to the inside surface of the lateral pipe to repair the lateral pipe in response to the lateral bladder body being inflated.

PIPE REPAIR APPARATUS AND METHOD

CROSS REFERENCE TO RELATED APPLICATION

[0001] This PCT Patent Application claims the benefit of and priority to U.S. Provisional Patent Application Serial No. 62/119,490 filed February 23, 2015, the entire disclosure of the application being considered part of the disclosure of this application, and hereby incorporated by reference.

BACKGROUND OF THE INVENTION

1. Field of the Invention

[0002] The subject invention relates generally to an apparatus for use in repairing main line and lateral line pipes. The subject invention is also related to a method of repairing a main pipe and a lateral pipe extending from the main pipe.

2. Description of the Prior Art

[0003] Pipes including at least one main pipe and a lateral pipe extending transversely or laterally from the main pipe are commonly used in both fluid supply and return pipe systems and may also be used for sewer pipes, for example. In a collection sewer pipe system, for example, junctions at which lateral pipes intersect with main pipes are generally known to be one of the weakest points. Consequently, leaks can develop at this junction due to damage or when a junction is not properly formed.

[0004] It is known to repair pipes from inside and/or outside of the pipe with patches or by removing and replacing a damaged or leaking portion. In addition, pipes used historically and those currently available in new construction are known to be a wide variety of different sizes. Thus, equipment to patch or repair the pipes must be sized accordingly to be used in any repairs that are undertaken, leading to a proliferation of equipment that a repair person must bring to a worksite. Many known solutions for repairing pipes are also not designed to properly repair junctions of lateral pipes and main pipes. As a result, such

repaired junctions may remain a weak point in the pipe system, prone to leaking in the future. Accordingly, there remains a significant need for a pipe repair apparatus and method that may be used to properly repair junctions of lateral pipes and main pipes of varying sizes.

SUMMARY AND ADVANTAGES OF THE INVENTION

[0005] The invention provides for such a pipe repair apparatus including a packer assembly having a main bladder body. The main bladder body has a cylindrical shape that extends radially from and along a first axis and is adapted to be inflated with a pressurized fluid from a first circumference narrower than an inner diameter defined by an inner surface of a main pipe to a second circumference at least equal to the inner diameter of the main pipe. A first roller assembly and a second roller assembly are each coupled to the bladder bodies and include at least one rotator motor for rotating the main bladder body. At least one camera is attached to the packer assembly for capturing imaging to determine a position and alignment of the packer assembly.

[0006] The invention also provides for a method of repairing a main pipe and a lateral pipe extending transversely from the main pipe including the step of wrapping at least one of a main liner around a main bladder body of a packer assembly and a lateral liner around a lateral bladder body of a packer assembly. The method proceeds by moving the packer assembly into the main pipe and capturing imaging to determine a position of the packer assembly in the main pipe with at least one camera. Then, locating the packer assembly proximate a damaged section of the main pipe. Next, rotating the main bladder body and the lateral bladder body of the packer assembly with at least one rotator motor. The next step of the method is inflating at least one of a main bladder body and a lateral bladder body of the packer assembly with a pressurized fluid. The method concludes by applying at least one of the main liner to an inner surface of the main pipe in response to the

inflation of the main bladder body and the lateral liner to an inside surface of the lateral pipe in response to the inflation of the lateral bladder body.

[0007] Thus, several advantages of one or more aspects of the pipe repair apparatus and method of repairing a main pipe and a lateral pipe extending from the main pipe are that the apparatus and method may be used for pipes of varying sizes. The pipe repair apparatus and method also advantageously provide for strong repairs of the junction of the lateral pipe and main pipe, thereby preventing future leaks.

BRIEF DESCRIPTION OF THE DRAWINGS

[0008] 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:

[0009] Figure 1 is a perspective view of a pipe repair apparatus illustrating a packer assembly constructed in accordance with an embodiment of the invention;

[0010] Figure 2 is a perspective view of the pipe repair apparatus of a pipe repair apparatus illustrating a packer assembly constructed in accordance with an embodiment of the invention;

[0011] Figure 3 is a perspective view of the pipe repair apparatus of FIG. 1 illustrating a main bladder body of the packer assembly inflated to a second circumference;

[0012] Figure 4 is an enlarged partial view of the pipe repair apparatus of FIG. 1 illustrating a first roller assembly with a plurality of first actuator arms in a deployed position;

[0013] Figure 5 is an enlarged partial view of the pipe repair apparatus of FIG. 1 illustrating the first roller assembly with the plurality of first actuator arms in a stowed position;

[0014] Figure 6 is an enlarged partial view of the pipe repair apparatus of FIG. 1 illustrating a first adjustable platform and locker assembly of the first roller assembly;

[0015] Figure 7 is a perspective view of a control unit of the pipe repair apparatus configured to connect to the packer assembly of FIG. 1;

[0016] Figure 8 is a perspective view of the control unit of FIG. 7 illustrating a reel for a control cable;

[0017] Figure 9 is an enlarged partial view of the control unit of FIG. 7 illustrating a first control and a second control;

[0018] Figure 10 is a flow chart illustrating steps of repairing a main pipe and a lateral pipe extending from the main pipe; and

[0019] Figures 11A and 11B are flow charts illustrating steps of repairing the main pipe and the lateral pipe extending from the main pipe.

DESCRIPTION OF THE ENABLING EMBODIMENT

[0020] Referring to the Figures, wherein like numerals indicate corresponding parts throughout the several views, a pipe repair apparatus **20** is generally shown in FIGS. 1 and 3 and extends along a first axis **A** for repairing a main pipe **22** and/or a lateral pipe **24** connected to the main pipe **22** and extending along a second axis **B** that is transverse to the first axis **A**. The lateral pipe **24** may extend at any angle laterally from the main pipe **22** including, for example, at a 90 degree angle or at a 45 degree angle. The industry may describe both the foregoing types of repairs of such lateral pipe **24** and main pipe **22** junctions as a “T” repair and a “Y” repair, respectively. The pipe repair apparatus **20** includes a packer assembly **26** having a main bladder body **28** and a lateral bladder body **30**. The packer assembly **26** also includes a first end cap **32** and a second end cap **34** disposed at opposite ends of the main bladder body **28** for encapsulating the bladder bodies **28**, **30**. More specifically, both of such end caps **32**, **34** are provided to form the final encapsulation

of the bladder bodies **28, 30** along with routing lines for inflation with the pressurized fluid, transportation (i.e., motors **36, 38** and/or cables), and vision, to be described in more detail below.

[0021] The packer assembly **26** is intended to be used in connection with inflation equipment, so as a result, both the main bladder body **28** and the lateral bladder body **30** are adapted to receive a pressurized fluid. The pressurized fluid may be a gas, a liquid, or a combination of a gas and a liquid. The first end cap **32** includes a first pressurized fluid port **40** in fluid communication with the main bladder body **28**. The first end cap **32** also includes a second pressurized fluid port (not shown) in fluid communication with the lateral bladder body **30**. It should be understood that, while the main bladder body **28** and lateral bladder body **30** can receive the pressurized fluid through separate fluid ports, the main bladder body **28** and lateral bladder body **30** could alternatively be connected so that a single pressurized fluid port could provide both bladder bodies **28, 30** with the pressurized fluid.

[0022] The main bladder body **28** has a cylindrical shape that extends radially from and along the first axis **A** and is adapted to be inflated with the pressurized fluid from a first circumference narrower than an inner diameter defined by an inner surface **44** of the main pipe **22** to a second circumference at least equal to the inner diameter of the main pipe **22**. A main liner **46** is disposed about the main bladder body **28** for engaging and adhering to the inner surface **44** of the main pipe **22** to repair the main pipe **22** in response to the main bladder body **28** being inflated to the second circumference, as best shown in FIG. 3 (i.e., the main liner **46** is pressed against the portion of the main pipe **22** requiring repair). In detail, the main liner **46** comprises a flat sheet of fiberglass impregnated with a curable resin. A main film **48** of plastic is wrapped around the main bladder body **28** for separating the curable resin of the main liner **46** from the main bladder body **28** (i.e., to prevent the curable

resin from adhering to the main bladder body **28**). The main film **48** and/or main liner **46** can be secured to the main bladder body **28** with any suitable fastener, such as but not limited to zip ties and/or tape. Once the main liner **46** is left in contact with the inner surface **44** of the main pipe **22**, the resin of the main liner **46** can begin to cure.

[0023] As best shown in FIGS. 1 and 3, the lateral bladder body **30** also has a cylindrical shape that extends radially from and along the second axis **B** transverse to the first axis **A**. However, in use, the lateral bladder body **30** may remain folded or rolled up adjacent the main bladder body **28** prior to being inflated. The lateral bladder body **30** attaches to the main bladder body **28** and is adapted to be inflated with pressurized fluid from a first size narrower than an inside diameter defined by an inside surface **50** of a lateral pipe **24** to a second size at least equal to the inside diameter of the lateral pipe **24**. The lateral bladder body **30** is adapted to be attached to the main bladder body **28** at a junction including fittings such as male and female fasteners. A lateral liner **52** (FIG. 3) is disposed about the lateral bladder body **30** for engaging and adhering to the inside surface **50** of the lateral pipe **24** to repair the lateral pipe **24** in response to the lateral bladder body **30** being inflated to the second size. As with the main liner **46**, the lateral liner **52** comprises a flat sheet of fiberglass impregnated with a curable resin. A lateral film **54** of plastic is wrapped around the lateral bladder body **30** for separating the curable resin of the lateral liner **52** from the lateral bladder body **30**. The lateral film **54** and/or lateral liner **52** may be secured to the lateral bladder body **30** using zip ties and/or tape, for example. It is important to provide for a smooth and uniform junction between the main bladder body **28** and the lateral bladder body **30**, so that the liners **46**, **52** are properly adhered and position against that portion of the repaired pipe during inflation. If such a proper junction is not formed, damage or leaking can occur at the junction between the lateral pipe **24** and the main pipe **22**, which is generally known as one of the weakest points in a collection sewer system.

While a lateral bladder body **30** may be used, it should be appreciated that the packer assembly **26** may not include a lateral bladder body **30**, as best shown in FIG. 2.

[0024] The packer assembly **26** also includes a first roller assembly **56** coupled to the first end cap **32** for supporting and rotating the first end cap **32** and the bladder bodies **28, 30**. The first roller assembly **56** includes a cable tie **58** for attachment to a guide cable that may be used in conjunction with a winch, for example, to move the packer assembly **26** through the main pipe **22**. The first roller assembly **56** includes a first rotator motor **36** coupled with the first end cap **32** for rotating the first end cap **32** and the bladder bodies **28, 30**. Additionally, the first roller assembly **56** includes a plurality of first actuator arms **60** movably coupled to the first roller assembly **56** for moving radially outwardly from the first roller assembly **56** (e.g., outwardly to a deployed position shown in FIG. 4 from a stowed position shown in FIG. 5). A first actuator motor (not shown) is coupled to the first actuator arms **60** for moving the first actuator arms **60** relative to the first roller assembly **56**. The first actuator arms **60** each include a first roller wheel **62** rotatably attached to the first actuator arm **60** to engage the inner surface **44** of the main pipe **22**. The first roller assembly **56** also includes a locker assembly **64** (FIG. 6) coupled to the first roller assembly **56** for locking the packer assembly **26** in position relative to the main pipe **22**.

[0025] Referring back to FIGS. 1 and 3, the packer assembly **26** includes a second roller assembly **66** coupled to the second end cap **34** for supporting and rotating the packer assembly **26**. As with the first roller assembly **56**, the second roller assembly **66** includes a plurality of second actuator arms **68** movably coupled to the second roller assembly **66** for moving radially outwardly from the second roller assembly **66**. The second actuator arms **68** each include a second roller wheel **70** rotatably attached to the second actuator arm **68** to engage the inner surface **44** of the main pipe **22**. The second roller assembly **66** also includes a second rotator motor **38** coupled with the second end cap **34** for rotating the

second end cap **34** and the bladder bodies **28, 30**. It should be appreciated that while both the first and second rotator motors **36, 38** may be used, the packer assembly **26** may instead only include one rotator motor. A second actuator motor (not shown) is coupled to the second actuator arms **68** for moving the second actuator arms **68** relative to the second roller assembly **66**. It should be understood that while the actuator arms **60, 68** may be moved by the first and/or second actuator motors **36, 38**, the actuator arms **60, 68** could alternatively be moved by a fluid or pneumatic force. In any event, the first and second actuator arms **60, 68** enable the pipe repair apparatus **20** to easily adapt to pipes of various sizes.

[0026] The first roller assembly **56** includes a first adjustable platform **72** (FIG. 6) coupled to the first roller assembly **56**. A first camera **74** is attached to the first adjustable platform **72** for capturing imaging to determine a position and alignment of the pipe repair apparatus **20**. The second roller assembly **66** similarly includes a second adjustable platform **76** (FIGS. 1 and 3) coupled to the second roller assembly **66** and a second camera **78** is attached to the second adjustable platform **76** for capturing imaging to determine a position and alignment of the pipe repair apparatus **20**. The first end cap **32** includes a first laser **80** attached to the first end cap **32** for projecting a beam axially toward the second camera **78**. The second end cap **34** includes a second laser **82** attached to the second end cap **34** for projecting a beam axially toward the first camera **74**. A handheld device **84** (FIG. 7) is in communication with the first camera **74** and the second camera **78** for receiving imaging from the first camera **74** and the second camera **78** to confirm positioning and alignment of the packer assembly **26**.

[0027] As best shown in FIGS. 7-9, a control unit **86** has a first control **88** and a second control **90** for coupling to and controlling the packer assembly **26**. While the control unit **86** can be used along with separate inflation equipment, the control unit **86** may instead

carry out the functions of any separate inflation equipment (e.g., supplying the pressurized fluid). A control line **92** is adapted to couple with the packer assembly **26** with the control unit **86** for providing power and control signals to the packer assembly **26** (e.g., power to the actuator motors **36, 38**). The control unit **86** may also include a reel **94** (FIGS. 7 and 8) to manage the control line **92**. A first pressurized fluid line (not shown) couples the control unit **86** with the packer assembly **26** through the first pressurized fluid port **40** for providing a pressurized fluid to the main bladder body **28** in response to operation of the first control **88**. Likewise, a second pressurized fluid line (not shown) couples the control unit **86** with the packer assembly **26** through the second pressurized fluid port **42** for providing a pressurized fluid to the lateral bladder body **30** in response to operation of the second control **90**. Use of the separate first and second pressurized fluid lines and control unit **86** permits the operator to properly inflate each of the main bladder body **28** and lateral bladder body **30** in order to cause a better seal at the junction.

[0028] As shown in FIGS. 10, 11A and 11B, a method of repairing a main pipe **22** and a lateral pipe **24** extending from the main pipe **22** is also disclosed. The method begins with the step of **100** wrapping at least one of a main liner **46** around a main bladder body **28** of a packer assembly **26** and a lateral liner **52** around a lateral bladder body **30** of the packer assembly **26**. Specifically, such a step may include **102** impregnating a main liner **46** with a curable resin and **104** wrapping a main film **48** around the main bladder body **28** of a packer assembly **26**. Next, **106** wrapping the main liner **46** around the main film **48**. The method proceeds by **108** impregnating the lateral liner **52** with a curable resin and **110** wrapping a lateral film **54** around the lateral bladder body **30** of the packer assembly **22**. Then, **112** wrapping the lateral liner **52** around the lateral film **54**.

[0029] The next steps of the method are **114** connecting the packer assembly **26** to a control unit **86** and **116** moving the packer assembly **26** into the main pipe **22**. For example,

the packer assembly **26** can be pulled with use of cables attached to the cable tie **58** to the damaged location. Then, **118** moving a plurality of first actuator arms **60** coupled to a first roller assembly **56** of the packer assembly **26** outwardly (FIG. 4). This can be accomplished by **120** driving at least one first actuator motor coupled to the first actuator arms **60** (i.e., the actuator arms **60**, **68** move in response to driving the at least one first actuator motor). As described above, the actuator arms **60**, **68** could instead be moved using a fluid or pneumatic pressure instead. The method continues with **122** positioning a plurality of first roller wheels **62** each attached to one of the first actuator arms **60** to engage an inner surface **44** of the main pipe **22**. As with the first actuator arms **60**, the method includes the step of **124** moving a plurality of second actuator arms **68** coupled to a second roller assembly **66** of the packer assembly **26** outwardly. Such movement can be carried out by **126** driving at least one second actuator motor coupled to the second actuator arms **68**. The method also includes the step of **128** positioning a plurality of second roller wheels **70** attached to each of the second actuator arms **68** to engage the inner surface **44** of the main pipe **22**.

[0030] The method continues by **130** positioning a first camera **74** coupled to the first roller assembly **56** with a first adjustable platform **72** and **132** positioning a second camera **78** coupled to the second roller assembly **66** with a second adjustable platform **76**. Next, **134** capturing imaging to determine a position of the packer assembly **26** in the main pipe **22** with the first camera **74** and the second camera **78**. The method proceeds by **136** viewing the imaging from the first camera **74** and the second camera **78** with a handheld device **84** and **138** locating the packer assembly **26** proximate a damaged section of the main pipe **22**.

[0031] Although the packer assembly **26** may be pulled to the longitudinal position of the damaged pipe, the repair required may be at some point inside the main pipe **22**

which requires the packer assembly **26** to be rotated about the first axis **A**. So the method includes the step of **140** rotating the main bladder body **28** and the lateral bladder body **30** of the packer assembly **26** with at least one rotator motor. Next, **142** aligning the main bladder body **28** and the lateral bladder body **30** relative to the first roller assembly **56** and the second roller assembly **66** with a first laser **80** and the first camera **74** and a second laser **82** and the second camera **78** using imaging from the first camera **74** and the second camera **78**. In detail, the operator uses the cameras **74, 78** to position the packer assembly **26** and the lasers **80, 82** to ensure each of the first and second end caps **32, 34** are in the appropriate position, typically aligned. Having the rotational adjustment is particularly important for locating and positioning the lateral bladder body **30** at the opening of a lateral pipe **24** (i.e., “T” or “Y” location). The method continues with **144** locking the packer assembly **26** into position laterally and longitudinally with a locker assembly **64** coupled to at least one of the first roller assembly **56** and the second roller assembly **66**.

[0032] The method includes **146** inflating at least one of a main bladder body **28** and a lateral bladder body **30** of the packer assembly **26** with a pressurized fluid and **148** applying at least one of a main liner **46** to an inner surface **44** of the main pipe **22** in response to the inflation of the main bladder body **28** and a lateral liner **52** to an inside surface **50** of the lateral pipe **24** in response to the inflation of the lateral bladder body **30**. More specifically, such a steps **146, 148** can include inflating the main bladder body **28** of the packer assembly **26** in the main pipe **22** with a first pressurized fluid line using a first control **88** of the control unit **86** (FIG. 3). Then, **152** applying an impregnated fiberglass of the main liner **46** to an inner surface **44** of the main pipe **22** in response to the inflation of the main bladder body **28**. The impregnated fiberglass can then cure against the damaged location of the main pipe **22** to form a properly sealed and repaired main pipe **22**.

[0033] The steps **146, 148** likewise can include the step of **154** inflating the lateral bladder body **30** of the packer assembly **26** in the lateral pipe **24** extending from the main pipe **22** with a second pressurized fluid line using a second control **90** of the control unit **86** to a second diameter. Next, **156** applying an impregnated fiberglass of the lateral liner **52** to an inside surface **50** of the lateral pipe **24** in response to the inflation of the lateral bladder body **30**. The impregnated fiberglass of the lateral liner **52** cures against the damaged location of the lateral pipe **24** to form a properly sealed and repaired lateral pipe **24**. It should be appreciated that while the method described above includes applying both a main liner **46** and a lateral liner **52**, the pipe repair apparatus **20** could be used to apply a main liner **46** only, or a lateral liner **52** only.

[0034] Obviously, many modifications and variations of the present invention are possible in light of the above teachings and may be practiced otherwise than as specifically described while within the scope of the appended claims. These antecedent recitations should be interpreted to cover any combination in which the inventive novelty exercises its utility. The use of the word "said" in the apparatus claims refers to an antecedent that is a positive recitation meant to be included in the coverage of the claims whereas the word "the" precedes a word not meant to be included in the coverage of the claims.

CLAIMS

What is claimed is:

Claim 1. A pipe repair apparatus comprising:

a packer assembly having a main bladder body;

said main bladder body having a cylindrical shape extending radially from and along a first axis and adapted to be inflated with a pressurized fluid from a first circumference narrower than an inner diameter defined by an inner surface of a main pipe to a second circumference at least equal to the inner diameter of the main pipe;

a first roller assembly and a second roller assembly each coupled to said bladder bodies and including at least one rotator motor for rotating said bladder bodies; and

at least one camera attached to said packer assembly for capturing imaging to determine a position and alignment of said packer assembly.

Claim 2. A pipe repair apparatus as set forth in claim 1, wherein:

said first roller assembly includes a plurality of first actuator arms movably coupled to said first roller assembly for moving radially outwardly from said first roller assembly;

said first actuator arms each include a first roller wheel rotatably attached to said first actuator arms to engage the inner surface of the main pipe;

said second roller assembly includes a plurality of second actuator arms movably coupled to said second roller assembly for moving radially outwardly from said second roller assembly; and

said second actuator arms each include a second roller wheel rotatably attached to said second actuator arms to engage the inner surface of the main pipe.

Claim 3. A pipe repair apparatus as set forth in claim 1, further including a main liner disposed about said main bladder body for engaging and adhering to the inner surface of the main pipe to repair the main pipe in response to said main bladder body being inflated to the second circumference.

Claim 4. A pipe repair apparatus as set forth in claim 3, wherein said main liner comprises a flat sheet of fiberglass impregnated with a curable resin.

Claim 5. A pipe repair apparatus as set forth in claim 4, further including a main film of plastic wrapped around said main bladder body for separating said curable resin adjacent to said sheet of fiberglass from said main bladder.

Claim 6. A pipe repair apparatus as set forth in claim 1, wherein said at least one camera includes a first camera attached to said first roller assembly and a second camera attached to said second roller assembly.

Claim 7. A pipe repair apparatus as set forth in claim 6, further including a first laser attached to said packer assembly for projecting a beam axially toward said second camera and said a second laser attached to said packer assembly for projecting a beam axially toward said first camera.

Claim 8. A pipe repair apparatus as set forth in claim 1, wherein said packer assembly includes a lateral bladder body having a cylindrical shape extending radially from and along a second axis transverse to said first axis and attached to said main bladder body and adapted to be inflated with the pressurized fluid from a first size narrower than an inside

diameter defined by an inside surface of a lateral pipe to a second size at least equal to the inside diameter of the lateral pipe and said pipe repair apparatus further including a lateral liner disposed about said lateral bladder body for engaging and adhering to the inside surface of the lateral pipe to repair the lateral pipe in response to said lateral bladder body being inflated to the second size.

Claim 9. A pipe repair apparatus as set forth in claim 8, further including a control unit having a first control for inflating and deflating said main bladder body and having a second control for inflating and deflating said lateral bladder body.

Claim 10. A method of repairing a main pipe and a lateral pipe extending transversely from the main pipe comprising the steps of:

wrapping at least one of a main liner around a main bladder body of a packer assembly and a lateral liner around a lateral bladder body of the packer assembly;

moving the packer assembly into the main pipe;

capturing imaging to determine a position of the packer assembly in the main pipe with at least one camera;

locating the packer assembly proximate a damaged section of the main pipe;

rotating the main bladder body and the lateral bladder body of the packer assembly with at least one rotator motor;

inflating at least one of a main bladder body and a lateral bladder body of the packer assembly with a pressurized fluid; and

applying at least one of a main liner to an inner surface of the main pipe in response to the inflation of the main bladder body and a lateral liner to an inside surface of the lateral pipe in response to the inflation of the lateral bladder body.

Claim 11. A method as set forth in claim 10, further including the steps of:

moving a plurality of first actuator arms coupled to a first roller assembly of the packer assembly outwardly;

positioning a plurality of first roller wheels attached to each of the first actuator arms to engage an inner surface of the main pipe;

moving a plurality of second actuator arms coupled to a second roller assembly of the packer assembly outwardly; and

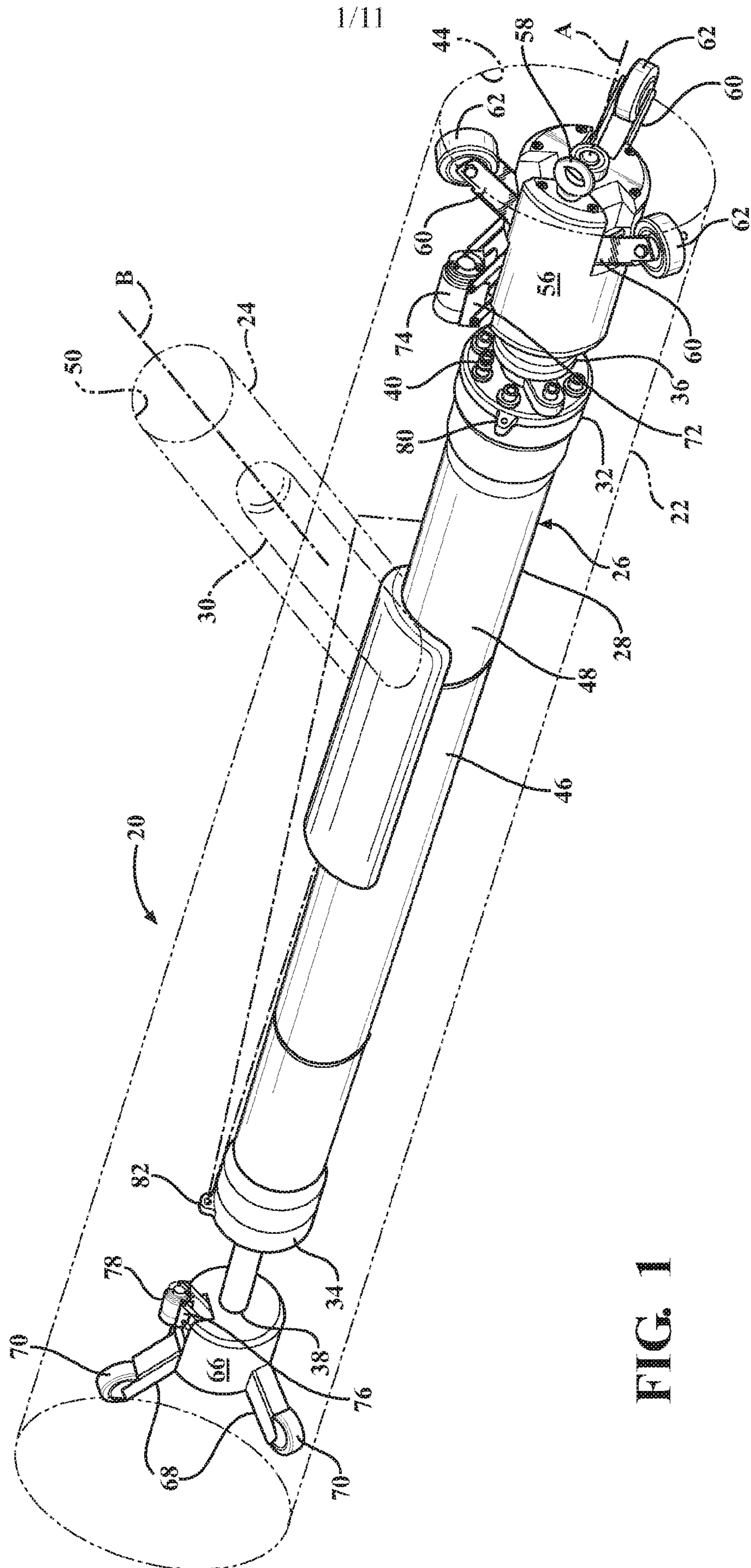
positioning a plurality of second roller wheels attached to each of the second actuator arms to engage the inner surface of the main pipe.

Claim 12. A method as set forth in claim 11, wherein the step of moving a plurality of first actuator arms coupled to a first roller assembly of the packer assembly outwardly includes driving at least one first actuator motor coupled to the first actuator arms and wherein the step of moving a plurality of second actuator arms coupled to a second roller assembly of the packer assembly outwardly includes driving at least one second actuator motor coupled to the second actuator arms.

Claim 13. A method as set forth in claim 10, further including the step of aligning the main bladder body and the lateral bladder body relative to the first roller assembly and the second roller assembly with a first laser and the first camera and a second laser and the second camera using imaging from the first camera and the second camera.

Claim 14. A method as set forth in claim 10, further including the step of locking the packer assembly into position laterally and longitudinally with a locker assembly.

Claim 15. A method as set forth in claim 10, further including the steps of:
impregnating the main liner with a curable resin;
wrapping the main film around the main bladder body;
wrapping the main liner around the main film;
impregnating the lateral liner with a curable resin;
wrapping a lateral film around the lateral bladder body; and
wrapping the lateral liner around the lateral film.



FIGURE

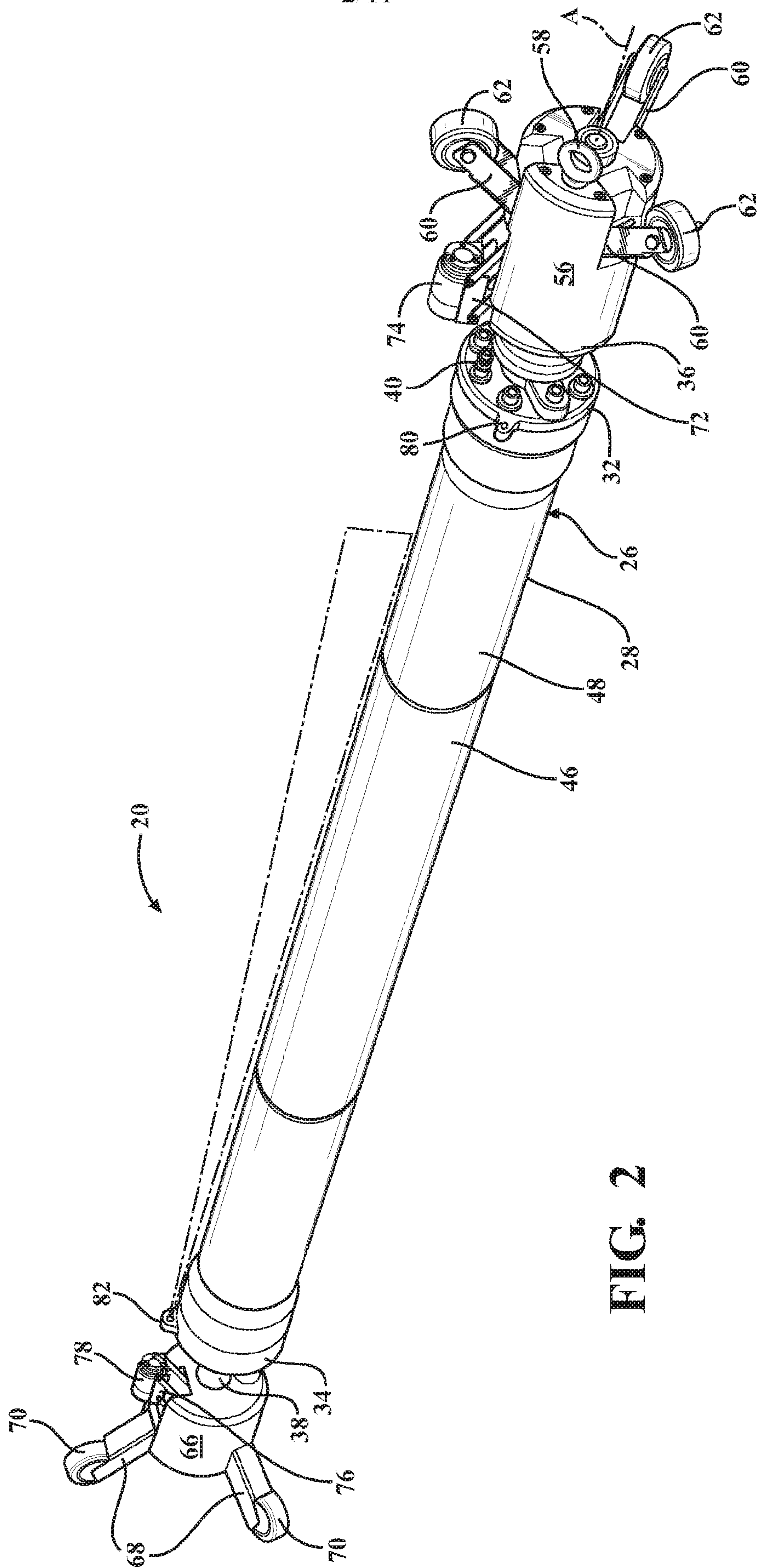


FIG. 2

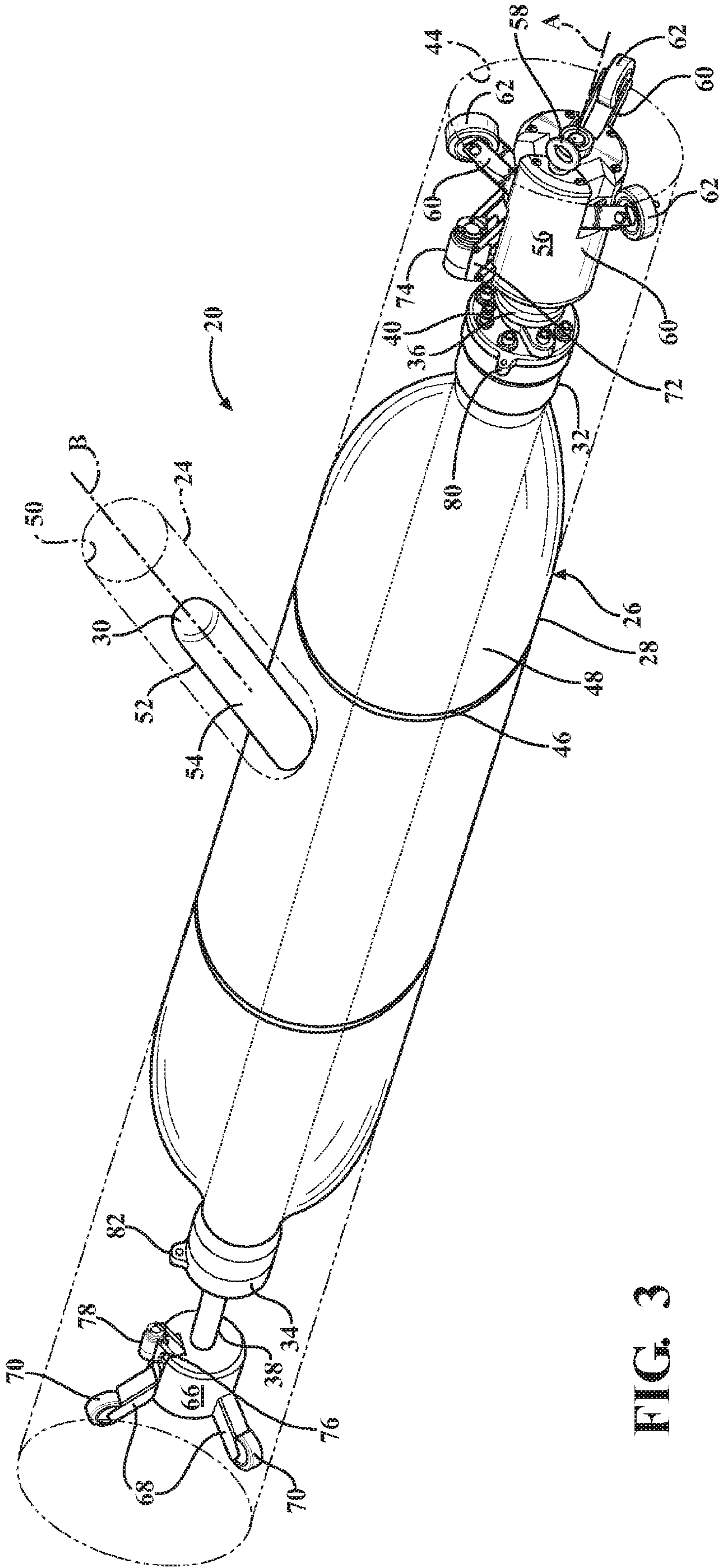


FIG. 3

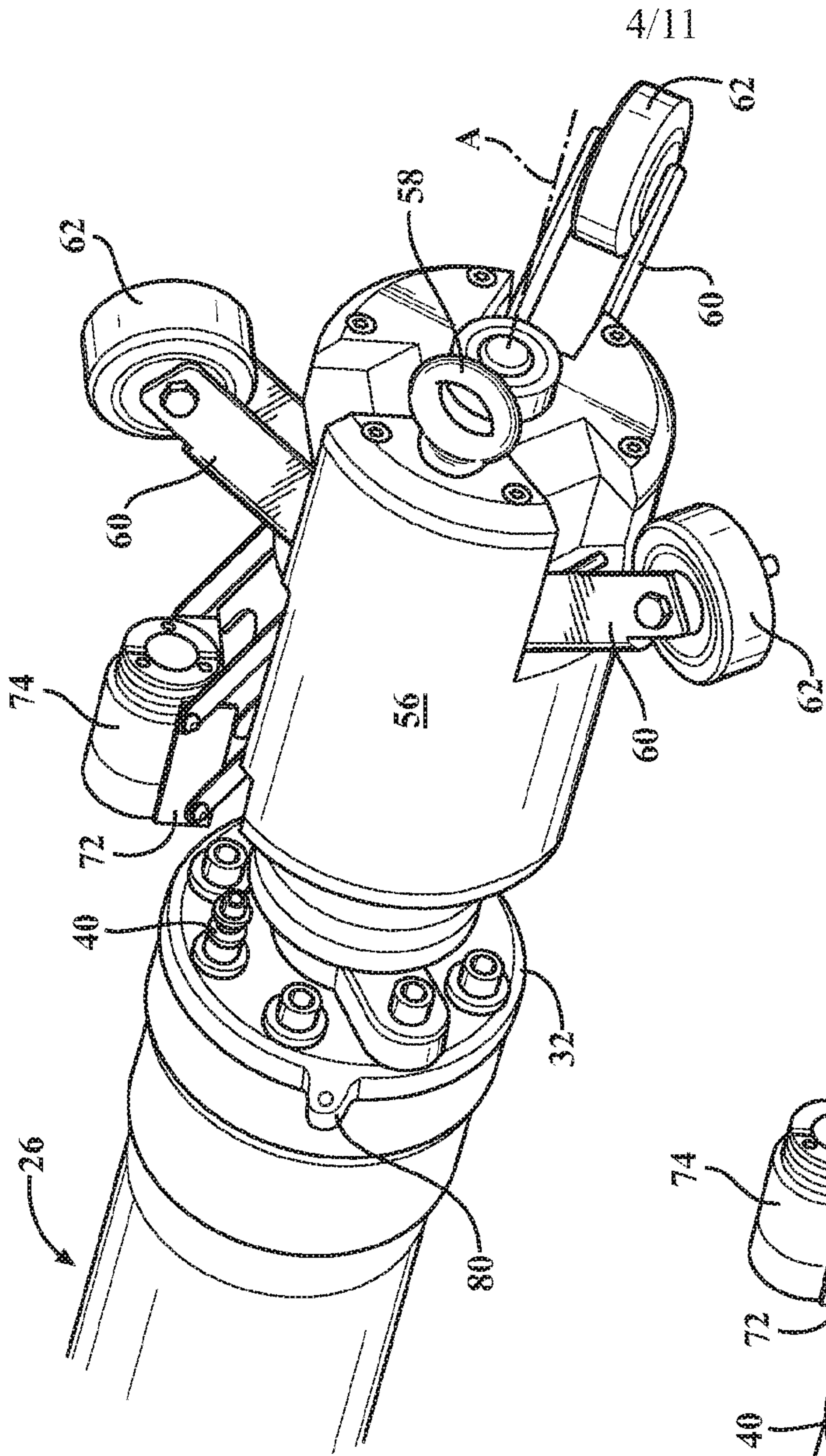


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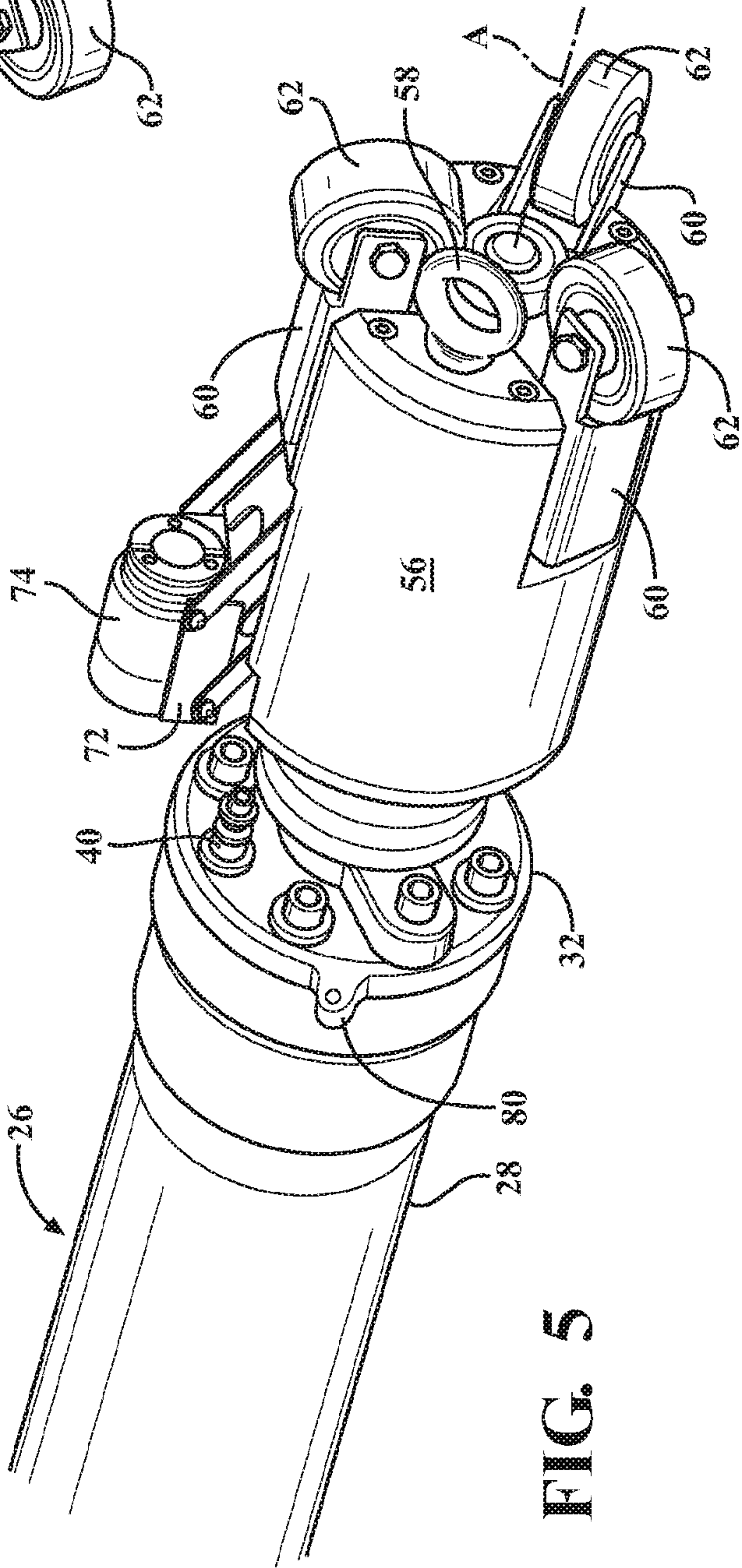


FIG. 5

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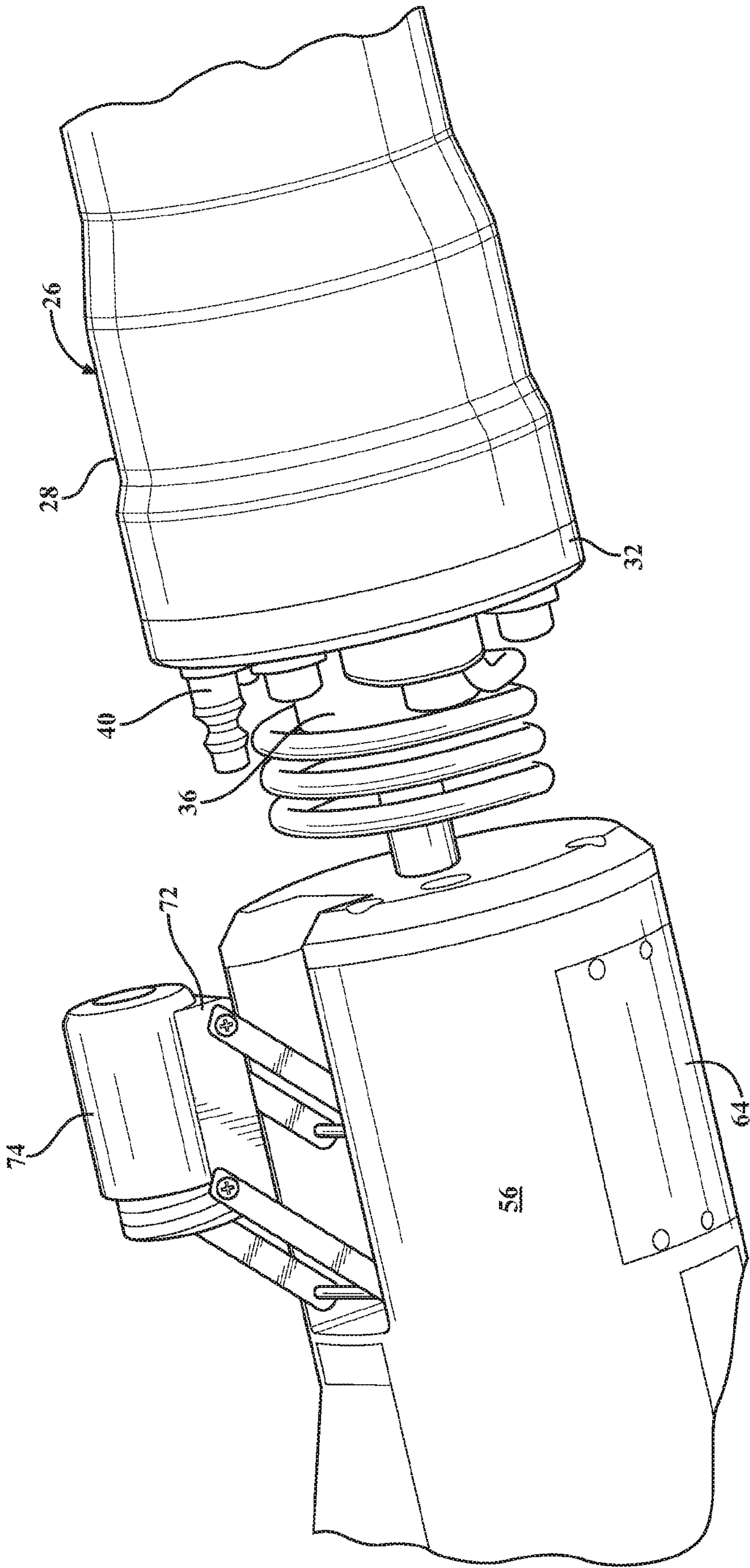
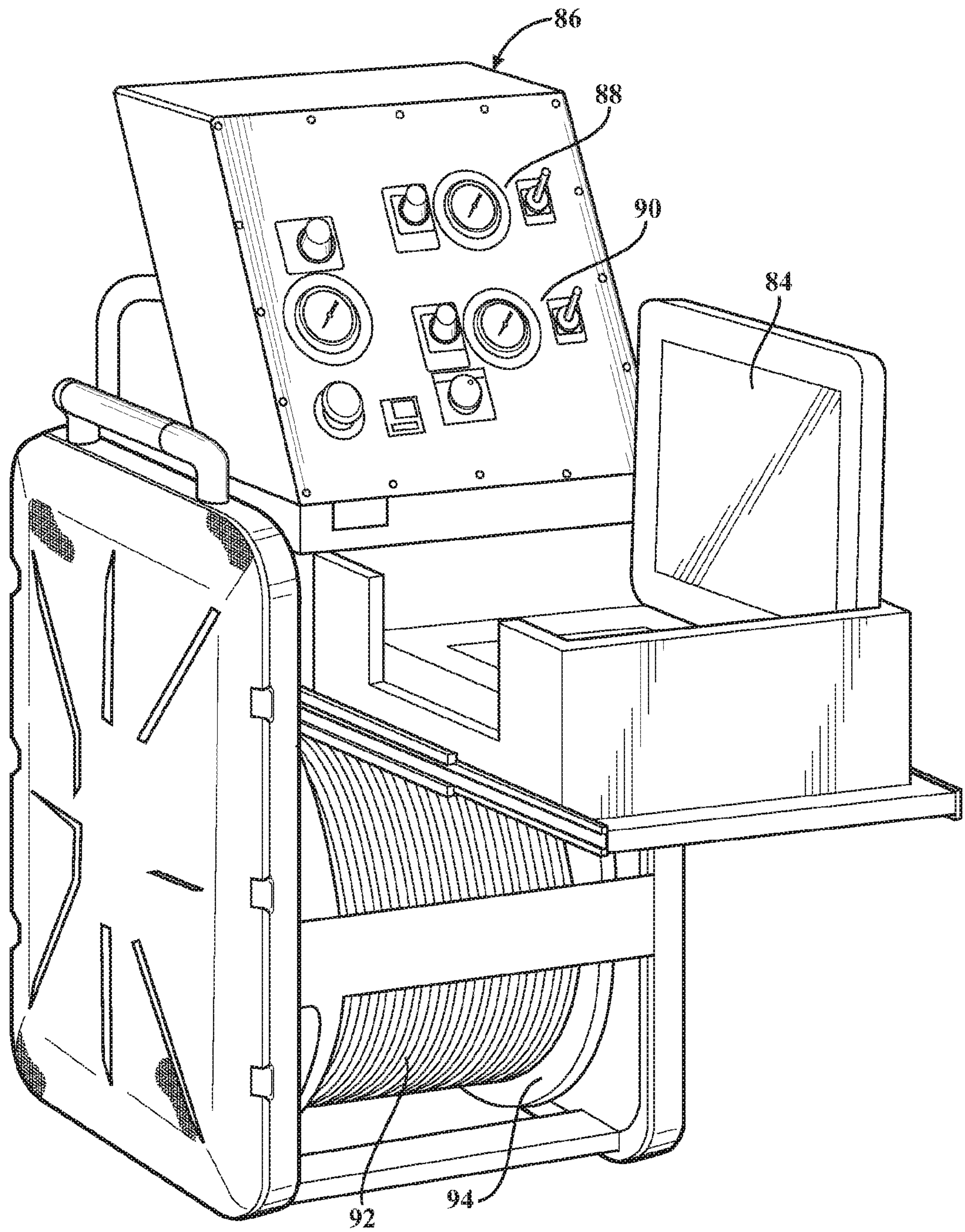
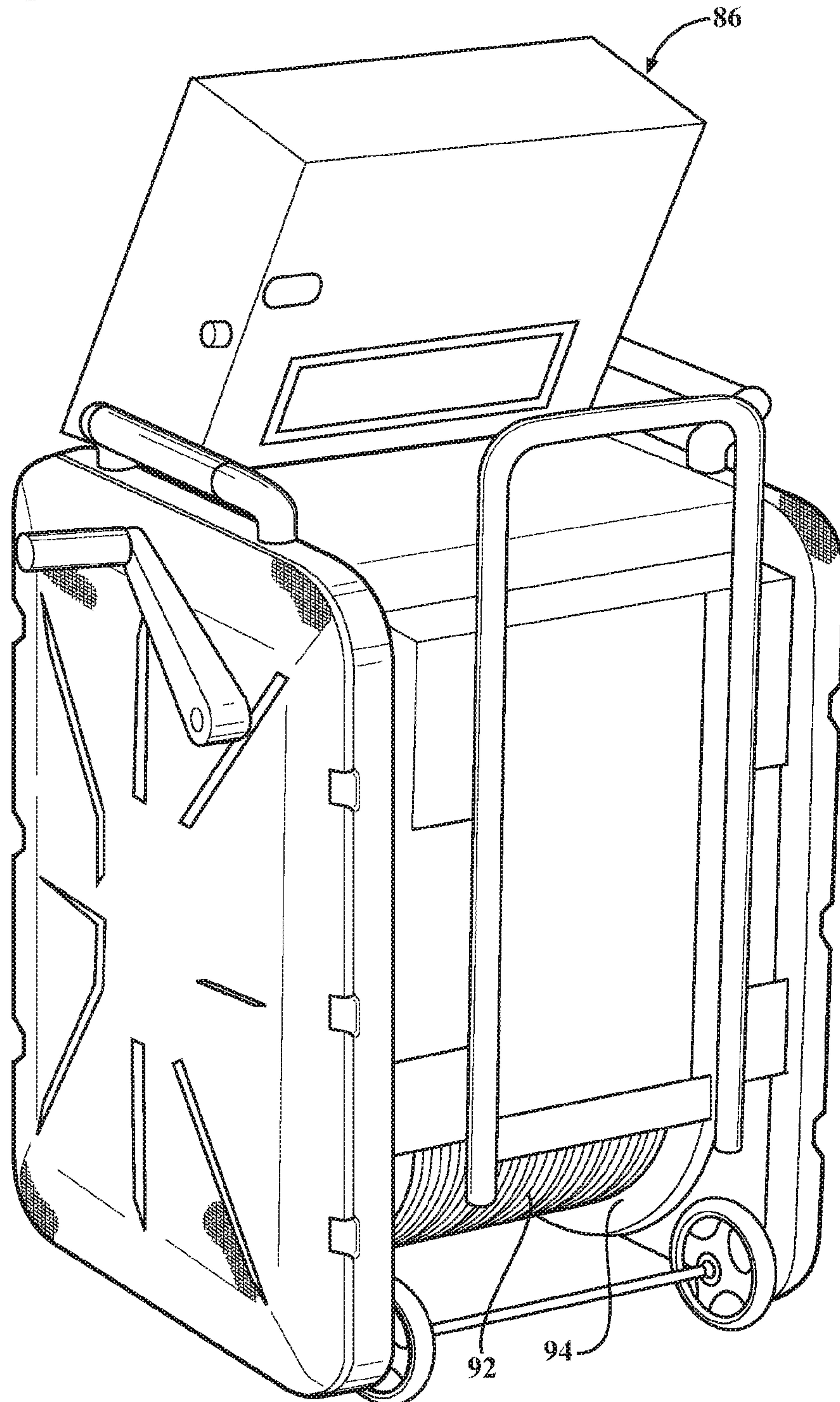


FIG. 6

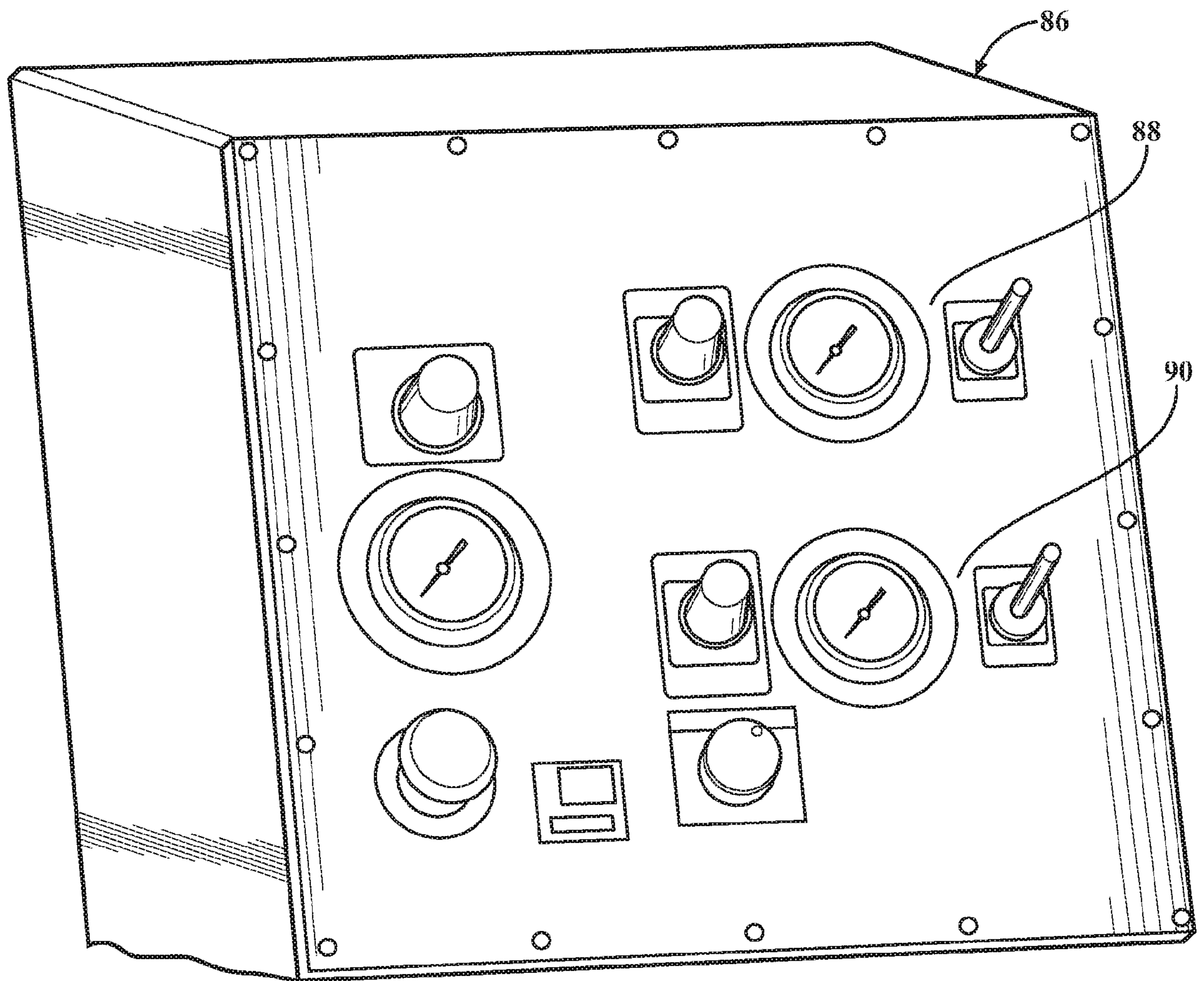
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FIG. 7

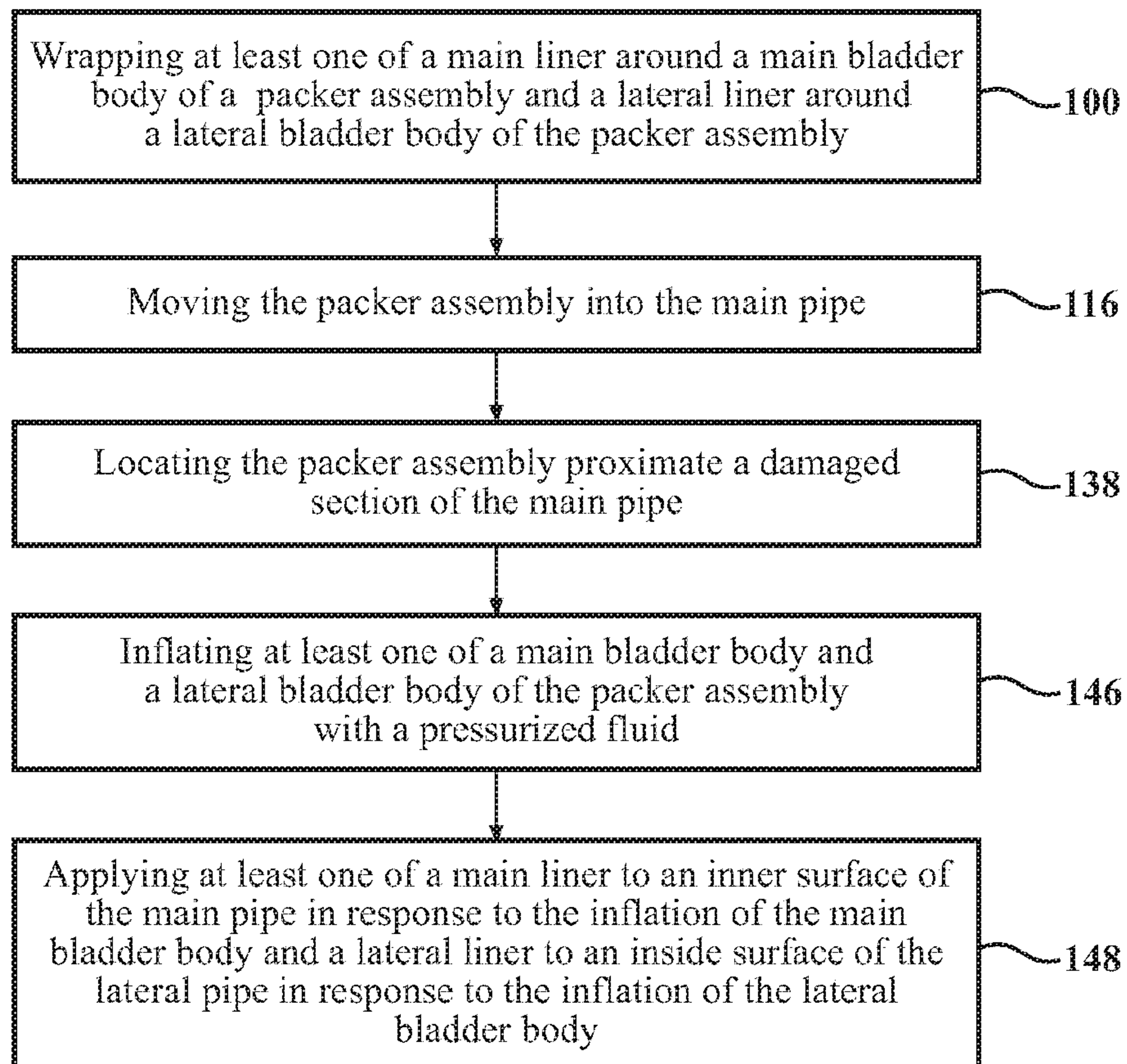
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FIG. 8

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**FIG. 9**

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**FIG. 10**

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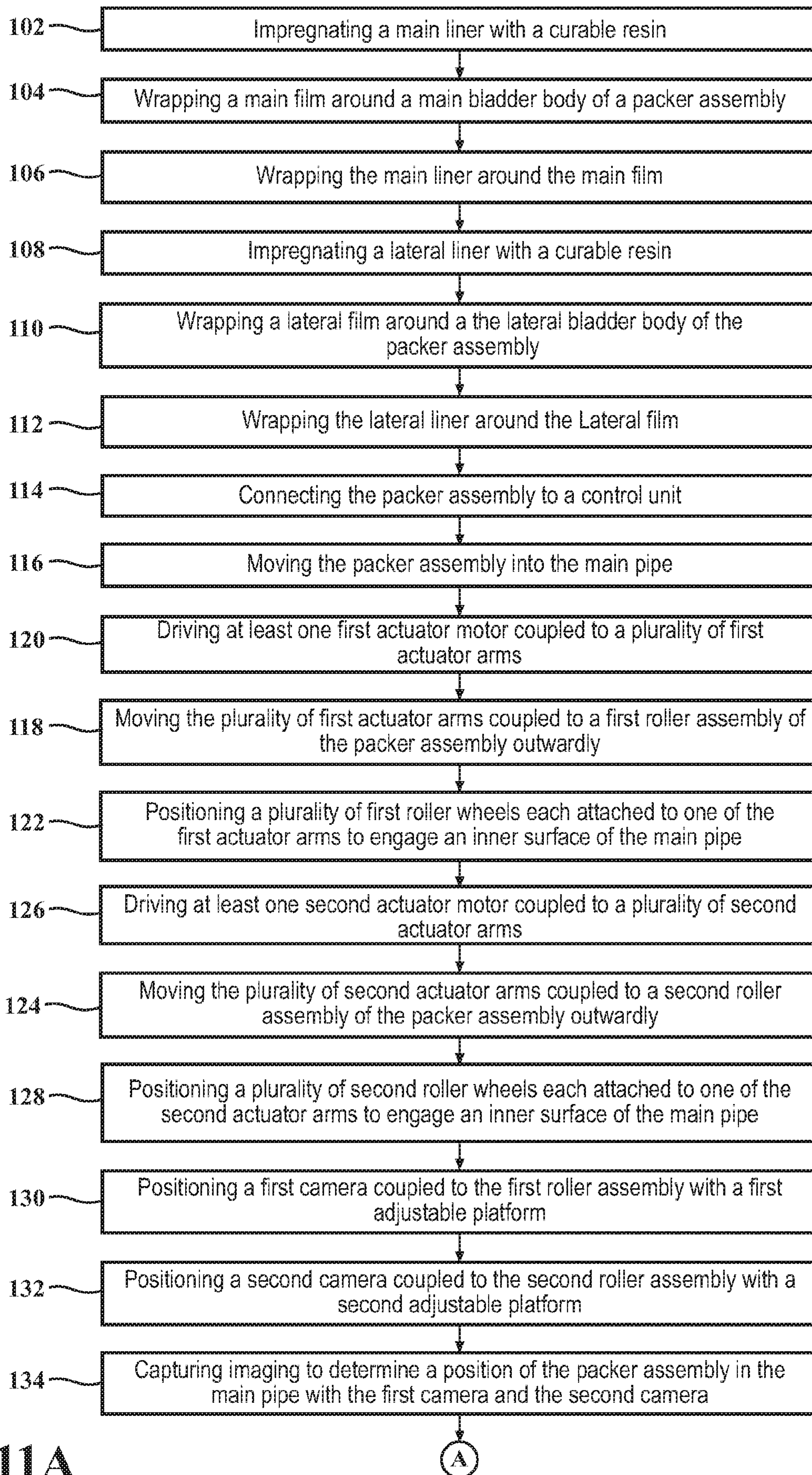
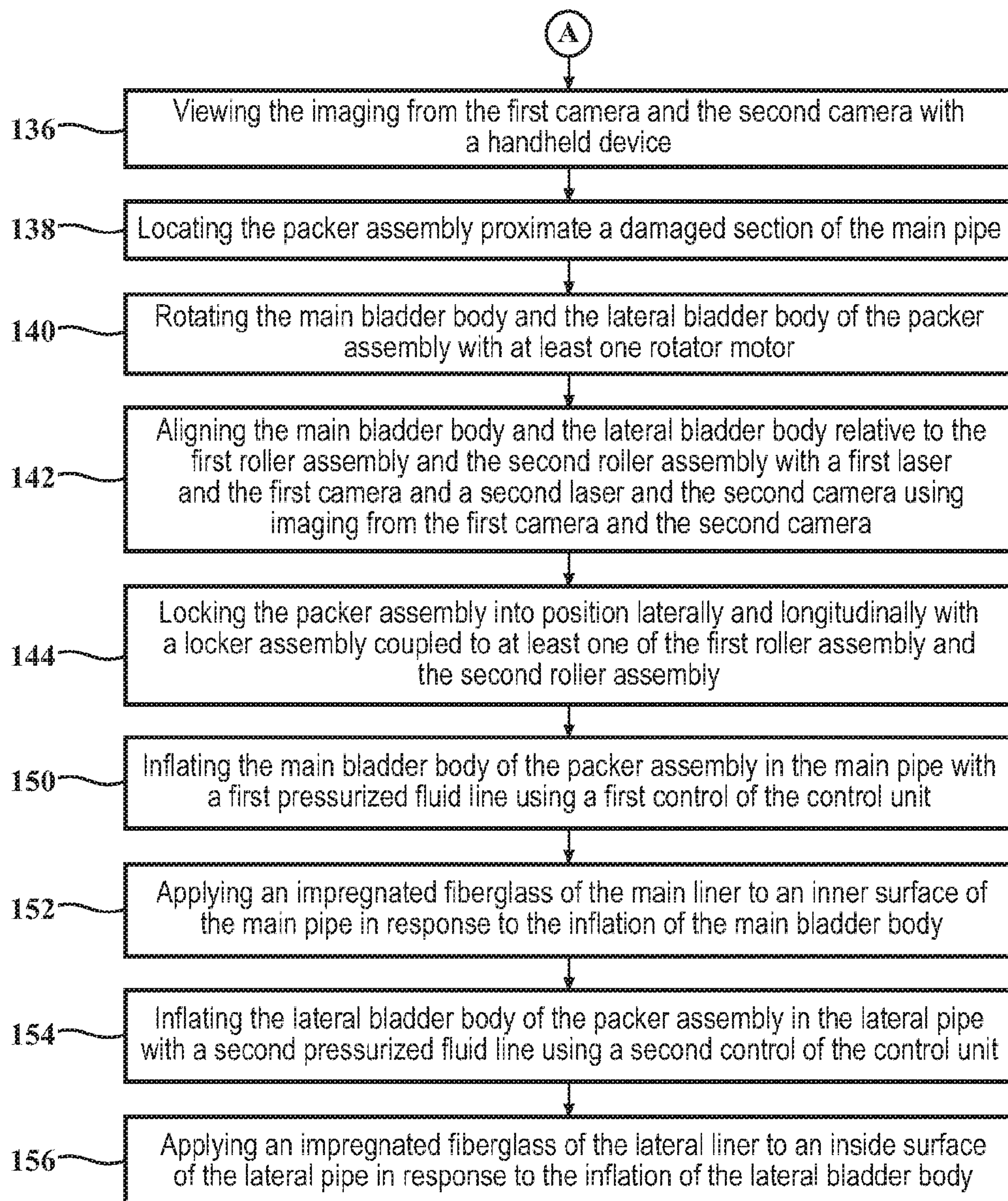


FIG. 11A

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**FIG. 11B**

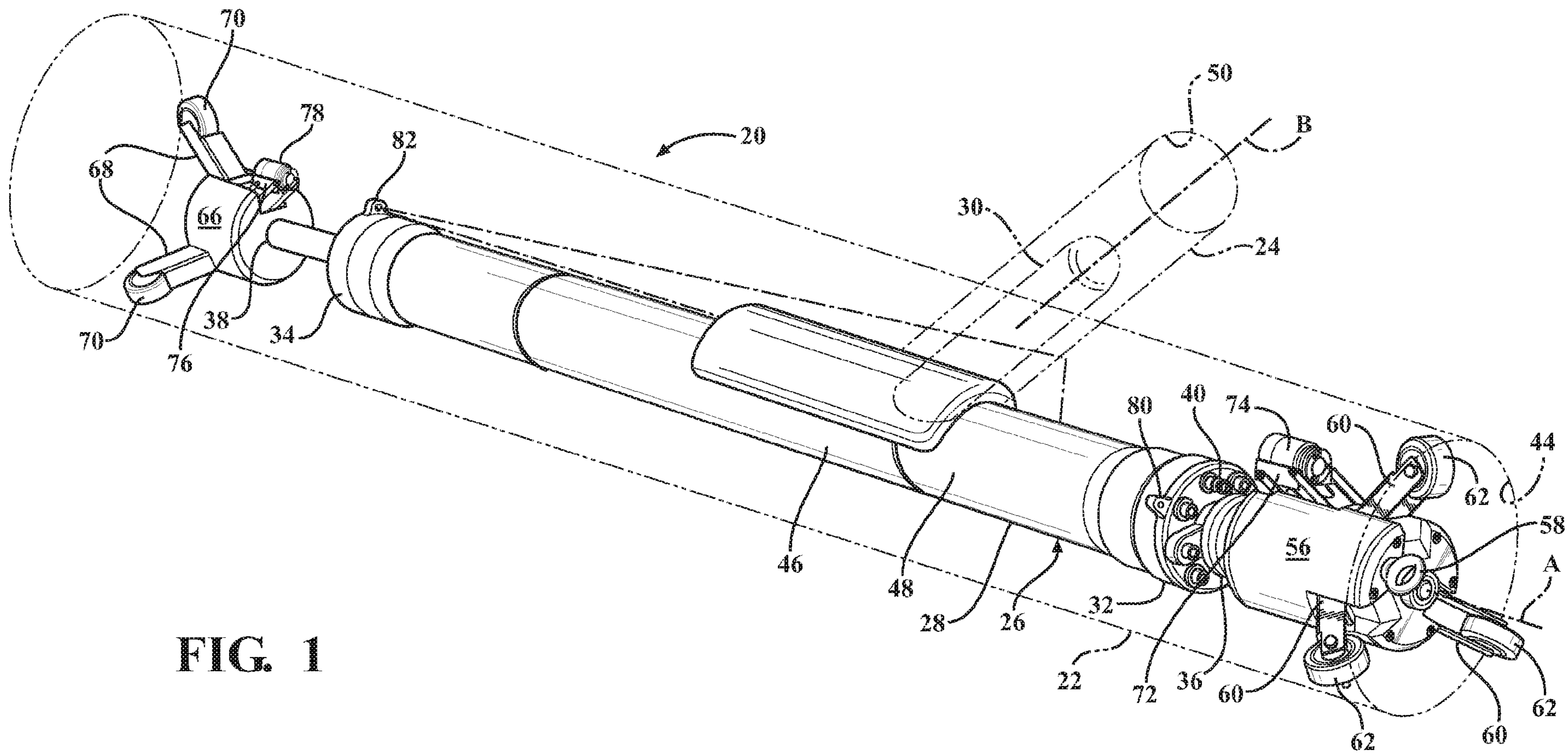


FIG. 1