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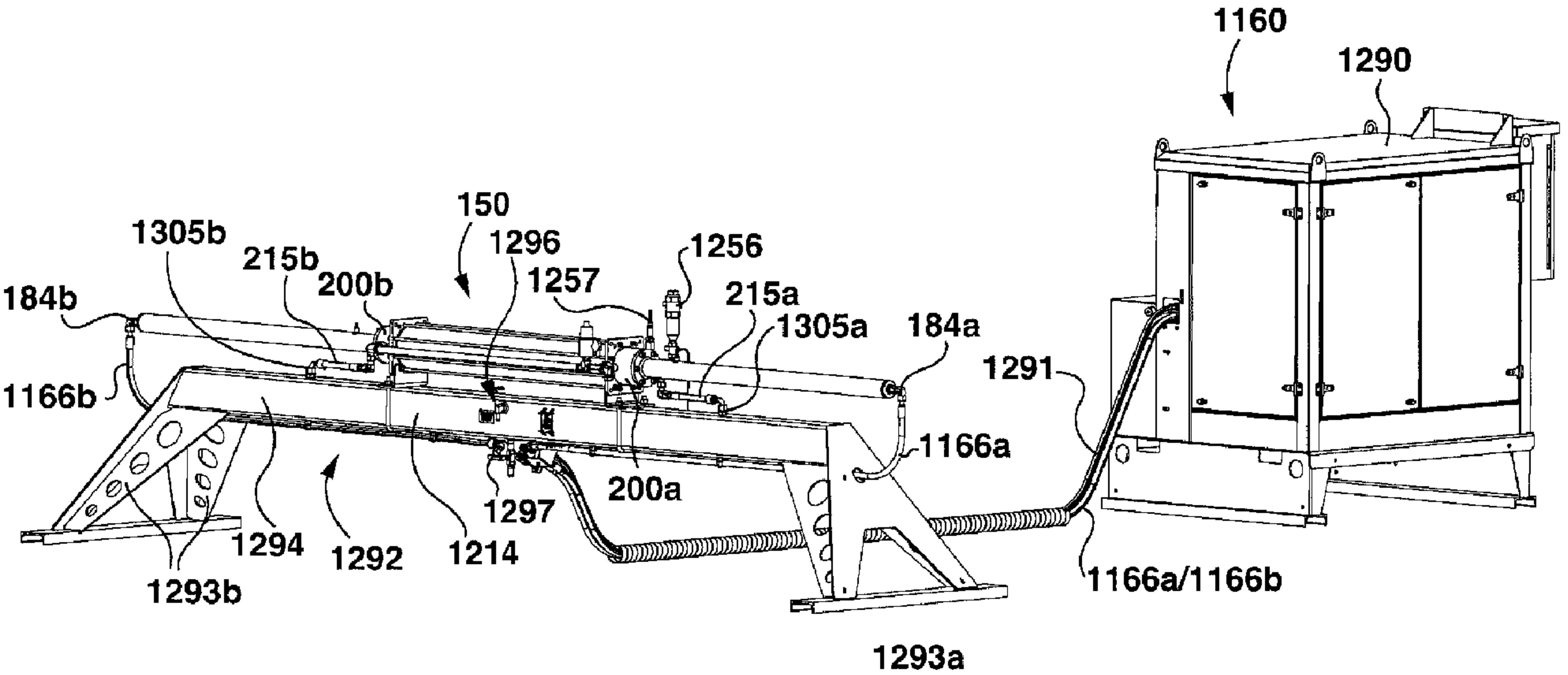

(57) Abrégé/Abstract:
A gas compressor system is disclosed which may have a driving fluid cylinder has a driving fluid chamber adapted for containing a driving fluid therein. The driving fluid cylinder may also have a driving fluid piston movable within the driving fluid chamber. The system may also include a gas compression cylinder having a gas compression chamber adapted for holding a gas therein and a gas piston movable within the gas compression chamber. A buffer chamber may be located between the driving fluid chamber and the gas compression chamber, and may be adapted to inhibit movement of at least one non-driving fluid component, when gas is located within the gas compression chamber, from the gas compression chamber into the driving fluid chamber. The buffer chamber may include a buffer gas which may be maintained at a pressure higher than the pressure reached in the gas compression chamber.

ABSTRACT

A gas compressor system is disclosed which may have a driving fluid cylinder has a driving fluid chamber adapted for containing a driving fluid therein. The driving fluid cylinder may also have a driving fluid piston movable within the driving fluid chamber. The system may also include a gas compression cylinder having a gas compression chamber adapted for holding a gas therein and a gas piston movable within the gas compression chamber. A buffer chamber may be located between the driving fluid chamber and the gas compression chamber, and may be adapted to inhibit movement of at least one non-driving fluid component, when gas is located within the gas compression chamber, from the gas compression chamber into the driving fluid chamber. The buffer chamber may include a buffer gas which may be maintained at a pressure higher than the pressure reached in the gas compression chamber.

GAS COMPRESSOR

TECHNICAL FIELD

[0001] The present disclosure relates to gas compressors driven by a driving fluid such as a hydraulic fluid, including hydraulic gas compressors driven by hydraulic fluid that are used in oil and gas field applications.

BACKGROUND

[0002] Various different types of gas compressors to compress a wide range of gases are known. Hydraulic gas compressors in particular are used in a number of different applications. One such category of, and application for, a is a gas compressor employed in connection with the operation of oil and gas producing well systems. When oil is extracted from a reservoir using a well and pumping system, it is common for natural gas, often in solution, to also be present within the reservoir. As oil flows out of the reservoir and into the well a wellhead gas may be formed as it travels into the well and may collect within the well and /or travel within the casing of the well. The wellhead gas may be primarily natural gas and also includes impurities such as water, hydrogen sulphide, crude oil, and natural gas liquids (often referred to as condensate).

[0003] The presence of natural gas within the well can have negative impacts on the functioning of an oil and gas producing well system. It can for example create a back pressure on the reservoir at the bottom of the well shaft that inhibits or restricts the flow of oil to the well pump from the reservoir. Accordingly, it is often desirable to remove the natural gas from the well shaft to reduce the pressure at the bottom of the well shaft particularly in the vicinity of the well pump. Natural gas that migrates into the casing of the well shaft may be drawn upwards - such as by venting to atmosphere or connecting the casing annulus to a pipe that allows for gas to flow out of the casing annulus. To further improve the flow of gas out of the casing annulus and reduce the pressure of the gas at the bottom of the well shaft, the natural gas flowing from the casing annulus may be compressed by a gas compressor and then may be utilized at the site of the well and/or transported for use elsewhere. The use of a gas compressor will further tend to create a lower pressure at the top of the well shaft compared to the bottom of the well shaft, assisting in the flow of natural gas upwards within the well bore and casing.

[0004] There are concerns in using hydraulic gas compressors in oil and gas field environments, relating to the potential contamination of the hydraulic fluid in the hydraulic cylinder of a gas compressor from components of the natural gas that is being compressed.

[0005] Improved gas compressors are desirable, including gas compressors employed in connection with oil and gas field operations including in connection with oil and gas producing wells.

SUMMARY

[0006] In one embodiment, the present disclosure relates to a gas compressor system that comprises a driving fluid cylinder having a driving fluid chamber adapted for containing a driving fluid therein, and a driving fluid piston movable within the driving fluid chamber. A gas compression cylinder having a gas compression chamber adapted for holding a gas therein and a gas piston movable within the gas compression chamber. A buffer chamber located between the driving fluid chamber and the gas compression chamber, the buffer chamber adapted to inhibit movement of at least one non-driving fluid component, when gas is located within the gas compression chamber, from the gas compression chamber into the driving fluid chamber.

[0007] In another embodiment, the present disclosure relates to a gas compressor system that comprises a first driving fluid cylinder having a first driving fluid chamber adapted for containing a first driving fluid therein, and a first driving fluid piston movable within the first driving fluid chamber. A gas compression chamber adapted for holding a gas therein and a gas piston movable within the gas compression chamber. A first buffer chamber located between the first driving fluid chamber and a first section of the gas compression chamber. A second driving fluid cylinder having a second driving fluid chamber adapted for containing a second driving fluid therein, and a second driving fluid piston movable within the second driving fluid chamber. A second buffer chamber located between the first driving fluid chamber and a second section of the gas compression chamber. The first buffer chamber is adapted to inhibit movement of at least one non-driving fluid component, when gas is located within a first section of the gas compression chamber, from the first section gas compression chamber section into the first driving fluid chamber. The second buffer chamber is adapted to inhibit movement of at least one non-driving fluid component, when gas is located within a second section of the gas compression chamber, from the second section of the gas compression chamber into the second driving fluid chamber.

[0008] In another embodiment, the present disclosure relates to a gas compressor that comprises a driving fluid cylinder having a driving fluid chamber operable for containing a driving fluid therein and a driving fluid piston movable within the driving fluid chamber. A gas compression cylinder having a gas compression chamber operable for holding a gas therein and a gas piston movable within the gas compression chamber. A buffer chamber located between the driving fluid chamber and the gas compression chamber, the buffer chamber configured and operable to inhibit movement of at least one non-driving fluid component from the gas compression chamber to substantially avoid contamination of the driving fluid, when gas is located within the gas compression chamber.

[0009] In another embodiment, the present disclosure relates to a gas compressor that comprises a driving fluid cylinder having a driving fluid chamber operable for containing a driving fluid therein and a driving fluid piston movable within the driving fluid chamber. A gas compression cylinder having a gas compression chamber operable for holding natural gas therein and a gas piston movable within the gas compression chamber. A buffer chamber located between the driving fluid chamber and the gas compression chamber, the buffer chamber containing a non-natural gas component so as to substantially avoid contamination of the driving fluid in the driving fluid chamber, when gas is located within the gas compression chamber.

BRIEF DESCRIPTION OF THE DRAWINGS

[0010] In the figures, which illustrate example embodiments:

[0011] **FIG. 1**. is a schematic view of an oil and gas producing well system;

[0012] **FIG. 1A**. is an enlarged schematic view of a portion of the system of **FIG. 1**;

[0013] **FIG. 1B** is an enlarged view of part of the system of **FIG. 1**;

[0014] **FIG. 1C** is an enlarged view of another part of the system of **FIG. 1**;

[0015] **FIG. 1D** is a schematic view of an oil and gas well producing system like the system of **FIG. 1** but with an alternate lift system;

[0016] **FIG. 2** is a side view of a gas compressor forming part of the system of **FIG. 1**;

[0017] **FIG. 3** (i) to (iv) are side views of the gas compressor or **FIG. 2** showing a cycle of operation;

[0018] **FIG.** 4 is a schematic side view of the gas compressor of **FIG. 2**;

[0019] **FIG. 5** is a perspective view a gas compressor system including the gas compressor of **FIG. 2** forming part of an oil and gas producing well systems of **FIG. 1 or 1D**;

[0020] **FIG. 6** is a perspective view of a potion of the gas compressor system of **FIG. 5** with some parts thereof exploded;

[0021] **FIG. 7** is a schematic diagram of the gas compressor system of **FIG. 8**;

[0022] **FIG. 8** is a perspective exploded view of a gas compressor substantially like the gas compressor of **FIG. 2**;

[0023] **FIG. 8A** is enlarged view of the portion marked **FIG. 8A** in **FIG. 8**;

[0024] **FIG. 8B** is enlarged view of the portion marked **FIG. 8B** in **FIG. 8**;

[0025] **FIG. 9A** is a perspective view of the gas compressor of **FIG. 2**;

[0026] **FIG. 9B** is a top view of the gas compressor of **FIG. 2**;

[0027] **FIG. 9C** is a side view of the gas compressor of **FIG. 2**.

DETAILED DESCRIPTION

[0028] With reference to **FIGS. 1, 1A, 1B** and **1C**, an example oil and gas producing well system **100** is illustrated schematically that may be installed at, and in, a well shaft (also referred to as a well bore) **108** and may be used for extracting liquid and/or gases (e.g. oil and/or natural gas) from an oil and gas bearing reservoir **104**.

[0029] Extraction of liquids including oil as well as other liquids such as water from reservoir **104** may be achieved by operation of a down-well pump **106** positioned at the bottom of well shaft **108**. For extracting oil from reservoir **104**, down-well pump **106** may be operated by the up-and-down reciprocating motion of a sucker rod **110** that extends through the well shaft **108** to and out of a well head **102**. It should be noted that in some applications, well shaft **108** may not be oriented entirely vertically, but may have horizontal components and/or portions to its path.

[0030] Well shaft **108** may have along its length, one or more generally hollow cylindrical tubular, concentrically positioned, well casings **120a, 120b, 120c**, including an inner-most production casing **120a** that may extend for substantially the entire length of the well shaft **108.** Intermediate casing **120b** may extend concentrically outside of production casing **120a** for a substantial length of the well shaft **108,** but not to the same depth as production casing **120a**. Surface casing **120c** may extend concentrically around both production casing **120a** and intermediate casing **120b**, but may only extend from proximate the surface of the ground level, down a relatively short distance of the well shaft **108**. The casings **120a, 120b, 120c** may be made from one or more suitable materials such as for example steel. Casings **120a, 120b, 120c** may function to hold back the surrounding earth / other material in the sub-surface to maintain a generally cylindrical tubular channel through the sub-surface into the oil / natural gas bearing formation **104**. Casings **120a, 120b, 120c** may each be secured and sealed by a respective outer cylindrical layer of material such as layers of cement **111a, 111b, 111c** which may be formed to surround casings **120a-120c** in concentric tubes that extend substantially along the length of the respective casing **120a-120c**. Production tubing **113** may be received inside production casing **120a** and may be generally of a constant diameter along its length and have an inner tubing passageway / annulus to facilitate the communication of liquids (eg. oil) from the bottom region of well shaft **108** to the surface region. Casings **120a-120c** generally, and casing **120a** in particular, can protect production tubing **120** from corrosion, wear/damage from use. Along with other components that constitute a production string, a continuous passageway (a tubing annulus) **107** from the region of pump **106** within the reservoir **104** to well head **102** is provided by production tubing **113**. Tubing annulus **107** provides a passageway for sucker rod **110** to extend and within which to move and provides a channel for the flow of liquid (oil) from the bottom region of the well shaft **108** to the region of the surface.

[0031] An annular casing passageway or gap **121** (referred to herein as a casing annulus) is typically provided between the inward facing generally cylindrical surface of the production casing **120a** and the outward facing generally cylindrical surface of production tubing **113**. Casing annulus **121** typically extends along the co-extensive length of inner casing **120a** and production tubing **113** and thus provides a passageway / channel that extends from the bottom region of well shaft **108**

proximate the oil / gas bearing formation **104** to the ground surface region proximate the top of the well shaft **108**. Natural gas (that may be in liquid form in the reservoir **104**) may flow from reservoir **104** into the well shaft **108** and may be, or transform into, a gaseous state and then flow upwards through casing annulus **121** towards well head **102**. In some situations, such as with a newly formed well shaft **108**, the level of the liquid (mainly oil and natural gas in solution) may actually extend a significant way from the bottom/end of the well shaft **108** to close to the surface in both the tubing annulus **107** and the casing annulus **121**, due to relatively high downhole pressures.

[0032] Down-well pump **106** may have a plunger **103** that is attached to the bottom end region of sucker rod **110** and plunger **103** may be moved downwardly and upwardly within a pump chamber by sucker rod **110**. Down well pump **106** may include a one way travelling valve **112** which is a mobile check valve which is interconnected with plunger **103** and which moves in up and down reciprocating motion with the movement of sucker rod **110**. Down well pump **106** may also include a one way standing intake valve **114** that is stationary and attached to the bottom of the barrel of pump **106** / production tubing **113**. Travelling valve **112** keeps the liquid (oil) in the channel **107** of production tubing **113** during the upstroke of the sucker rod **110**. Standing valve **114** keeps the fluid (oil) in the channel **107** of the production tubing **113** during the downstroke of sucker rod **110**. During a downstroke of sucker rod **110** and plunger **103,** travelling valve **112** opens, admitting liquid (oil) from reservoir **104** into the annulus of production tubing **113** of down-well pump **106**. During this downstroke, one-way standing valve **114** at the bottom of well shaft **108** is closed, preventing liquid (oil) from escaping.

[0033] During each upstroke of sucker rod **110**, plunger **103** of down-well pump **106** is drawn upwardly and travelling valve **112** is closed. Thus, liquid (oil) drawn in through one-way valve **112** during the prior downstroke can be raised. And as standing valve **114** opens during the upstroke, liquid (oil) can enter production tubing **113** below plunger **103** through perforations **116** in production casing **120a** and cement layer **111a**, and past standing valve **114**. Successive upstrokes of down-well pump **106** form a column of liquid/oil in well shaft **108** above down-well pump **106**. Once this column of liquid/oil is formed, each upstroke pushes a volume of oil toward the surface and well head **102**. The liquid/oil, eventually reaches a T-junction device **140** which has connected thereto an oil flow line **133**. Oil flow line **133** may contain a valve device **138** that is configured to permit oil to flow only towards a T-junction interconnection **134** to be mixed with compressed natural gas from piping **130** that is delivered from a gas compressor system **126** and then together both flow way in a main oil/gas output flow line **132**.

[0034] Sucker rod **110** may be actuated by a suitable lift system **118** that may for example as illustrated schematically in **FIG. 1**, be a pump jack system **119** that may include a walking beam mechanism **117** driven by a pump jack drive mechanism **120** (often referred to as a prime mover). Prime mover **120** may include a motor **123** that is powered for example by electricity or a supply of natural gas, such as for example, natural gas produced by oil and gas producing well system **100**. Prime move **120** may be interconnected to and drive a rotating counter weigh device **122** that may cause the pivoting movement of the walking beam mechanism **120** that causes the reciprocating upward and downward movement of sucker rod **110**.

[0035] As shown in **FIG. 1D**, lift mechanism **118** may in other embodiments be a hydraulic lift system **1119** that includes a hydraulic fluid based power unit **1120** that supplies hydraulic fluid through a fluid supply circuit to a master cylinder apparatus **1117** to controllably raise and lower the sucker rod **110**. The power unit **1120** may include a suitable controller to control the operation of the hydraulic lift system **1119**.

[0036] With reference to **FIGS. 1** to **1C**, natural gas exiting from annulus **121** of casing **120** may be fed by suitable piping **124** through valve device **128** to inter-connected gas compressor system **126**. Piping **124** may be made of any suitable material(s) such as steel pipe or flexible hose such as Aeroquip FC 300 AOP elastomer tubing made by Eaton Aeroquip LLC. In normal operation of system **100**, the flow of natural gas communicated through piping **124** to gas compressor system

126 is not restricted by valve device **128** and the natural gas will flow there through. Valve **128** may be closed (eg. manually) if for some reason it is desired to shut off the flow of natural gas from annulus **121**.

[0037] Compressed natural gas that has been compressed by gas compressor system **126** may be communicated via piping **130** through a one way check valve device **131** to interconnect with oil flow line **133** to form a combined oil and gas flow line **132** which can deliver the oil and gas therein to a destination for processing and/or use. Piping **130** may be made of any suitable material(s) such as steel pipe or flexible hose such as Aeroquip FC 300 AOP elastomer tubing made by Eaton Aeroquip LLC.

[0038] Gas compressor system **126** may include a gas compressor **150** that is driven by a driving fluid. As indicated above, natural gas from casing annulus **121** of well shaft **108** may be supplied by piping **124** to gas compressor system **126**. Natural gas may be compressed by gas compressor **150** and then communicated via piping **130** through a one way check valve device **131** to interconnect with oil flow line **133** to form combined oil and gas flow line **132.**

[0039] The driving fluid for driving gas compressor **150** may be any suitable fluid such as a fluid that is substantially incompressible, and may contain anti-wear additives or constituents. The driving fluid may, for example, be a suitable hydraulic fluid. For example, the hydraulic fluid may be SKYDROL ™ aviation fluid manufactured by Solutia Inc. The hydraulic fluid may for example be a fluid suitable as an automatic transmission fluid, a mineral oil, a bio-degradable hydraulic oil, or other suitable synthetic or semi-synthetic hydraulic fluid.

[0040] Hydraulic gas compressor **150** may be in hydraulic fluid communication with a hydraulic fluid supply system which may provide an open loop or closed loop hydraulic fluid supply circuit. For example gas compressor **150** may in hydraulic fluid communication with a hydraulic fluid supply system **1160** as depicted in **FIG. 10.**

[0041] Turning now to **FIGS. 2** and **7,** hydraulic gas compressor **150** may have first and second, one-way acting, hydraulic cylinders **152a, 152b** positioned at opposite ends of hydraulic gas compressor **150**. Cylinders **152a, 152b** are each configured to provide a driving force that acts in an opposite direction to each other, both acting inwardly towards each other and towards a gas compression cylinder **180**. Thus, positioned generally inwardly between hydraulic cylinders **152a, 152b** is gas compression cylinder **180**. Gas compression cylinder **180** may be divided into two gas compression chamber sections **181a, 181b** by a gas piston **182**. In this way, gas such as natural gas in each of the gas chamber sections **181a, 181b**, may be alternately compressed by alternating, inwardly directed driving forces of the hydraulic cylinders **152a, 152b** driving the reciprocal movement of gas piston **182** and piston rod **194**

[0042] Gas compression cylinder **180** and hydraulic cylinders **152a**, **152b** may have generally circular cross-sections although alternately shaped cross sections are possible in some embodiments.

[0043] Hydraulic cylinder **152a** may have a hydraulic cylinder base **183a** at an outer end thereof. A first hydraulic fluid chamber **186a** may thus be formed between a cylinder barrel / tubular wall **187a**, hydraulic cylinder base **183a** and hydraulic piston **154a**. Hydraulic cylinder base **183a** may have a hydraulic input/output fluid connector **1184a** that is adapted for connection to hydraulic fluid communication line **1166a.** Thus hydraulic fluid can be communicated into and out of first hydraulic fluid chamber **186a**.

[0044] At the opposite end of gas compressor **150**, is a similar arrangement. Hydraulic cylinder **152b** has a hydraulic cylinder base **183b** at an outer end thereof. A second hydraulic fluid chamber **186b** may thus be formed between a cylinder barrel / tubular wall **187b**, hydraulic cylinder base **183b** and hydraulic piston **154b**. Hydraulic cylinder base **183b** may have an input /output fluid connector **1184b** that is adapted for connection to a hydraulic fluid communication line **1166b**. Thus hydraulic fluid can be communicated into and out of second hydraulic fluid chamber **186b**.

[0045] In embodiments such as is illustrated in **FIG. 7**, the driving fluid connectors **1184a, 1184b** may each connect to a single hydraulic line **1166a, 1166b** that may, depending upon the operational configuration of the system, either be communicating hydraulic fluid to, or communicating hydraulic fluid away from, each of hydraulic fluid chamber **186a** and hydraulic fluid chamber **186b,** respectively. However, other configurations for communicating hydraulic fluid to and from hydraulic fluid chambers **186a, 186b** are possible.

[0046] As indicated above, gas compression cylinder **180** is located generally between the two hydraulic cylinders **152a, 152b**. Gas compression cylinder **180** may be divided into the two adjacent gas chamber sections **181a, 181b** by gas piston **182**. First gas chamber section **181a** may thus be defined by the cylinder barrel / tubular wall **190**, gas piston **182** and first gas cylinder head **192a**. The second gas chamber section **181b** may thus be defined by the cylinder barrel / tubular wall **190**, gas piston **182** and second gas cylinder head **192b** and formed on the opposite side of gas piston **182** to first gas chamber section **181a**.

[0047] The components forming hydraulic cylinders **154a, 154b** and gas compression cylinder **180** may be made from any one or more suitable materials. By way of example, barrel **190** of gas compression cylinder **180** may be formed from chrome plated steel; the barrel of hydraulic cylinders **152a, 152b**, may be made from a suitable steel; gas piston **182** may be made from T6061aluminum; the hydraulic pistons **154a, 154b** may be made generally from ductile iron; and piston rod **194** may be made from induction hardened chrome plated steel.

[0048] The diameter of hydraulic pistons **154a, 154b** may be selected dependent upon the required output gas pressure to be produced by gas compressor **150** and a diameter (for example about 3 inches) that is suitable to maintain a desired pressure of hydraulic fluid in the hydraulic fluid chambers **186a, 186b** (for example – a maximum pressure of about 2800 psi).

[0049] Hydraulic pistons **154a, 154b** may also include seal devices **196a, 196b** respectively at their outer circumferential surface areas to provide fluid / gas seals with the inner wall surfaces of respective hydraulic cylinder barrels **187a, 187b** respectively. Seal devices **196a, 196b**, may substantially prevent or inhibit movement of hydraulic fluid out of hydraulic fluid chambers **186a, 186b** during operation of hydraulic gas compressor **150** and may prevent or at least inhibit the migration of any gas/liquid that may be in respective adjacent buffer chambers **195a, 195b** (as described further hereafter) into hydraulic fluid chambers **186a, 186b**.

[0050] Also with reference now to **FIGS. 8, 8A and 8B**, hydraulic piston seal devices **196a, 196b** may include a plurality of olytetrafluoroethylene (PTFE) (eg.Teflon (TM) seal rings and may also include Hydrogenated nitrile butadiene rubber (HNBR) energizers / energizing rings for the seal rings. A mounting nut **188a 188b** may be threadably secured to the opposite ends of piston rod 194 and may function to secure the respective hydraulic pistons **154a, 154b** onto the end of piston rod **194.**

[0051] The diameter of the gas piston **182** and corresponding inner surface of gas cylinder barrel **190** will vary depending upon the required volume of gas and may vary widely (eg. from about 6 inches to 12 inches or more). In one example embodiment, hydraulic pistons **154a, 154b** have a diameter of 3 inches; piston rod **194** has a diameter or 2.5 inches and gas piston **182** has a diameter of 8 inches.

[0052] Gas piston **182** may also include a conventional gas compression piston seal device at its outer circumferential surfaces to provide a seal with the inner wall surface of gas cylinder barrel **190** to substantially prevent or inhibit movement of natural gas and any additional components associated with the natural gas, between gas compression cylinder sections **181a, 181b**. Gas piston seal device may also assist in maintaining the gas pressure differences between the adjacent gas compression cylinder sections **181a, 181b,** during operation of hydraulic gas compressor **150**.

[0053] As noted above, hydraulic pistons **154a, 154b** may be formed at opposite ends of a piston rod **194.** Piston rod **194** may pass through gas compression cylinder sections **181a, 181b** and pass through a sealed (eg. by welding) central axial opening **191** through gas piston **182** and be configured and adapted so that gas piston **182** is fixedly and sealably mounted to piston rod **194.**

[0054] Piston rod **194** may also pass through axially oriented openings in head assemblies **200a, 200b** that may be located at opposite ends of gas cylinder barrel **190**. Thus, reciprocating axial / longitudinal movement of piston rod **194** will result in reciprocating synchronous axial / longitudinal movement of each of hydraulic pistons **154a, 154b** in respective hydraulic fluid chambers **186a, 186b**, and of gas piston **182** within gas compression chamber sections **181a, 181b** of gas compression cylinder **180**.

[0055] Located on the inward side of hydraulic piston **154a**, within hydraulic cylinder **154a**, between hydraulic fluid chamber **186a** and gas compression cylinder section **181a**, may be located first buffer chamber **195a**. Buffer chamber **195a** may be defined by an inner surface of hydraulic piston **154a**, the cylindrical inner wall surface of hydraulic cylinder barrel **187a**, and hydraulic cylinder head **189a**.

[0056] Similarly, located on the inward side of hydraulic piston **154b** , within hydraulic cylinder **154b,** between hydraulic fluid chamber **186b** and gas compression cylinder section **181b**, may be located second buffer chamber **195b**. Buffer chamber **195b** may be defined by an inner surface of hydraulic piston **154b**, the cylindrical inner wall surface of cylinder barrel **187b**, and hydraulic cylinder head **189b**.

[0057] As hydraulic pistons **154a, 154b** are mounted at opposite ends of piston rod **194**, piston rod **194** also passes through buffer chambers **195a, 195b.**

[0058] With particular reference now to **FIGS. 2, 6, 8, 8A-C,** and **9A-C and 13A-C**, head assembly **200a** may include hydraulic cylinder head **189a** and gas cylinder head **192a** and a hollow tubular casing **201a.** Hydraulic cylinder head **189a** may have a generally circular hydraulic cylinder head plate **206a** formed or mounted within casing **201a (FIG. 8B).**

[0059] A barrel flange plate **290a (FIG. 9A)**, hydraulic cylinder head plate **206a (FIG. 8B)** and a gas cylinder head plate **212a** may have casing **201a** disposed there between. Gas cylinder head plate **212a** may be interconnected to an inward end of hollow tubular casing **201a** for example by welds or the two parts may be integrally formed together. In other embodiments, hollow tubular casing **201a** may be integrally formed with both hydraulic cylinder head plate **206a** and gas cylinder head plate **212a.**

[0060] Hydraulic cylinder barrel **187a** may have an inward end **179a**, interconnected such as by welding to the outward facing edge surface of a barrel flange plate **290a.** Barrel flange plate **290a** may be configured as shown in **FIGS. 2, 8,8A-C, and 9A-C.**

[0061] Barrel flange plate **290a** may be connected to the hydraulic cylinder head plate **206a** by bolts **217 (FIG. 8)** received in threaded openings **218** of outward facing surface **213a** of hydraulic head plate 206a (**FIGS. 8** and **8B**). A gas and liquid seal may be created between the mating surfaces of hydraulic head plate **206a** and barrel flange plate **290a**. A sealing device may be provided between these plate surfaces such as TEFLON hydraulic seals and buffers.

[0062] Gas cylinder barrel **190** may have an end **155a** (**FIG. 8B**) interconnected to the inward facing surface of gas cylinder head plate **212a** such as by passing first threaded ends of each of the plurality of tie rods **193** through openings in head plate **212a** and securing them with nuts **168**.

[0063] Piston rod **194** may have a portion that moves longitudinally within the inner cavity formed through openings within barrel flange plate **290a,** hydraulic cylinder head plate **206a** and gas cylinder head plate **212a** and within tubular casing **210a**.

[0064] A structure and functionality corresponding to the structure and functionality just described in relation to hydraulic cylinder **152a**, buffer chamber **195a**, and gas compression cylinder section **181a**, may be provided on the opposite side of hydraulic gas compression cylinder **150** in relation to hydraulic cylinder **152b**, buffer chamber **195b**, and gas compression cylinder section **181b**.

[0065] Thus with particular reference to **FIGS. 8, 8A and 8B**, head assembly **200b** may include hydraulic cylinder head **189b,** gas cylinder head **192b** and a hollow tubular casing **201b.** Hydraulic cylinder head **189b** may have a hydraulic cylinder head plate **206b** formed or mounted within casing **201b (FIG. 8A)**

[0066] A barrel flange plate **290b** /hydraulic cylinder head plate **206b** and a gas cylinder head plate **212b (FIGS. 8** and **8A)** may have casing **201b** generally disposed there between. Gas cylinder head plate **212b** may be interconnected to hollow tubular casing **201b** for example by welds or the two parts may be integrally formed together. In other embodiments, hollow tubular casing **201b** may be integrally formed with hydraulic cylinder head plate **206b** and gas cylinder head plate **212b.**

[0067] Hydraulic cylinder barrel **187b** (**FIG. 9A**) may have an inward end **179b**, interconnected such as by welding to the outward facing edge surface of a barrel flange plate **290b**. Barrel flange plate **290b** may also be configured as shown in **FIGS. 2, 8, 8A-C, and FIGS. 9A-C**.

[0068] Barrel flange plate **290b** may be connected to the hydraulic cylinder head plate **206b** by bolts **217** received in threaded openings **218b** of outward facing surface **213b** of hydraulic head plate **206b (FIG. 9B).** A gas and liquid seal may be created between the mating surfaces of hydraulic head plate **206b** and barrel flange plate **290b**. A sealing device may be provided between these plate surfaces such as TEFLON hydraulic seals and buffers.

[0069] Gas cylinder barrel **190** may have an end **155b** (**FIG. 9A**) interconnected to the inward facing surface of gas cylinder head plate **212b** such as by passing first threaded ends of each of the plurality of tie rods **193** through openings in head plate **212b** and securing them with nuts **168**.

[0070] Piston rod **194** may have a portion that moves longitudinally within the inner cavity formed through openings within hydraulic cylinder head plate **206b** and gas cylinder head plate **212b** and within tubular casing **210b**.

[0071] With particular reference now to **FIGS. 8, 8A** and **8B**, two head sealing O-rings **308a, 308b** may be provided and which may be made from highly saturated nitrile-butadiene rubber (HNBR). One O-ring **308a** may be located between a first circular edge groove **216a** at end **155a** of gas cylinder barrel **190** and the inward facing surface of gas cylinder head plate **212a.** O-ring **308a** may be retained in a groove in the inward facing surface of gas cylinder head plate **212a**. O-ring **308b** may be located between a second opposite circular edge groove **216b** of at the opposite end of gas cylinder barrel **190** and the inward facing surface of gas cylinder head plate **212b.** O-ring **308b** may be retained in a groove in the inward facing surface of gas cylinder head plate **212b.** In this way gas seals are provided between gas compression chamber sections**181a, 181b** and their respective gas cylinder head plates **212a, 212b.**

[0072] By securing threaded both opposite ends of each of the plurality of tie rods **193** through openings in gas cylinder head plates **212a**, **212b** and securing them with nuts **168**, tie rods **193** will function to tie together the head plates **212a** and **212b** with gas cylinder barrel **190** and O-rings **308a, 308b** securely held there between and providing a sealed connection between cylinder barrel **190** and head plates **212a, 212b.**

[0073] Seal / wear devices **198a, 198b** may be provided within casing **201a** to provide a seal around piston rod **194** and with an inner surface of casing **201a** to prevent or limit the movement of natural gas out of gas compression cylinder section

181a, into buffer chamber **195a**. Corresponding seal / wear devices may be provided within casing **201b** to provide a seal around piston rod **194** and with an inner surface of casing **201b** to prevent or limit the movement of natural gas out of gas compression cylinder section **181b**, into buffer chamber **195b.** These seal devices**198a, 198b** may also prevent or at least limit/inhibit the movement of other components (such as contaminants) that have been transported with the natural gas from well shaft **108** into gas compression cylinder sections **181a**, **181b**, from migrating into respective buffer chambers **195a, 195b.**

[0074] While in some embodiments, the gas pressure in gas compression chamber sections **181a, 181b** will remain generally, if not always, above the pressure in the adjacent respective buffer chambers **195a, 195b**, the seal / wear devices **198a, 198b** may in some situations prevent migration of gas and/or liquid that may be in buffer chambers **195a, 195b** from migrating into respective gas compression chamber sections **181a 181b**. The seal / wear devices **198a, 198b** may also assist to guide piston rod **194** and keep piston rod **194** centred in the casings **201a, 201b** and absorb transverse forces exerted upon piston rod **194.**

[0075] Also, with particular reference to **FIGS. 8, 8A and 8B**, each seal device **198a, 198b** may be mounted in a respective casing **201a, 201b**. Associated with each head assembly **200a, 200b** may also be a rod seal retaining nut **151** which may be made from any suitable material, such as for example aluminium bronze. A rod seal retaining nut **151** may be axially mounted around piston rod **194**. Rod seal retaining nut **151** may be provided with inwardly directed threads **156.** The threads **156** of rod sealing nut **151** may engage with internal mating threads in opening **153** of the respective casing **201a, 201b**. By tightening rod sealing nut **151,** components of sealing devices **198a, 198b** may be axially compressed within casing **201a, 201b.** The compression causes components of the sealing devices **198a, 1987b** to be pushed radially outwards to engage an inner cylindrical surface of the respective casings **201a, 201b** and radially inwards to engage the piston rod **194**. Thus seal devices **198a, 198b** are provided to function as described above in providing a sealing mechanism.

[0076] As each rod seal retaining nut **151** can be relatively easily unthreaded from engagement with its respective casing **201a, 201b**, maintenance and/or replacement of one or more components of seal devices **198a, 198b** is made easier. Additionally, by turning a rod seal retaining nut **151** may be engaged to thread the rod seal retaining nut further into opening **153** of the casing, adjustments can be made to increase the compressive load on the components of the sealing devices **198a, 198b** to cause them to be being pushed radially further outwards into further and stronger engagement with an inner cylindrical surface of the respective casings **201a, 201b** and further inwards to engage with the piston rod 194. Thus the level of sealing action / force provided by each seal device **198a, 198b** may be adjusted.

[0077] However, even with an effective seal provided by the sealing devices **198a, 198b**, it is possible that small amounts of natural gas, and/or other components such as hydrogen sulphide, water, oil may still at least in some circumstances be able to travel past the sealing devices **198a, 198b** into respective buffer chambers **195a, 195b** For example, oil may be adhered to the surface of piston rod **194** and during reciprocating movement of piston rod **194**, it may carry such other components from the gas compression cylinder section **181a, 181b** past sealing devices **198a, 198b**, into an area of respective cylinder barrels **187a, 187b** that provide respective buffer chambers **195a, 195b**. High temperatures that typically occur within gas compression chamber sections **181a, 181b** may increase the risk of contaminants being able to pass seal devices 198a, 198b. However buffer chambers **195a, 195b** each provide an area that may tend to hold any contaminants that move from respective gas compression chamber sections **181a, 181b** and restrict the movement of such contaminants into the areas of cylinder barrels that provide hydraulic cylinder fluid chambers **186a, 186b.**

[0078] Mounted on and extending within cylinder barrel **187a** close to hydraulic cylinder head **189a,** is a proximity sensor **157a**. Proximity sensor **157a** is operable such that during operation of gas compressor **150**, as piston **154a** is moving from left to right, just before piston **154a** reaches the position shown in **FIG. 3(i),** proximity sensor **157a** will detect the presence of hydraulic piston **154a** within hydraulic cylinder **152a** at a longitudinal position that is shortly before the end of the stroke. Sensor **157a** will then send a signal to controller **200**, in response to which controller **200** can take steps to change the operational mode of hydraulic fluid supply system **1160 (FIG. 7)**.

[0079] Similarly, mounted on and extending within cylinder barrel **187b** close to hydraulic cylinder head **189b**, is another proximity sensor **157b**. Proximity sensor **157b** is operable such that during operation of gas compressor **150**, as piston **154b** is moving from right to left, just before piston **154b** reaches the position shown in **FIG. 5(iii),** proximity sensor **157b** will detect the presence of hydraulic piston **154b** within hydraulic cylinder **152b** at a longitudinal position that is shortly before the end of the stroke. Proximity sensor **157b** will then send a signal to controller **200**, in response to which controller **200** can take steps to change the operational mode of hydraulic fluid supply system **1160.**

[0080] Proximity sensors **157a, 157b** may be in communication with controller **200**. In some embodiments, proximity sensors **157a, 157b** may be implemented using inductive proximity sensors, such as model BI 2--M12-Y1X-H1141 sensors manufactured by Turck, Inc. These inductive sensors are operable to generate proximity signals responsive to the proximity of a metal portion of piston rod **194** proximate to each of hydraulic piston **154a, 154b**. For example sensor rings may be attached around piston rod **194** at suitable positions towards, but spaced from, hydraulic pistons **154a, 154b** respectively such as annular collar **199b** in relation to hydraulic piston **154b** - **FIGS. 6** and **8**. Proximity sensors **157a, 157b** may detect when collars 199a, 199b on piston rod 194 pass by. Steel annular collars 199a, 199b may be mounted to piston rod **194** and may be held on piston rod 194 with set screws and a LOCTITE ™ adhesive made by Henkel Corporation.

[0081] It is possible for controller **200 (FIG. 7)** to be programmed in such manner to control the hydraulic fluid supply system **1160** in such a manner as to provide for a relatively smooth slowing down, a stop, reversal in direction and speeding up of piston rod **194** along with the hydraulic pistons **154a, 154b** and gas piston **182** as the piston rod **194**, hydraulic pistons **154a, 154b** and gas piston **182** transition between a drive stroke providing movement to the right to a drive stroke providing the stroke to the left and back to a stroke providing movement to the right.

[0082] An example hydraulic fluid supply system **1160** for driving hydraulic pistons **154a, 154b** of hydraulic cylinders **152a, 152b** of hydraulic gas compressor **150** in reciprocating movement is illustrated in **FIG. 7.** Hydraulic fluid supply subsystem **1160** may be a closed loop system and may include a pump unit **1174,** hydraulic fluid communication lines **1163a, 1163b, 1166a, 1166b,** and a hot oil shuttle valve device **1168**. Shuttle valve device **1168** may be for example a hot oil shuttle valve device made by Sun Hydraulics Corporation under model XRDCLNN-AL.

[0083] Fluid communication line **1163a** fluidly connects a port **S** of pump unit **1174** to a port **Q** of shuttle valve **1168**. Fluid communication line **1163b** fluidly connects a port **P** of pump **1174** to a port **R** of shuttle valve **1168**. Fluid communication line **1166a** fluidly connects a port **V** of shuttle valve **1168** to a port **1184a** of hydraulic cylinder **152a**. Fluid communication line **1166b** fluidly connects a port **W** of shuttle valve **1168** to a port **1184b** of hydraulic cylinder **152b**.

[0084] An output port **M** of shuttle valve **1168** may be connected to an upstream end of a bypass fluid communication line **1169** having a first portion **1169a**, a second portion **1169b** and a third portion **1169c** that are arranged in series A filter **1171** may be interposed in bypass line **1169** between portions **1169a** and **1169b**. Filter **1171** may be operable to remove contaminants from hydraulic fluid flowing from shuttle valve device **1168** before it is returned to reservoir **1172**. Filter **1171** may for example include a type HMK05/25 5 micro-m filter device made by Donaldson Company, Inc. The downstream end of line portion **1169b** joins with the upstream end of line portion **1169c** at a T-junction where a downstream end of a pump case drain line **1161** is also fluidly connected. Case drain line **1161** may drain hydraulic fluid leaking within pump unit **1174.** Fluid communication line portion **1169c** is connected at an opposite end to an input port of a thermal valve device **1142**. Depending upon the temperature of the hydraulic fluid flowing into thermal valve device **1142** from communication line portion **1169c** of bypass line **1169**, thermal valve device **1142** directs the hydraulic fluid to either fluid communication line **1141a** or **1141b**. If the temperature of the hydraulic fluid flowing into thermal valve device **1142** is greater than a set threshold level, valve device **1142** will direct the hydraulic fluid through fluid communication line **1141a** to a cooling device **1143** where hydraulic fluid can be cooled before being passed through fluid communication line **1141c** to reservoir **1172**. If the hydraulic fluid entering fluid valve device **1142** does not require cooling, then thermal valve **1142** will direct the hydraulic fluid received therein from communication line portion **1169c** to communication line **1141b** which leads directly to reservoir **1172**. An example of a suitable thermal valve device 1142 is a model 67365-110F made by TTP (formerly Thermal Transfer Products). An example of a suitable cooler 1143 is a a model BOL-16-216943 also made by TTP.

[0085] Drain line **1161** connects output case drain ports **U** and **T** of pump unit **1174** to a T-connection in communication line **1169b** at a location after filter **1171**. Thus any hydraulic fluid directed out of case drain ports **U** / **T** of pump unit **1174** can pass through drain line **1161** to the T-connection of communication line portions **1169b**, **1169c**, (without going through the filter device **1171**) where it can mix with any hydraulic fluid flowing from filter **1171** and then flow to thermal valve device **1142** where it can either be directed to cooler **1143** before flowing to reservoir **1172** or be directed directly to reservoir **1172**. By not passing hydraulic fluid from case drain **1161** through relatively fine filter **1171**, the risk of filter **1171** being clogged can be reduced. It will be noted that filter **1182** provides a secondary filter for fluid that is re-charging pump unit **1174** from reservoir **1172**.

[0086] Hydraulic fluid supply system **1160** may include a reservoir **1172** may utilize any suitable driving fluid, which may be any suitable hydraulic fluid that is suitable for driving the hydraulic cylinders **152a, 152b**.

[0087] Cooler **1143** may be operable to maintain the hydraulic fluid within a desired temperature range, thus maintaining a desired viscosity. For example, in some embodiments, cooler **1143** may be operable to cool the hydraulic fluid when the temperature goes above about **50**℃ and to stop cooling when the temperature falls below about **45**^{0}C. In some applications such as where the ambient temperature of the environment can become very cold, cooler **1143** may be a combined heater and cooler and may further be operable to heat the hydraulic fluid when the temperature reduces below for example about -**10**℃. The hydraulic fluid may be selected to maintain a viscosity generally in hydraulic fluid supply system **1160** of between about **20** and about **40** mm^2s^{-1} over this temperature range.

[0088] Hydraulic pump unit **1174** is generally part of a closed loop hydraulic fluid supply system **1160**. Pump unit **1174** includes outlet ports **S** and **P** for selectively and alternately delivering a pressurized flow of hydraulic fluid to fluid communication lines **1163a** and **1163b** respectively, and for allowing hydraulic fluid to be returned to pump unit **1174** at ports **S** and **P**. Thus hydraulic fluid supply system 1160 may be part of a closed loop hydraulic circuit, except to the extent described hereinafter. Pump unit **1174** may be implemented using a variable-displacement hydraulic pump capable of producing a controlled flow hydraulic fluid alternately at the outlets **S** and **P**. In one embodiment, pump unit **1174** may be an axial piston pump having a swashplate that is configurable at a varying angle α. For example pump unit **1174** may be a HPV-02 variable pump manufactured by Linde Hydraulics GmBH & Co. KG of Germany, a model that is operable to deliver displacement of hydraulic fluid of up to about 55 cubic centimeters per revolution at pressures in the range of 58-145 psi. In other embodiments, the pump unit **1174** may be other suitable variable displacement pump, such as a variable piston pump or a rotary vane pump, for example. For the Linde HPV-02 variable pump, the angle α of the swashplate may be adjusted from a maximum negative angle of about -21°, which may correspond to a maximum flow rate condition at the outlet **S**, to about 0°, corresponding to a substantially no flow condition from either port **S** or **P**, and a maximum positive angle of about +21°, which corresponds to a maximum flow rate condition at the outlet **P**.

[0089] In this embodiment the pump unit **1174** may include an electrical input for receiving a displacement control signal from controller **200**. The displacement control signal at the input is operable to drive a coil of a solenoid (not shown) for controlling the displacement of the pump unit **1174** and thus a hydraulic fluid flow rate produced alternately at the outlets **P** and **S**. The electrical input is connected to a **24**VDC coil within the hydraulic pump **1174**, which is actuated in response to a controlled pulse width modulated (PWM) excitation current of between about **232** mA (i_{0U}) for a no flow condition and about **425** mA (i_U) for a maximum flow condition.

[0090] For the Linde HPV-**02** variable pump unit **1174**, the swashplate is actuated to move to an angle α either +**21**° or **-21**°, only when a signal is received from controller **200**. Controller **200** will provide such a signal to pump unit **1174** based on the position of the hydraulic pistons **154a, 154b** as detected by proximity sensors **157a, 157b** as described above, which provide a signal to the controller **200** when the gas compressor **150** is approaching the end of a drive stroke in one direction, and commencement of a drive stroke in the opposite direction is required.

[0091] Pump unit **1174** may also have be part of a fluid charge system **1180.** Fluid charge system **1180** is operable to maintain sufficient hydraulic fluid within pump unit **1174** and may maintain/hold fluid pressure of for example at least 300 psi at both ports **S** and **P** so as to be able to control and maintain the operation of the main pump so it can function to supply a flow of hydraulic fluid under pressure alternately at ports **S** and **P**.

[0092] Fluid charge system **1180** may include a charge pump that may be a 16cc charge pump supplying for example 6-7 gpm and it may be incorporated as part of pump unit **1174**. Charge system **1180** functions to supply hydraulic fluid as may be required by pump unit **1174**, to replace any hydraulic fluid that may be directed from port **M** of shuttle valve device **1168** through a relief valve associated with shuttle valve device **1168** to reservoir **1172** and to address any internal hydraulic fluid leakage associated with pump unit **1174**. The shuttle valve device **1168** may for example redirect in the range of 3-4 gpm from the hydraulic fluid circuit. The charge pump will then replace the redirected hydraulic fluid 1:1 by maintain a low side loop pressure.

[0093] The relief valve associated with shuttle valve device **1168** will typically only divert to port **M** a very small proportion of the total amount of hydraulic fluid circulating in the fluid circuit and which passes through shuttle valve device **1168** into and out of hydraulic cylinders **152a, 152b**. For example, the relief valve associated with shuttle valve device may only divert approximately 3 to 4 gallons per minute of hydraulic fluid at 200 psi, accounting for example only about 1% of the hydraulic fluid in the substantially closed loop the hydraulic fluid circuit. This allows at least a portion of the hydraulic fluid being circulated to gas compressor **150** on each cycle to be cooled and filtered.

[0094] The charge pump may draw hydraulic fluid from reservoir **1172** on a fluid communication line **1185** that connects reservoir **1172** with an input port **B** of pump unit **1174**. The charge pump of pump unit **1174** then directs and forces that fluid to port **A** where it is then communicated on fluid communication line **1181** to a filter device **1182** (which may for example be a 10 micro-m filter made by Linde.

[0095] Upon passing through filter device **1182** the hydraulic fluid may then enter port **F** of pump unit **1174** where it will be directed to the fluid circuit that supplies hydraulic fluid at ports **S** and **P**. In this way a minimum of 300 psi of pressure of the hydraulic fluid may be maintained during operation at ports **S** and **P**. The charge pressure gear pump may mounted on the rear of the main pump and driven through a common internal shaft.

[0096] In a swashplate pump, rotation of the swashplate drives a set of axially oriented pistons (not shown) to generate fluid flow. In an embodiment of Figure **10**, the swashplate of the pump unit **1174** is driven by a rotating shaft **1173** that is coupled to a prime mover **1175** for receiving a drive torque. In some embodiments, prime mover **1175** is an electric motor but in other embodiments, the prime mover may be implemented in other ways such as for example by using a diesel engine, gasoline engine, or a gas driven turbine.

[0097] Prime mover **1175** is responsive to a control signal received from controller **200** at a control input to deliver a controlled substantially constant rotational speed and torque at the shaft **1173**. While there may be some minor variations in rotational speed, the shaft **1173** may be driven at a speed that is substantially constant and can for a period of time required, produce a substantially constant flow of fluid alternately at the outlet ports **S** and **P**. In one embodiment the prime mover **256** is selected and configured to deliver a rotational speed of about **1750** rpm which is controlled to be substantially constant within about ±1%.

[0098] To alternately drive the hydraulic cylinders **152a, 152b** to provide the reciprocating axial motion of the hydraulic pistons **154a, 154b** and thus reciprocating motion of gas piston **182,** a displacement control signal is sent from controller **200** to pump unit **1174** and a signal is also provided by controller to prime mover **1175.** In response, prime mover **1175** drives rotating shaft **1173**, to drive the swashplate in rotation. The displacement control signal at the input of pump unit **1174** drives a coil of a solenoid (not shown) to cause the angle α of the swashplate to be adjusted to desired angle such as a maximum negative angle of about -21 °, which may correspond to a maximum flow rate condition at the outlet **S** and no flow at outlet **P**. The result is that pressurized hydraulic fluid is driven from port **S** of pump unit **1174** along fluid communication line **1163a** to input port **Q** of shuttle valve device **1168**. The shuttle valve device 1168 with the lower pressure hydraulic fluid at port **R** will be configured such that the pressurized hydraulic fluid flows into port **Q** will flow out port **V** of shuttle valve device **1168** and into and along fluid communication line **1166a**

and then will enter hydraulic fluid chamber **186a** of hydraulic cylinder **152a.** The flow of hydraulic fluid into hydraulic fluid chamber **186a** will cause hydraulic piston **154a** to be driven axially in a manner which expands hydraulic fluid chamber **186a**, thus resulting in movement in one direction of piston rod **194**, hydraulic pistons **154a, 154b** and gas piston **182.**

[0099] During the expansion of hydraulic fluid chamber **186a** as piston **154a** moves within cylinder barrel **187a,** there will be a corresponding contraction in size of hydraulic fluid chamber **186b** of hydraulic cylinder **152b** within cylinder barrel **187b.** This results in hydraulic fluid being driven out of hydraulic fluid chamber **186b** through port **1184b** and into and along fluid communication line **1166b**. The configuration of shuttle valve device **1168** will be such that on this relatively low pressure side, hydraulic fluid can flow into port **W** and out of port **R** of shuttle valve device **1168**, then along fluid communication line **1163b** to port **P** of pump unit **1174**. However, the relief valve associated with shuttle valve device **1168** may in this operational configuration, direct a small portion of the hydraulic fluid flowing along line **1166b** to port **M** for communication to reservoir **1172**, as discussed above. However, most (eg. about 99%) of the hydraulic fluid flowing in communication line **1166b** will be directed to communication line **1163b** for return to pump unit **1174** and enter at port **P**.

[00100] When the hydraulic piston **154a** approaches the end of its drive stroke, a signal is sent by proximity sensor **157a** to controller **200** which causes controller **200** to send a displacement control signal to pump unit **1174.** In response to receiving the displacement control signal at the input of pump unit **1174,** a coil of the solenoid (not shown) is driven to cause the angle α of the swashplate of pump unit **1174** to be altered such as to be set at a maximum negative angle of about +21 °, which may correspond to a maximum flow rate condition at the outlet **P** and no flow at outlet **S**. The result is that pressurized hydraulic fluid is driven from port **P** of pump unit **1174** along fluid communication line **1163b** to port **R** of shuttle valve device **1168**. The configuration of shuttle valve device **1168** will have been adjusted due to the change in relative pressures of hydraulic fluid in lines **1163a** and **1163b**, such that on this relatively high pressure side, hydraulic fluid can flow into port **R** and out of port **W** of shuttle valve device **1168**, then along fluid communication line **1166b** to port **1184b.** Pressurized hydraulic fluid will then enter hydraulic fluid chamber **186b** of hydraulic cylinder **152b**. This will cause hydraulic piston **154b** to be driven in an opposite axial direction in a manner which expands hydraulic fluid chamber **186b**, thus resulting in synchronized movement in an opposite direction of hydraulic cylinders **154a, 154b** and gas piston **182.**

[00101] During the expansion of hydraulic fluid chamber **186b,** there will be a corresponding contraction of hydraulic fluid chamber **186a** of hydraulic cylinder **152a.** This results in hydraulic fluid being driven out of hydraulic fluid chamber **186a** through port **1184a** and into and along fluid communication line **1166a**. The configuration of shuttle valve device **1168** will be such that on what is now now a relatively low pressure side, hydraulic fluid can now flow into port **V** and out of port **Q** of shuttle valve device **1168**, then along fluid communication line **1163a** to port **S** of pump unit **1174**. However, the relief valve associated with shuttle valve device **1168** may in this operational configuration, direct as small portion of the hydraulic fluid flowing along line **1166a** to port **M** for communication to reservoir **1172**, as discussed above. Again most of the hydraulic fluid flowing in communication line **1166a** will be directed to communication line **1163a** for return to pump unit **1174** at port **S** but a small portion (eg. 1%) may be directed by shuttle valve device **1168 to** port **M** for communication to reservoir **1172**, as discussed above. However, most (eg. about 99%) of the hydraulic fluid flowing in communication line **1166a** will be directed to communication line **1163a** for return to pump unit **1174** and enter at port **S**.

[00102] The foregoing describes one cycle which can be repeated continuously for multiple cycles, as may be required during operation of gas compressor system **126**. If a change in flow rate / fluid pressure is required in hydraulic fluid supply system **1160**, to change the speed of movement and increase the frequency of the cycles, controller **200** may send an appropriate signal to prime mover **1175** to vary the output to vary the rotational speed of shaft **1173**. Alternately and/or additionally, controller **200** may send a displacement control signal to the input of pump unit **1174** to drives the solenoid (not shown) to cause a different angle α of the swashplate to provide different flow rate conditions at the port **P** and no flow at outlet **S** or to provide different flow rate conditions at the port **S** and no flow at outlet **P.** If zero flow is required, the swash plate may be moved to an angle of zero degrees.

[00103] Controller **200** may also include an input for receiving a start signal operable to cause the controller **200** to start operation of gas compressor system **126** and outputs for producing a control signal for controlling operation of the prime mover **1175** and pump unit **1174**. The start signal may be provided by a start button within an enclosure that is depressed by an operator on site to commence operation. Alternatively, the start signal may be received from a remotely located controller, which may be communication with the controller via a wireless or wired connection. The controller **200** may be implemented using a microcontroller circuit although in other embodiments, the controller may be implemented as an application specific integrated circuit (ASIC) or other integrated circuit, a digital signal processor, an analog controller, a hardwired electronic or logic circuit, or using a programmable logic device or gate array, for example.

[00104] With reference now to **Figure 4**, it may be appreciated that hydraulic cylinder barrel **187a** may be divided into three zones: (i) a zone ZH dedicated exclusively to holding hydraulic fluid; (ii) a zone ZB dedicated exclusively for the buffer area and (iii) a overlap zone that which, depending upon where the hydraulic piston **154a** is in the stroke cycle, will vary between an area holding hydraulic fluid and an area providing part of the buffer chamber. Hydraulic cylinder barrel **187b** may be divided into a corresponding set of three zones in the same manner with reference to the movement of hydraulic piston **154b**.

[00105] If the length **XBa** (which is the length of the cylinder barrel from gas cylinder head **192a** to the inward facing surface of hydraulic cylinder **154a** at its full right position) is greater than the stroke length **Xs**, then any point **P1**a on piston rod **194** on the piston rod **194** that is at least for part of the stroke within gas compression chamber section **181a,** will not move beyond the distance **XBa** when the gas piston **182** and the hydraulic cylinder **154a** move from the farthermost right positions of the stroke position (1) to the farthermost left positions of the stroke position (2). Thus, any materials/contaminants carried on piston rod **194** starting at **P1a** will not move beyond the area of the hydraulic cylinder barrel **187a** that is dedicated to providing buffer chamber **195a**. Thus, any such contaminants travelling on piston rod **194** will be prevented, or at least inhibited, from moving into the zones ZH and Zo of hydraulic cylinder barrel **187a** that hold hydraulic fluid. Thus any point **P1a** on piston rod **194** that passes into the gas compression chamber will not pass into an area of the hydraulic cylinder barrel **187a** that will encounter hydraulic fluid (ie. It will not pass into Zh or Zo). Thus, all portions of piston rod **194** that encounter gas, will not be exposed to an area that is directly exposed to hydraulic fluid. Thus cross contamination of contaminants that may be present with the natural gas in the gas compression cylinder **180** may be prevented or inhibited from migrating into the hydraulic fluid that is in that areas of hydraulic cylinder barrel **187a** adapted for holding hydraulic fluid. It may be appreciated, that since there is an overlap zone, the hydraulic pistons do move from a zone where there should be never anything but hydraulic fluid to a zone which transitions between hydraulic fluid and the contents (eg. air) of the buffer zone. Therefore, contaminants on the inner surface wall of the cylinder barrel 187a, 187b in the overlap zone could theoretically get transferred to the edge surface of the piston. However, the presence of buffer zone significantly reduces the level of risk of cross contamination of contaminants into the hydraulic fluid.

[00106] With reference continuing to **Figure 4**, it may be appreciated that hydraulic cylinder barrel **187b** may also be divided into three zones - like hydraulic cylinder barrel **187a**, namely**:** (i) a zone ZH dedicated exclusively to holding hydraulic fluid; (ii) a zone ZB dedicated exclusively for the buffer area and (iii) a overlap zone that which, depending upon where the device is in the stroke cycle, will vary between an area holding hydraulic fluid and an area providing part of the buffer chamber.

[00107] If the length **XBb** (which is the length of the cylinder barrel from gas cylinder head **192b** to the inward facing surface of hydraulic cylinder **152b** at its full right position) is greater than the stroke length **Xs**, then any point **P1b** on piston rod **194** will not move beyond the distance **XBb** when the gas piston **182** and the hydraulic cylinder **154b** move from the farthermost right positions of the stroke (1) to the farthermost left positions of the stroke (2). Thus any materials/contaminants on piston rod **194** starting at **P1b** will be prevented or at least inhibited from moving beyond the area of the hydraulic cylinder barrel **187b** that provides buffer chamber **195b**. Thus, any such contaminants travelling on piston rod **194** will be prevented, or at least inhibited, from moving into the zones ZH and Zo of hydraulic cylinder barrel **187b** that hold hydraulic fluid. Thus any point **P2b** on piston rod **194** that passes into the gas compression chamber will not pass into an area of the hydraulic cylinder barrel **187b** that will encounter hydraulic fluid (ie. It will not pass into Zh or Zo). Thus, all portions of piston rod **194** that encounter gas, will not be exposed to an area that is directly exposed to hydraulic fluid. Thus cross contamination of contaminants that may be present with the natural gas in the gas compression cylinder **180** may be prevented or inhibited from migrating into the hydraulic fluid that is in that areas of hydraulic cylinder barrel **187b** adapted for holding hydraulic fluid. Thus, any such contaminants travelling on piston rod **194** will be prevented or a least inhibited from moving into the area of hydraulic cylinder barrel **187b** that in operation, holds hydraulic fluid. Thus cross contamination of contaminants that may be present with the natural gas in the gas compression cylinder **180** may be prevented or at least inhibited from migrating into the hydraulic fluid that is in that area of hydraulic cylinder barrel **187b** that is used to hold hydraulic fluid.

[00108] In some embodiments, during operation of hydraulic gas compressor **150**, buffer chambers **195a, 195b** may each be separately open to ambient air, such that air within buffer chamber may be exchanged with the external environment (eg.

air at ambient pressure and temperature). However, it may not desirable for the air in buffer chambers **195a, 195b** to be discharged into the environment and possibly other components to be discharged directly into the environment, due to the potential for other components that are not environmentally friendly also being present with the air. Thus a closed system may be highly undesirable such that for example buffer chambers **195a, 195b** may be in communication with each such that a substantially constant amount of gas (eg. such as air) can be shuttled back and forth through communication lines – such as communication lines **215a, 215b** in **FIG. 7**.

[00109] Buffer chambers **195a** and/or **195b** may in some embodiments be adapted to function as a purge region. For example, buffer chambers **195a, 195b** may be fluidly interconnected to each other, and may also in some embodiments, be in fluid communication with a common pressurized gas regulator system **214** (**Figure 7**), through gas lines **215a, 215b** respectively. Pressurized gas regulator system **214** may for example maintain a gas at a desired gas pressure within buffer chambers **195a, 195b** that is always above the pressure of the compressed natural gas and/or other gases that are communicated into and compressed in gas compression cylinder chamber sections **181a, 181b** respectively. For example, pressurized gas regulator system **214** may provide a buffer gas such as purified natural gas, air, or purified nitrogen gas, or another inert gas, within buffer chambers **195a, 195b**. This may then prevent or substantially restrict natural gas and any contaminants contained in gas compression cylinder sections **181a, 181b** migrating into buffer chambers **195a, 195b**. The high pressure buffer gas in buffer chambers **195a, 195b** may prevent movement of natural gas and possibly contaminants into the buffer chambers **195a, 195b**. Furthermore if the buffer gas is inert, any gas that seeps into the gas compression cylinder chamber sections **181a, 181b** will not react with the natural gas and/or contaminants. This can be particularly beneficial if for example the contaminants include hydrogen sulphide gas which may be present in one or both of gas compression cylinder chamber sections **181a, 181b**.

[00110] In some embodiments, gas lines **215a, 215b** (**FIG. 7)** may not be in fluid communication with a pressurized gas regulator system **214** – but instead may be interconnected directly with each other to provide a substantially unobstructed communication channel for whatever gas is in buffer chambers **195a, 195b.** Thus during operation of gas compressor **150**, as hydraulic pistons **154a, 154b** move right and then left (and/or upwards downwards) in unison, as one buffer chamber (eg. buffer chamber **195a**) increases in size, the other buffer chamber (eg. buffer chamber **195b**) will decrease in size. So instead of gas in in each buffer chamber **195a, 195b** being alternately compressed and then de-compressed, a fixed total volume of gas at a substantially constant pressure may permit gas thereof to shuttle between the buffer chambers **195a, 195b** in a buffer chamber circuit.

[00111] Also, instead of being directly connected with each other, buffer chambers **195a, 195b** may be both in communication with a common holding tank **1214** (**FIG. 7**) that may provide a source of gas that may be communicated between buffer chambers **195a, 195b**. The gas in the buffer chamber gas circuit may be at ambient pressure in some embodiments and pressurized in other embodiments. The holding tank **1214** may in some embodiments also serve as a separation tank whereby any liquids being transferred with the gas in the buffer chamber system can be drained off.

[00112] In the embodiment of **FIGS. 2, and 9A-9C**, a drainage port **207a** for buffer chamber **195a** may be provided on an underside surface of hydraulic cylinder barrel **187a**. A corresponding drainage port **207b** may be provided for buffer chamber **195b**. Drainage ports **207a, 207b** may allow drainage of any liquids that may have accumulated in each of buffer chambers **195a, 195b** respectively. Alternately or additionally such liquids may be able to be drained from an outlet in a holding tank **1214.**

[00113] As illustrated in **FIGS. 5** and **6**, gas compressor system **126** may include a cabinet enclosure **1290** for holding components of hydraulic fluid supply system **1160** including pump unit **1174**, prime mover **1175**, reservoir **1172**, shuttle device **1168**, filters **1182** and **1171**, thermal valve device **1142** and cooler **1143**. Controller **200** may also be held in cabinet enclosure **1290**. One or more electrical cables **1291** may be provided to provide power and communication pathways with the components of gas compressor system **126** that are mounted on a support frame **1292.** Additionally, piping **124 (FIG. 1**) carrying natural gas to compressor **150** may be connected to connector **250** when gas compressor **150** is mounted on support frame **1292** to provide a supply of natural gas to gas compressor **150.**

[00114] Gas compressor system **126** may thus also include a support frame **1292**. Support frame **1292** may be generally configured to support gas compressor **150** in a generally horizontal orientation. Support frame **1292** may include a longitudinally extending hollow tubular beam member **1295** which may be made from any suitable material such as steel or aluminium. Beam member **1295** may be supported proximate each longitudinal end by pairs of support legs **1293a**, **1293b** which may be attached to beam member **1295** such as by welding. Pairs of support legs **1293a, 1293b** may be transversely braced by transversely braced support members **1294a, 1294b** respectively that are attached thereto such as by welding. Support legs **1293a, 1293b** and brace members **1294a, 1294b** may be made also be made from any suitable material such as steel or aluminium.

[00115] Mounted to an upper surface of beam member **1295** may be L-shaped, transversely oriented support brackets **1298a, 1298b** that may be appropriately longitudinally spaced from each other (see also **FIGS. 8** to **9C**). Support brackets **1298a, 1298b** may be secured to beam member **1295** by U-members **1299a, 1299b** respectively that are secured around the outer surface of beam member **1295** and then secured to support brackets **1298a, 1298b** by passing threaded ends through openings **1300a, 1300b** and securing the ends with pairs of nuts **1303a, 1303b (FIG. 6).** Support bracket **1298a** may be secured to gas cylinder head plate **212a** by bolts **1302** received through aligned openings in support bracket **1298a** and gas cylinder head plate **212a**, secured by nuts **1301**. Similarly, support bracket **1298b** may be secured to gas cylinder head plate **212b** by bolts **1302** received through aligned openings in support bracket **1298b** and gas cylinder head plate **212**, secured by nuts **1301**. In this way, gas compressor **150** may be securely mounted to and supported by support frame **1292**.

[00116] Hydraulic fluid communication lines **1166a, 1166b** extend from ports **184a, 184b** respectively to opposite ends of support frame **1294** and may extend under a lower surface of beam member **1295** to a common central location where they may then extend together to enclosure cabinet **1290** housing shuttle valve device **1168**.

[00117] Tubular beam member **1295** maybe hollow and may be configured to act as, or to hold a separate tank such as, holding tank **1214**. Thus beam member **1285** may serve to act as a gas / liquid separation and holding tank and may serve to provide a gas reservoir for gas for buffer chamber system of buffer chambers **195a, 195b**. Lines **215a, 215b** may lead from ports of buffer chambers **195a, 195b** into ports **1305a, 1305b** into holding tank **1214** within tubular member **1295**.

[00118] Holding tank **1214** within beam member **1295** may also have an externally accessible tank vent **1296** that allow for gas in holding tank **1214** to be vented out. Also, holding tank **1214** may have a manual drain device **1297** that is also externally accessible and may be manually operable by an operator to permit liquids that may accumulate in holding tank **1214** to be removed.

[00119] In operation of gas compressor system **126** including hydraulic gas compressor **150**, the reciprocal movement of the hydraulic pistons **152a, 152b**, can be driven by a hydraulic fluid supply system such as for example hydraulic fluid supply system **1160** as described above. The reciprocal movement of hydraulic pistons **154a, 154b** will cause the size of the buffer chambers **195a, 195b** to grow smaller and larger, with the change in size of the two buffer chambers **195a, 195b** being for example 180 degrees out of phase with each other. Thus, as hydraulic piston **154b** moves from position 1 to position 2 in **FIG. 6** driven by hydraulic fluid forced into hydraulic fluid chamber **186b**, some of the gas (eg. air) in buffer chamber

195b will be forced into gas line(s) **215a, 215b** (**FIG. 7)** that interconnect chambers **195a, 195b**, and flow through holding tank **1214** towards and into buffer chamber **195a**. In the reverse direction, as hydraulic piston **154a** moves from position 2 to position 1 in **FIG. 4** driven by hydraulic fluid forced into hydraulic fluid chamber **186a**, some of the gas (eg air) in buffer chamber **195a** will be forced into gas lines **215a, 215b** and flow through holding tank **1214** towards and into buffer chamber **195b**. In this way, the gas in the system of buffer chambers **195a, 195b** can be part of a closed loop system, and gas may simply shuttle between the two buffer chambers **195a, 195b**, (and optionally through holding tank **1214**) thus preventing contaminants that may move into buffer chambers **195a, 195b** from gas cylinder sections **181a, 181b** respectively, from contaminating the outside environment. Additionally, such a closed loop system can prevent any contaminants in the outside environment from entering the buffer chambers **195a, 195b** and thus potentially migrating into the hydraulic fluid chambers **186a, 186b** respectively.

[00120] Gas compressor system **126** may also include a natural gas communication system to allow natural gas to be delivered from piping **124 (FIG. 1)** to the two gas compression chamber sections **181a, 181b** of gas compression cylinder **180** of gas compressor **150**, and then communicate the compressed natural gas from the sections **181a, 181b** to piping **130** for delivery to oil and gas flow line **133**.

[00121] With reference to **FIG. 2** in particular, the natural gas communication system may include a first input valve and connector device **250**, a second input valve and connector device **260**, a first output valve and connector device **261** and a second output valve and connector device **251**. A gas input suction distribution line **204** fluidly interconnects input valve and connector device **250** with input valve and connector device **260**. A gas output pressure distribution line **209** fluidly interconnects output valve and connector device **261**with valve and connector device **251**.

[00122] With reference also to **FIGS. 8**, **8A** and **8B**, input valve and connector device **250** may include a gas compression chamber section valve and connector, a gas pipe input connector, and a gas suction distribution line connector. In an embodiment as shown in **FIGS. 2 and 3(i) to (iv)** an excess pressure valve and bypass connector is also provided. In an alternate embodiment as shown in **FIGS. 8 to 9C,** there is no bypass connector. However, in this latter embodiment there is a lubrication connector **1255** to which is attached in series to an input port of a lubrication device **1256** comprising suitable fittings and valves. Lubrication device **1256** allows a lubricant such as a lubricating oil (like WD-40 oil) to be injected into the passageway where the natural gas passes though connector device **250**. The WD40 can be used to dissolve hydrocarbon sludges and soots to keep seals functional.

[00123] An electronic gas pressure sensing / transducer device **1257** may also be provided which may for example be a model AST46HAP00300PGT1L000 made by American Sensor technologies. This sensor reads the casing gas pressure.

[00124] Gas pressure sensing device / transducer **1257** may be in electronic communication with controller **200** and may provide signals to controller **200** indicative of the pressure of the gas in the casing / gas distribution line **204**. In response to such signal, controller **200** may modify the operation of system **100** and in particular the operation of hydraulic fluid supply system **1160.** For example, if the pressure in gas suction distribution line **204** descends to a first threshold level (eg. 8 psi), controller **200** can control the operation of hydraulic fluid supply system **170** to slow down the reciprocating motion of gas compressor **150,** which should allow the pressure of the gas that is being fed to connector device **250** and gas suction distribution line **204** to increase. If the pressure measured by sensing device **1257** reaches a second lower threshold – such that it may be getting close to zero or negative pressure (eg. 3 psi) controller **200** may cause hydraulic fluid supply system **1160** to cease the operation of gas compressor **150.**

[00125] Hydraulic fluid supply system **1160** may then be re-started by controller **200**, if and when the pressure measured by gas pressure sensing device / transducer **1257** again rises to an acceptable threshold level as detected by a signal received by controller **200.**

[00126] The output port of gas pressure sensing device **1257** may be connected to an input connector of gas suction distribution line **204**.

[00127] With reference to **FIGS. 8A** and **8B**, output valve and connector device **251** may include a gas compression chamber section valve, gas pipe output connector **205** and a gas pressure distribution line connector **263**. In an embodiment as shown in **FIG. 2**, an excess pressure valve and bypass connector is also provided. In an alternate embodiment as shown in **FIGS. 8 to 9C,** there is no bypass connector.

[00128] With reference to the embodiment of **FIGS. 2 and 3(i) to 3(iv)**, a pressure relief valve **265** is provided limit the gas discharge pressure. In some embodiments, relief valve **265** may discharge pressurized gas to the environment. However, in this illustrated embodiment, the relieved gas can be sent back through a bypass hose **266** to the suction side of the gas compressor 150 to limit environmental discharge. One end of a bypass hose **266** may be connected for communication of natural gas from a port of an excess gas pressure bypass valve **265 (FIG. 2)**. The opposite end of bypass port may be connected to an input port of connector **250**. The output port from bypass valve **265** may provide one way fluid communication through bypass hose 266 of excessively pressured gas in for example gas output distribution line **209**, to connector **250** and back to the gas input side of gas compressor 150. Thus, once the pressure is reduced the pressure to a level that is suitable for transmission in piping **120** (**FIG. 2A)** gas pressure relief valve will close.

[00129] With reference to **FIGS. 8** and **8B**, installed within connector **250** is a one way check valve device **1250**. When connector **250** is received in an opening

1270 on the inward seal side of casing **201a**, gas may flow through connector **250** and its check valve device **1250**, through casing **201a** into gas compression chamber section **181a**. Similarly within connector **251** is a one way check valve device **1251**. When connector **262** is received in an opening **1271** on the inward seal side of casing **201b**, gas may flow out of gas compression chamber section **181a** through casing **201a**, and then through one-way valve device **1251 of** connector **251** where gas can then flow through output connector **205** (**FIG. 2**) into piping **130** (**FIG. 1**).

[00130] The check valve device **1250** associated with connector **250** is operable to allow gas to flow into casing **201a** and gas compression chamber section **181a**, if the gas pressure at connector **250** is higher than the gas pressure on the inward side of the check valve device **1250**. This will occur for example when gas compression chamber section **181a** is undergoing expansion in size as gas piston **182** moves away from head assembly **200a** resulting in a drop in pressure within compression chamber section **181a**. Check valve device **1251** is operable to allow gas to flow out of casing **201a** and gas compression chamber section **181a**, if the gas pressure in gas compression chamber section **181a** and casing **201a** is higher than the gas pressure on the outward side of check valve device **1251** of connector **251,** and when the gas pressure reaches a certain minimum threshold pressure that allows it to open. The check valve device **1251** may be operable to be adjusted to set the threshold opening pressure difference that causes/allows the one way valve to open. The increase in pressure gas compression chamber section **181a** and casing **201a** will occur for example when gas compression chamber section **181a** is undergoing reduction in size as gas piston **182** moves towards from head assembly **200a** resulting in an increase in pressure within compression chamber section **181a.**

[00131] With reference to **FIG. 8**, at the opposite end of gas suction distribution line **204** to the end connected to gas pressure sensing device **1257**, is a second input connector **260**. Installed within connector **260** is a one way check valve device

1260. When connector **260** is received in an opening on the inward seal side of casing **201b**, gas may flow from gas distribution line **204** through connector **260** and valve device **1260**, through casing **201b** into gas compression chamber section **181b**.

[00132] Similarly at the opposite end of gas pressure distribution line **209** to the end connected to connector **210**, is an output connector **261**. Installed within connector **261** is a one way check valve device **1261**. When connector **261** is received in an opening on the inward seal side of casing **201b**, gas may flow out of gas compression chamber section **181b** through casing **201b** and then through valve device **1261** and connector **261** where pressurized gas can then flow through gas pressure distribution line **209** to output connector **205** and into piping **130** (**FIG. 1**).

[00133] One way check valve device **1260** is operable to allow gas to flow into casing **201b** and gas compression chamber section **181b**, if the gas pressure at connector **260** is higher than the gas pressure on the inward side of check valve device **1260**. This will occur for example when gas compression chamber section **181b** is undergoing expansion in size as gas piston **182** moves away from head assembly **200b** resulting in a drop in pressure within compression chamber section **181b**. One way check valve device **1261** is operable to allow gas to flow out of casing **201b** and gas compression chamber section **181b**, if the gas pressure in gas compression chamber section **181b** and casing **201b** is higher than the gas pressure on the outward side of check valve device **1261** of connector **261,** and when the gas pressure reaches a certain minimum threshold pressure that allows it to open. The check valve device **1261** may be operable to be adjusted to set the threshold opening pressure difference that causes/allows the one way valve to open. The increase in pressure gas compression chamber section **181b** and casing **201b** will occur for example when gas compression chamber section **181b** is undergoing reduction in size as gas piston **182** moves towards from head assembly **200b** resulting in an increase in pressure within compression chamber section **181b.**

[00134] With particular reference to **FIG. 8B**, interposed between an output end of gas pressure distribution line **209** and valve and connector **251** may be a bypass valve **1265.** If the gas pressure in gas pressure distribution line **209** and/or in connector **250**, reaches or exceeds a pre-determined upper pressure threshold level, excess pressure valve 1**265** will open to relieve the pressure and reduce the pressure to a level that is suitable for transmission into piping **130 (FIG. 1)**.

[00135] In operation of gas compressor **150**, hydraulic pistons **154a, 154b** may be driven in reciprocating longitudinal movement for example by hydraulic fluid supply system **1160** as described above, thus driving gas piston **182** as well. The following describes the operation of the gas flow and gas compression in gas compressor system **126**.

[00136] With hydraulic pistons **154a, 154b** and gas piston **182** in the positions shown in **FIG. 3(i)** natural gas will be already located in gas cylinder compression section **181a**, having been previously drawn into gas cylinder compression section **181a** during the previous stroke due to pressure the differential that develops between the outer side of one way valve device **1250** and the inner side of valve device **1250** as piston **182** moved from left to right. During that previous stroke, natural gas will have been drawn from pipe **124** through connector **202** and connector device **250** and its check valve device **1250** into gas compression chamber section **181a,** with check valve 1**251** of connector device **251** being closed due to the pressure differential between the inner side of check valve device **1251** and the outer side of check valve device **1251** thus allowing gas compression cylinder section **181a** to be filled with natural gas at a lower pressure than the gas on the outside of connector device **251**.

[00137] Thus, with the pistons in the positions shown in **FIG. 3(i),** hydraulic cylinder chamber **186b** is supplied with pressurized hydraulic fluid in a manner such as is described above, thus driving hydraulic piston **154b**, along with piston rod **194**, gas piston **182** and hydraulic piston **154a** attached to piston rod **194**, from the position shown in **FIG. 3(i)** to the position shown in **FIG. 3(ii).** As this is occurring, hydraulic fluid in hydraulic cylinder chamber **186a** will be forced out of chamber **186a**, and flow as described above.

[00138] As hydraulic piston **154b**, along with piston rod **194**, gas piston **182** and hydraulic piston **154a** attached to piston rod **194**, move from the position shown in **FIG. 3(i)** to the position shown in **FIG. 3(ii),** natural gas will be drawn from supply line **124**, through connector device **250** into gas suction distribution line **204**, and then pass through input valve connector **260** and one way valve device **1260** and into gas compression section **181b**. Natural gas will flow in such a manner because as gas piston **182** moves to the left as shown in **FIGS. 3(i) to (ii),** the pressure in gas compression chamber **181b** will drop, which will create a suction that will cause the natural gas in pipe **124** to flow.

[00139] Simultaneously, the movement of gas piston **182** to the left, will compress the natural gas that is already present in gas compression chamber section **181a**. As the pressure rises in gas chamber section **181a**, gas flowing into connector **250** from pipe **124** will not enter chamber section **181a**. Additionally, gas being compressed in gas compression chamber section **181a** will stay in gas compression chamber section **181a** until the pressure therein reaches the threshold level of gas pressure that is provided by one way check valve device **1251**. Gas being compressed in chamber section **181a** can't flow out of chamber section **181a** into connector **250** because of the orientation of check valve device **1250**.

[00140] The foregoing movement and compression of natural gas and movement of hydraulic fluid will continue as the pistons continue to move from the positions shown in **FIG. 3(ii)** to the position shown in **FIG. 3(iii)**. During that time, dependent upon the pressure in gas compression chamber section **181a**, gas will be allowed to pass out of gas compression chamber section **181a** through connector **251** and will pass into piping **130** once the pressure is high enough to activate one way valve device **1251**.

[00141] Just before hydraulic piston **154b** reaches the position shown in **FIG. 3(iii),** proximity sensor **157b** will detect the presence of hydraulic piston **154b** within hydraulic cylinder **152b** at a longitudinal position that is a short distance before the end of the stroke within hydraulic cylinder **152b**. Proximity sensor **157b** will then send a signal to controller **200**, in response to which controller **200** will change the operational configuration of hydraulic fluid supply system **1160**, as described above. This will result in hydraulic piston **154b** not being driven any further to the left in hydraulic cylinder **152b** than the position shown in **FIG. 3(iii**).

[00142] Once hydraulic piston **154b**, along with piston rod **194**, gas piston **182** and hydraulic piston **154a** attached to piston rod **194**, are in the position shown in **FIG. 3(iii),** natural gas will have been drawn through connector **260** and one way valve device **1260** again due to the pressure differential that is developed between gas compression chamber section 181b and gas suction distribution pipe 204, so that gas compression chamber section **181b** is filled with natural gas. Much of the gas in gas compression chamber **181a** that has been compressed by the movement of gas piston **182** from the position shown in **FIG. 3(i)** to the position shown in **FIG. 3(iii),** will, once compressed sufficiently to exceed the threshold level of valve device **1251**, have exited gas compression chamber **181a** and pass from gas pipeline output connector **205** into piping **130 (FIG. 1**) for delivery to oil and gas pipeline **133**. If the gas pressure is too high to be received in piping **130**, excess valve and bypass connector **265/1265** will be opened to allow excess gas to exit to reduce the pressure.

[00143] Next, gas compressor system **126**, including hydraulic fluid supply system **1160** is reconfigured for the return drive stroke. As natural gas has been drawn into gas compression cylinder section **181b** it is ready to be compressed by gas piston **182**. With hydraulic pistons **154a, 154b** and gas piston **182** in the positions shown in **FIG. 3(iii),** hydraulic cylinder chamber **186a** is supplied with pressurized hydraulic fluid by hydraulic fluid supply system **1160** for example as described above. This movement drives hydraulic piston **154a**, along with piston rod

194, gas piston **182** and hydraulic piston **154a** attached to piston rod **194**, from the position shown in **FIG. 3(iii)** to the position shown in **FIG. 3(iv).** As this is occurring, hydraulic fluid in hydraulic cylinder chamber **186b** will be forced out of the hydraulic fluid chamber **186a** and may be handled by hydraulic fluid supply system **1160** as described above.

[00144] As hydraulic piston **154a**, along with piston rod **194**, gas piston **182** and hydraulic piston **154b** attached to piston rod **194**, move from the position shown in **FIG. 5(iii)** to the position shown in **FIG. 3(iv),** natural gas will be drawn from supply line **124**, through connector **253** of valve and connector device **250** into gas compression section **181a** due the drop in pressure of gas in gas compression section **181a**, relative to the gas pressure in supply line **124** and the outside of connector **250**. Simultaneously, the movement of gas piston **182** will compress the natural gas that is already present in gas compression section **181b**. As the gas in gas compression chamber **181b** is being compressed by the movement of gas piston **182**, once the gas pressure reaches the threshold level of valve device **1261** to be activated, gas will be able to exit gas compression chamber **181b** and pass through connector **261**, into gas pressure distribution line **209** and then pass through output connector **205** into piping **130 (FIG. 3**) for delivery to oil and gas pipeline **133.** Again, if the gas pressure is too high to be received in piping **130**, excess valve and bypass connector **265/1265** will be opened to allow excess gas to exit to reduce the gas pressure in gas pressure distribution line **209** and piping **130.**

[00145] The foregoing movement and compression of natural gas and hydraulic fluid will continue as the pistons continue to move from the positions shown in **FIG. 3(iv)** to return to the position shown in **FIG. 3(i)**. Just before piston **154a** reaches the position shown in **FIG. 3(i),** proximity sensor **157a** will detect the presence of hydraulic piston **154a** within hydraulic cylinder **152a** at a longitudinal position that is shortly before the end of the stroke within hydraulic cylinder **152a.** Proximity sensor **157a** will then send a signal to controller **200**, in response to which controller **200** will reconfigure the operational mode of hydraulic fluid supply system

1160 as described above. This will result in hydraulic piston **154a** not be driven any further to the right than the position shown in **FIG. 3(i).**

[00146] Once hydraulic piston **154a**, along with piston rod **194**, gas piston **182** and hydraulic piston **154b** attached to piston rod **194**, are in the position shown in **FIG. 3(i),** natural gas will have been drawn through valve and connector **253** so that gas compression chamber section **181a** is once again filled and controller **200** will send a signal to the hydraulic fluid supply system **1160** so that gas compressor system **126** is ready to commence another cycle of operation.

[00147] During the operation of the gas compressor **150** as described above, any contaminants that may be carried with the natural gas from supply pipe **124** will enter into gas compression chamber sections **181a, 181b**. However, the components of seal devices **198a, 198b** associated with casings **201a, 201b,** as described above, will provide a barrier preventing, or at least significantly limiting, the migration of any contaminants out of gas compression chamber sections **181a, 181b**. However, any contaminants that do pass seal devices **198a, 198b** are likely to be held in respective buffer chambers **195a, 195b** and in combination with seal devices **196a, 196b** of hydraulic pistons **154a, 154b** respectively, may prevent contaminants from entering into the respective hydraulic cylinder chambers **186a, 186b** Particularly if buffer chambers **195a, 195b** are pressurized, such as with pressurized air or a pressurized inert gas, then this should greatly restrict or inhibit the movement of contaminants in the natural gas in gas compression chamber sections **181a, 181b** from migrating into buffer chambers **195a, 195b**, thus further protecting the hydraulic fluid in hydraulic cylinder chambers **186a, 186b**.

[00148] It should be noted that in use, hydraulic gas compressor **150** may be oriented generally horizontally, generally vertically, or at an angle to both vertical and horizontal directions.

[00149] While the gas compressor system **126** that is illustrated in **FIGS. 1 to 9C** discloses a single buffer chamber **195a, 195b** on each side of the gas compressor **150** between the gas compression cylinder **180** and the hydraulic fluid chambers **186a, 186b**, in other embodiments more than one buffer chamber may be configured on one or both sides of gas compression cylinder **180**. Also, the buffer cavities may be pressurized with an inert gas to a pressure that is always greater than the pressure of the gas in the gas compression chambers so that if there is any gas leakage through the gas piston rod seals, that leakage is directed from the buffer chamber(s) toward the gas compression chamber(s) and not in the opposite direction. This may ensure that no dangerous gases such as H2S are leaked from the gas compressor system.

[00150] Various other variations to the foregoing are possible. By way of example only - instead of having two opposed hydraulic cylinders each being single acting but in opposite directions to provide a combined double acting hydraulic cylinder powered gas compressor:

- a single but double acting hydraulic cylinder with two adjacent hydraulic fluid chambers may be provided with a single buffer chamber located between the innermost hydraulic fluid chamber and the gas compression cylinder;

- a single, one way acting hydraulic cylinder with one hydraulic fluid chamber may be provided with a single buffer chamber located between the hydraulic fluid chamber and the gas compression cylinder, in which gas in only compressed in one gas compression chamber when the hydraulic piston of the hydraulic cylinder is moving on a drive stroke.

[00151] In various other variations a buffer chamber may be provided adjacent to a gas compression chamber but a driving fluid chamber may be not immediately adjacent to the buffer chamber; one or more other chambers may be interposed between the driving fluid chamber and the buffer chamber – but the buffer chamber still functions to inhibit movement of contaminants out of the gas compression chamber and in some embodiments may also protect a driving fluid chamber.

[00152] In other embodiments, more than one separate buffer chamber may be located in series to inhibit gas and contaminants migrating from the gas compression chamber.

[00153] One or more buffer chambers may also be used to ensure that a common piston rod through a gas compression chamber and hydraulic fluid chamber, which may contain adhered contamination from the gas compressor, is not transported into any hydraulic fluid chamber where the hydraulic oil may clean the rod. Accumulation of contamination over time into the hydraulic system is detrimental and thus employment of one or more buffer chambers may assist in reducing or substantially eliminating such accumulation.

[00154] When introducing elements of the present invention or the embodiments thereof, the articles “a,” “an,” “the,” and “said” are intended to mean that there are one or more of the elements. The terms “comprising,” “including,” and “having” are intended to be inclusive and mean that there may be additional elements other than the listed elements.

[00155] Of course, the above described embodiments are intended to be illustrative only and in no way limiting. The described embodiments of carrying out the invention are susceptible to many modifications of form, arrangement of parts, details, and order of operation. The invention, therefore, is intended to encompass all such modifications within its scope.

CLAIMS:

1. A gas compressor system comprising:
- a driving fluid cylinder having a driving fluid chamber adapted for containing a driving fluid therein, and a driving fluid piston movable within said driving fluid chamber;
- a gas compression cylinder having a gas compression chamber adapted for holding a gas therein and a gas piston movable within said gas compression chamber;
- a buffer chamber located between said driving fluid chamber and said gas compression chamber;

said buffer chamber adapted to inhibit movement of at least one non-driving fluid component, when gas is located within said gas compression chamber, from said gas compression chamber into said driving fluid chamber.

2. A gas compressor systems as claimed in claim 1 wherein said buffer chamber is adapted such that during operation when said when gas is compressed in said gas compression chamber, said buffer chamber is operable to inhibit movement of at least one non-driving fluid component, when gas is located within said gas compression chamber, from said gas compression chamber into said driving fluid chamber.

3. A gas compressor system as claimed in claims 1 or 2 further comprising a piston rod that is fixedly connected to said driving fluid piston and said gas piston, such that in operation when said driving fluid flows into said driving fluid chamber said driving fluid piston drives said driving fluid piston such that said driving piston and said gas piston move together within said respective driving fluid chamber and said gas compression chamber.

4. A gas compressor as claimed in claim 3 wherein a volume of said driving fluid chamber and a volume of said buffer chamber overlap within said driving fluid cylinder.

5. A gas compressor as claimed in claims 3 or 4 wherein said piston rod extends from said driving fluid piston through said buffer chamber into said gas compression chamber to said gas piston.

6. A gas compressor as claimed in any one of claims 1 to 5 wherein during operation, said buffer chamber varies in length dependent upon the position of said driving fluid piston in said driving fluid cylinder.

7. A gas compressor as claimed in claim 5 wherein during operation, said buffer chamber varies in length dependent upon the position of said driving fluid piston in said driving fluid cylinder and the minimum length of said buffer chamber is greater than the stroke length of said gas piston, said piston rod and said hydraulic fluid piston.

8. A gas compressor as claimed in claim 5 wherein said buffer chamber is configured such that in operation, no portion of said piston rod that is received within said gas compression chamber will be received in a portion of said hydraulic cylinder that receives hydraulic fluid.

9. A gas compressor system as claimed in any one of claims 1 to 8 wherein said at least one non-driving fluid component comprises natural gas.

10. A gas compressor system as claimed in any one of claims 1 to 8 wherein said at least one non-driving fluid component comprises a contaminant.

11. A gas compressor system as claimed in any one of claims 1 to 10, wherein said at least one non-driving fluid component comprises hydrogen sulphide.

12. A gas compressor system as claimed in any one of claims 1 to 11 wherein said driving fluid is a hydraulic fluid.

13. A gas compressor system as claimed in any one of claims 1 to 12 wherein said buffer chamber is located immediately adjacent to said gas compression chamber.

14. A gas compressor system as claimed in claim 13 wherein said buffer chamber is located immediately adjacent to said driving fluid chamber.

15. A gas compressor system as claimed in any one of claims 1 to 14 wherein said driving fluid chamber and said buffer chamber are both located within said driving fluid cylinder.

16. A gas compressor system as claimed in any one of claims 1 to 15 wherein said buffer chamber is located on an opposite side of said driving fluid piston to said driving fluid chamber.

17. A gas compressor as claimed in any one of claims 1 to 16 wherein a volume of said driving fluid chamber and a volume of said buffer chamber overlap within said driving fluid cylinder.

18. A gas compressor system as claimed in any one of claims 1 to 17 further comprising a casing assembly located between said buffer chamber and said gas compression chamber.

19. A gas compressor system as claimed in claim 18 further comprising a seal device located at least partially within said casing, said seal device operable to inhibit gas from migrating from said gas compression chamber into said buffer chamber.

20. A gas compressor system as claimed in claim 18 further comprising a seal device located at least partially within said casing, said seal device operable to inhibit a non-gas component in said gas compression chamber from migrating from said gas compression chamber into said buffer chamber.

21. A gas compressor system as claimed in claim 19 wherein said seal device is also operable to inhibit a non-gas component from migrating from said gas compression chamber into said buffer chamber.

22. A gas compressor system as claimed in claim 18 further comprising a seal device located at least partially within a casing located between said gas compression chamber and said buffer chamber, said seal device operable to inhibit gas from migrating from said gas compression chamber into said buffer chamber; and wherein said seal device comprises a plurality of sealing rings mounted in said casing and engaging with an outer surface of said piston rod and an inner surface of said casing to provide a gas seal between said casing and said piston rod.

23. A gas compressor system as claimed in any one of claims 1 to 22 further comprising:

- a controller;
- a proximity sensor associated with said driving fluid cylinder, said proximity sensor operable to detect a position of said driving fluid piston within said driving fluid cylinder and send a signal to said controller;

- said controller operable in response to receiving said signal received from said proximity sensor, to control the flow of driving fluid into and out of said driving fluid chamber.

24. A gas compressor system as claimed in claim 23 wherein said proximity sensor is operable to detect a position of said piston rod within said driving fluid chamber at a position proximate an end point of a drive stroke of said driving fluid piston.

25. A gas compressor system as claimed in any one of claims 1 to 24 wherein in operation, said buffer chamber is filled with an inert gas maintained at a pressure that exceeds the pressure at any time within the gas compression chamber.

26. A gas compressor system as claimed in claim 25 wherein said inert gas comprises nitrogen.

27. A gas compressor as claimed in claims 25 or 26 further comprising a gas pressure regulator system in communication with said buffer chamber, said gas pressure regulator system operable to maintain the inert gas in said buffer chamber at a pressure that exceeds the pressure within the gas compression chamber during compression of the gas in the gas compression chamber.

28. A gas compressor system as claimed in any one of claims 1 to 24 wherein said buffer chamber is filled with air.

29. A gas compressor system as claimed in claim 28 wherein said air in said buffer chamber is in communication with a holding tank.

30. A gas compressor system as claimed in any one of claims 1 to 29 wherein said gas compression cylinder and said driving fluid cylinder are mounted on a support frame.

31. A gas compressor system as claimed in claim 30 wherein said gas compression cylinder, said driving fluid cylinder and said holding tank are mounted on a support frame.

32. A gas compressor system as claimed in claim 31 wherein said holding tank is integrated within said support frame.

33. A gas compressor system as claimed in any one of claims 1 to 32, said system further comprising a driving fluid supply system operable to supply driving fluid to said driving fluid chamber to drive said driving fluid piston.

34. A gas compressor system as claimed in claim 33 wherein said driving fluid supply system comprises a pump unit and at least one fluid communication line operable for supplying pressurized driving fluid to said driving fluid chamber.

35. A gas compressor system as claimed in claims 33 or 34 wherein said driving fluid supply system is a closed loop system.

36. A gas compressor system as claimed in any one of claims 33 to 35 further comprising a controller for controlling said driving fluid supply system for controlling the flow of driving fluid to said driving fluid chamber.

37. A gas compressor system as claimed in claim 36 further comprising:
- a proximity sensor associated with said driving fluid cylinder, said proximity sensor operable to detect a position of said driving fluid piston within said driving fluid cylinder and send a signal to said controller;

- said controller operable in response to receiving said signal received from said proximity sensor, and send a signal to said driving fluid supply system to control the flow of driving fluid into and out of said driving fluid chamber.

38. A gas compressor system as claimed in any one of claims 1 to 37 further comprising a gas communication system operable to supply gas to said gas compression chamber and operable to remove gas compressed by said gas piston in gas compression chamber, from said gas compression chamber.

39. A gas compressor as claimed in any one of claims 1 to 38 wherein:
- said driving fluid chamber is a first driving fluid cylinder having a first driving fluid chamber and a first driving fluid piston movable within said first driving chamber;
- said buffer chamber is a first buffer chamber located between a first driving fluid chamber and a first section of said gas compression chamber,
- said gas compressor further comprises:
    - a second driving fluid cylinder having a second driving fluid chamber operable in use for containing a driving fluid and a second driving fluid piston movable within said second driving fluid chamber, and wherein said second driving fluid cylinder is located on an opposite side of said gas compression cylinder as said first driving fluid cylinder;
    - a second buffer chamber located between said second driving fluid chamber and a second section of said gas compression chamber, said second section of said gas compression chamber being on an opposite side of said gas piston to said first section of said gas compression chamber in said gas compression cylinder,
- said first buffer chamber is adapted to inhibit movement of a gas located within said first gas compression chamber section into said first driving fluid chamber; and
- said second buffer chamber is adapted to inhibit movement of a gas located within said second gas compression chamber section, from said second gas compression chamber section into said second driving fluid chamber.

40. A gas compressor system as claimed in claim 39 further comprising a driving fluid supply system operable to supply driving fluid to said first driving fluid chamber to drive said first driving fluid piston and operable to supply driving fluid to said second driving fluid chamber to drive said second driving fluid piston.

41. A gas compressor system as claimed in claim 40 wherein said driving fluid supply system comprises a pump unit and at least one fluid communication line operable for supplying pressurized driving fluid to said driving fluid chambers.

42. A gas compressor system as claimed in claims 40 or 41 wherein said driving fluid supply system is a closed loop system.

43. A gas compressor system as claimed in any one of claims 40 to 42 further comprising a controller for controlling said driving fluid supply system for controlling the flow of driving fluid to said first and second driving fluid chambers.

44. A gas compressor system as claimed in any one of claims 39 to 43 wherein said piston rod that is fixedly connected to said first driving fluid piston, said gas piston and said second driving fluid piston, such that in operation when said driving fluid flows into said first driving fluid chamber said first driving fluid piston drives said first driving fluid piston such that said first driving fluid piston, said second driving fluid piston and said gas piston move together within said respective first driving fluid chamber, said second driving fluid chamber and said gas compression chamber, and such that in operation when said driving fluid flows into said second driving fluid chamber, said second driving fluid piston drives said second driving fluid piston such that said first driving fluid piston, said second driving fluid piston and said gas piston move together in an opposite direction within said respective first driving fluid chamber, said second driving fluid chamber and said gas compression chamber.

45. A gas compressor as claimed in claim 44 wherein a volume of said first driving fluid chamber and a volume of said first buffer chamber overlaps within said first driving fluid cylinder and a volume of said second driving fluid chamber and a volume of said second buffer chamber overlap within said second driving fluid cylinder.

46. A gas compressor as claimed in claims 44 or 45 wherein said piston rod extends from said first driving fluid piston through said first buffer chamber into said gas compression chamber to said gas piston and extends further through said second buffer chamber to said second driving fluid piston.

47. A gas compressor as claimed in any one of claims 39 to 46 wherein during operation, said first buffer chamber varies in length dependent upon the position of said first driving fluid piston in said first driving fluid cylinder and said second buffer chamber varies in length dependent upon the position of said second driving fluid piston in said second driving fluid cylinder.

48. A gas compressor as claimed in claim 47 wherein during operation, said first buffer chamber varies in length dependent upon the position of said first driving fluid piston in said first driving fluid cylinder and the minimum length of said first buffer chamber is greater than the stroke length of said gas piston, said piston rod and said first and second hydraulic fluid pistons.

49. A gas compressor as claimed in claim 48 wherein during operation, said second buffer chamber varies in length dependent upon the position of said second driving fluid piston in said second driving fluid cylinder and the minimum length of said second buffer chamber is greater than the stroke length of said gas piston, said piston rod and said first and second hydraulic fluid pistons.

50. A gas compressor as claimed in any one of claims 44 to 49 wherein said first buffer chamber is configured such that in operation, no portion of said piston rod that is received within said gas compression chamber will be received in a portion of said first hydraulic cylinder that receives hydraulic fluid and wherein said second buffer chamber is configured such that in operation, no portion of said piston rod that is received within said gas compression chamber will be received in a portion of said second hydraulic cylinder that receives hydraulic fluid.

51. A gas compressor as claimed in any one of claims 39 to 50 wherein said first driving fluid piston is operable to drive said gas piston in an opposite direction to said second driving fluid piston.

52. A gas compressor system comprising:

- a first driving fluid cylinder having a first driving fluid chamber adapted for containing a first driving fluid therein, and a first driving fluid piston movable within said first driving fluid chamber;
- a gas compression chamber adapted for holding a gas therein and a gas piston movable within said gas compression chamber;
- a first buffer chamber located between said first driving fluid chamber and a first section of said gas compression chamber;
- a second driving fluid cylinder having a second driving fluid chamber adapted for containing a second driving fluid therein, and a second driving fluid piston movable within said second driving fluid chamber;
- a second buffer chamber located between said first driving fluid chamber and a second section of said gas compression chamber;
- wherein said first buffer chamber is adapted to inhibit movement of at least one non-driving fluid component, when gas is located within a first section of said gas compression chamber, from said first section gas compression chamber section into said first driving fluid chamber;

- wherein said second buffer chamber adapted to inhibit movement of at least one non-driving fluid component, when gas is located within a second section of said gas compression chamber, from said second section of said gas compression chamber into said second driving fluid chamber.

53. A gas compressor systems as claimed in claim 52 wherein said first buffer chamber is adapted such that during operation when gas is compressed in said first gas compression chamber section, said first buffer chamber is operable to inhibit movement of at least one non-driving fluid component, when gas is located within said first gas compression chamber section, from said first gas compression chamber into said first driving fluid chamber; and wherein said second buffer chamber is adapted such that during operation when gas is compressed in said second gas compression chamber section, said second buffer chamber is operable to inhibit movement of at least one non-driving fluid component, when gas is located within said second gas compression chamber section, from said second gas compression chamber section into said second driving fluid chamber.

54. A gas compressor system as claimed in claims 52 or 53 wherein said at least one non-driving fluid component in both of said first and second gas compression chamber sections comprises natural gas.

55. A gas compressor system as claimed in claims 52, 53 or 54 wherein said at least one non-driving fluid component in both of said first and second gas compression chamber sections comprises a contaminant.

56. A gas compressor system as claimed in any one of claims 52 to 55, wherein said at least one non-driving fluid component in both of said first and second gas compression chamber sections comprises hydrogen sulphide.

57. A gas compressor system as claimed in any one of claims 52 to 56 wherein said first buffer chamber is located adjacent to said first gas compression chamber section and said second buffer chamber is located adjacent to said second gas chamber section.

58. A gas compressor system as claimed in any one of claims 52 to 57 wherein said first driving fluid chamber and said first buffer chamber are both located within said first driving fluid cylinder.

59. A gas compressor system as claimed in claim 58 further comprising a first seal device operable to inhibit gas in said first gas compression chamber section from migrating from said first gas compression chamber section into said first buffer chamber.

60. A gas compressor system as claimed in claim 59 further comprising a second seal device operable to inhibit gas in said second gas compression chamber section from migrating from said second gas compression chamber section into said second buffer chamber.

61. A gas compressor system as claimed in claims 58, 59 or 60 wherein said second driving fluid chamber and said second buffer chamber are both located within said second driving fluid cylinder.

62. A gas compressor system as claimed in any one of claims 52 to 61 wherein said first buffer chamber is located on an opposite side of said first driving fluid piston to said first driving fluid chamber.

63. A gas compressor system as claimed in claim 62 wherein said second buffer chamber is located on an opposite side of said second driving fluid piston to said second driving fluid chamber.

64. A gas compressor system as claimed in any one of claims 52 to 63 wherein said gas compression chamber is formed in a gas compression cylinder located between said first driving fluid cylinder and said second driving fluid cylinder.

65. A gas compressor system as claimed in claim 64 wherein first driving fluid cylinder, said gas compression cylinder and said second driving fluid cylinder are interconnected to each other.

66. A gas compressor system as claimed in any one of claims 52 to 65 further comprising a piston rod that is fixedly connected to said first driving fluid piston, said gas piston, and said second driving fluid piston such that in operation, said driving fluid flowing into said first driving fluid chamber drives said first driving fluid piston in a first direction, and said driving fluid entering said second driving fluid chamber drives said second driving fluid piston in a second direction opposite to said first direction, and said first fluid driving piston, said gas piston and said second fluid driving piston are operable to move together within said respective first driving fluid cylinder, said gas compression cylinder and said second driving fluid cylinder, in reciprocating movement.

67. A gas compressor as claimed in claim 66 wherein a volume of said first driving fluid chamber and a volume of said first buffer chamber overlap within said first driving fluid cylinder and a volume of said second driving fluid chamber and a volume of said second buffer chamber overlap within said second driving fluid cylinder.

68. A gas compressor as claimed in claims 66 or 67 wherein said piston rod extends from said first driving fluid piston through said first buffer chamber into said gas compression chamber to said gas piston and extends further through said second buffer chamber to said second driving fluid piston.

69. A gas compressor as claimed in any one of claims 66 to 68 wherein during operation, said first buffer chamber varies in length dependent upon the position of said first driving fluid piston in said first driving fluid cylinder and said second buffer chamber varies in length dependent upon the position of said second driving fluid piston in said second driving fluid cylinder.

70. A gas compressor as claimed in claim 69 wherein during operation, said first buffer chamber varies in length dependent upon the position of said first driving fluid piston in said first driving fluid cylinder and the minimum length of said first buffer chamber is greater than the stroke length of said gas piston, said piston rod and said first and second hydraulic fluid pistons.

71. A gas compressor as claimed in claim 70 wherein during operation, said second buffer chamber varies in length dependent upon the position of said second driving fluid piston in said second driving fluid cylinder and the minimum length of said second buffer chamber is greater than the stroke length of said gas piston, said piston rod and said first and second hydraulic fluid pistons.

72. A gas compressor as claimed in any one of claims 66 to 71 wherein said first buffer chamber is configured such that in operation, no portion of said piston rod that is received within said gas compression chamber will be received in a portion of said first hydraulic cylinder that receives hydraulic fluid and wherein said second buffer chamber is configured such that in operation, no portion of said piston rod that is received within said gas compression chamber will be received in a portion of said second hydraulic cylinder that receives hydraulic fluid.

73. A gas compressor system as claimed in any one of claims 52 to 72, further comprising a first casing located between said first buffer chamber and said first gas compression chamber section and further comprising a second casing located

between said second buffer chamber and said second gas compression chamber section.

74. A gas compressor system as claimed in claim 73 further comprising a first seal device located at least partially within said first casing, said first seal device operable to inhibit gas from migrating from said gas compression chamber into said first buffer chamber; and further comprising a second seal device located at least partially within said second casing, said second seal device operable to inhibit gas from migrating from said gas compression chamber into said second buffer chamber.

75. A gas compressor system as claimed in claim 74 further comprising a first seal device located at least partially within said first casing, said first seal device operable to inhibit a non-gas component in said first gas compression chamber section from migrating from said first gas compression chamber section into said first buffer chamber.

76. A gas compressor system as claimed in claim 75 further comprising a second seal device located at least partially within said second casing, said second seal device operable to inhibit a non-gas component in said second gas compression chamber section from migrating from said second gas compression chamber section into said second buffer chamber.

77. A gas compressor system as claimed in claim 76 wherein said first and second seal devices each further comprise a rod wiper operable to remove contaminants that may deposited onto said piston rod, from a portion of said piston rod as said portion of said piston rod moves from within respective said first and second gas compression chamber seconds into respective said first and second casings.

78. A gas compressor system as claimed in any one of claims 52 to 77 further comprising:
- a controller;
- a first proximity sensor associated with said first driving fluid cylinder, said first proximity sensor operable to detect a position of said first driving fluid piston within said first driving fluid cylinder and send a signal to said controller;
- a second proximity sensor associated with said second driving fluid cylinder, said first second proximity sensor operable to detect a position of said second driving fluid piston within said second driving fluid cylinder and send a signal to said controller;
- said controller operable in response to receiving said signal received from said first proximity sensor, to control the flow of driving fluid into and out of said first driving fluid chamber and operable in response to receiving said signal received from said seond proximity sensor, to control the flow of driving fluid into and out of said second driving fluid chamber.

79. A gas compressor system as claimed in claim 78 wherein said first proximity sensor is operable to detect a position of said first driving fluid piston within said first driving fluid chamber at a position proximate an end point of a drive stroke of said first driving fluid piston and said second proximity sensor is operable to detect a position of said second driving fluid piston within said second driving fluid chamber at a position proximate an end point of a drive stroke of said first driving fluid piston.

80. A gas compressor system as claimed in any one of claims 52 to 79 wherein in operation, said first and second buffer chamber each contain an inert gas maintained at a pressure that exceeds the pressure within the respective first and second gas compression chambers sections during compression of gas in said first and second gas compression chamber sections.

81. A gas compressor system as claimed in claim 80 wherein said inert gas comprises nitrogen.

82. A gas compressor as claimed in claims 80 or 81 further comprising a gas pressure regulator system in communication with said first and second buffer chambers, said gas pressure regulator system operable to maintain the inert gas in said first and second buffer chambers at pressures that exceeds the respective pressure within the first and second gas compression chamber sections during compression of gas in said first and second gas compression chamber sections.

83. A gas compressor system as claimed in any one of claims 52 to 82 wherein each of said first and second buffer chambers contains air.

84. A gas compressor as claimed in claim 83 wherein said air is pressurized to a pressure that exceeds the respective pressure within the first and second gas compression chamber sections during compression of gas in said first and second gas compression chamber sections.

85. A gas compressor system as claimed in claims 83 or 84 wherein said air in said buffer chamber is in communication with a holding tank.

86. A gas compressor system as claimed in claims 83, 84 or 85 wherein said holding tank and said first and second buffer chambers are in a closed system.

87. A gas compressor system as claimed in any one of claims 52 to 85 wherein said first and second buffer chambers are in a closed system.

88. A gas compressor system as claimed in any one of claims 52 to 87 wherein said gas compression cylinder and said first and second driving fluid cylinder are

supported on a support frame with said gas compression cylinder positioned between said first and second driving fluid cylinders.

89. A gas compressor system as claimed in claim 85 wherein said holding tank, said gas compression cylinder and said first and second driving fluid cylinder are supported on a support frame with said gas compression cylinder positioned between said first and second driving fluid cylinders and wherein said gas compression cylinder, said driving fluid cylinder and said holding tank are mounted on a support frame.

90. A gas compressor system as claimed in claim 89 wherein said holding tank is integrated within said support frame.

91. A gas compressor system as claimed in any one of claims 52 to 90 further comprising a driving fluid supply system operable to supply driving fluid to said first driving fluid chamber to drive said first driving fluid piston and operable to supply driving fluid to said second driving fluid chamber to drive said second driving fluid piston.

92. A gas compressor system as claimed in claim 91 wherein said driving fluid supplied to said first fluid driving chamber and the driving fluid supplied to said second fluid driving chamber are part of driving fluid supply circuit.

93. A gas compressor system as claimed in claims 91 or 92 wherein said driving fluid supply system comprises a pump unit and at least two fluid communication lines, operable for supplying pressurized driving fluid to each of said first and second driving fluid chambers.

94. A gas compressor system as claimed in claims 91, 92 or 93 wherein said driving fluid supply system is a closed loop system.

95. A gas compressor system as claimed in any one of claims 91 to 94 further comprising a controller for controlling said driving fluid supply system for controlling the flow of driving fluid to and from said first and second driving fluid chambers.

96. A gas compressor system as claimed in claim 95 further comprising:
- a proximity sensor associated with said driving fluid cylinder, said proximity sensor operable to detect a position of said driving fluid piston within said driving fluid cylinder and send a signal to a controller;
- a controller operable in response to receiving said signal received from said proximity sensor, and send a signal to said driving fluid supply system to selectively control the flow of driving fluid into and out of said first and second driving fluid chamber to provide reciprocating movement of said first and second driving fluid pistons and said gas piston.

97. A gas compressor system as claimed in any one of claims 52 to 96 further comprising a gas supply system operable to supply gas to said gas compression chamber and operable to remove gas compressed by said gas piston in gas compression chamber, from said gas compression chamber.

98. An oil well producing system comprising:
- a production tubing having a length extending along a well shaft that extends to an oil bearing formation;
- a passageway extending along at least the well shaft , said passageway operable to supply natural gas to a gas supply line, said gas supply line in communication with a gas compression chamber of a gas compressor system, said gas compressor system comprising any of the gas compressor systems of claims 1 to 97.

99. A system as claimed in claim 98 further comprising a casing surrounding the production tubing and extending along at least part of the length of the production

tubing and wherein the passageway extends between an outer surface of said production tubing and an inner surface of said casing.

100. A gas compressor comprising:
- a driving fluid cylinder having a driving fluid chamber operable for containing a driving fluid therein and a driving fluid piston movable within said driving fluid chamber;
- a gas compression cylinder having a gas compression chamber operable for holding a gas therein and a gas piston movable within said gas compression chamber;
- a buffer chamber located between said driving fluid chamber and said gas compression chamber, said buffer chamber configured and operable to inhibit movement of at least one non-driving fluid component from said gas compression chamber to substantially avoid contamination of said driving fluid, when gas is located within said gas compression chamber.

101. A gas compressor comprising:
- a driving fluid cylinder having a driving fluid chamber operable for containing a driving fluid therein and a driving fluid piston movable within said driving fluid chamber;
- a gas compression cylinder having a gas compression chamber operable for holding natural gas therein and a gas piston movable within said gas compression chamber;
- a buffer chamber located between said driving fluid chamber and said gas compression chamber, said buffer chamber containing a buffer gas component so as to substantially avoid contamination of said driving fluid in said driving fluid chamber, when natural gas is located within said gas compression chamber.

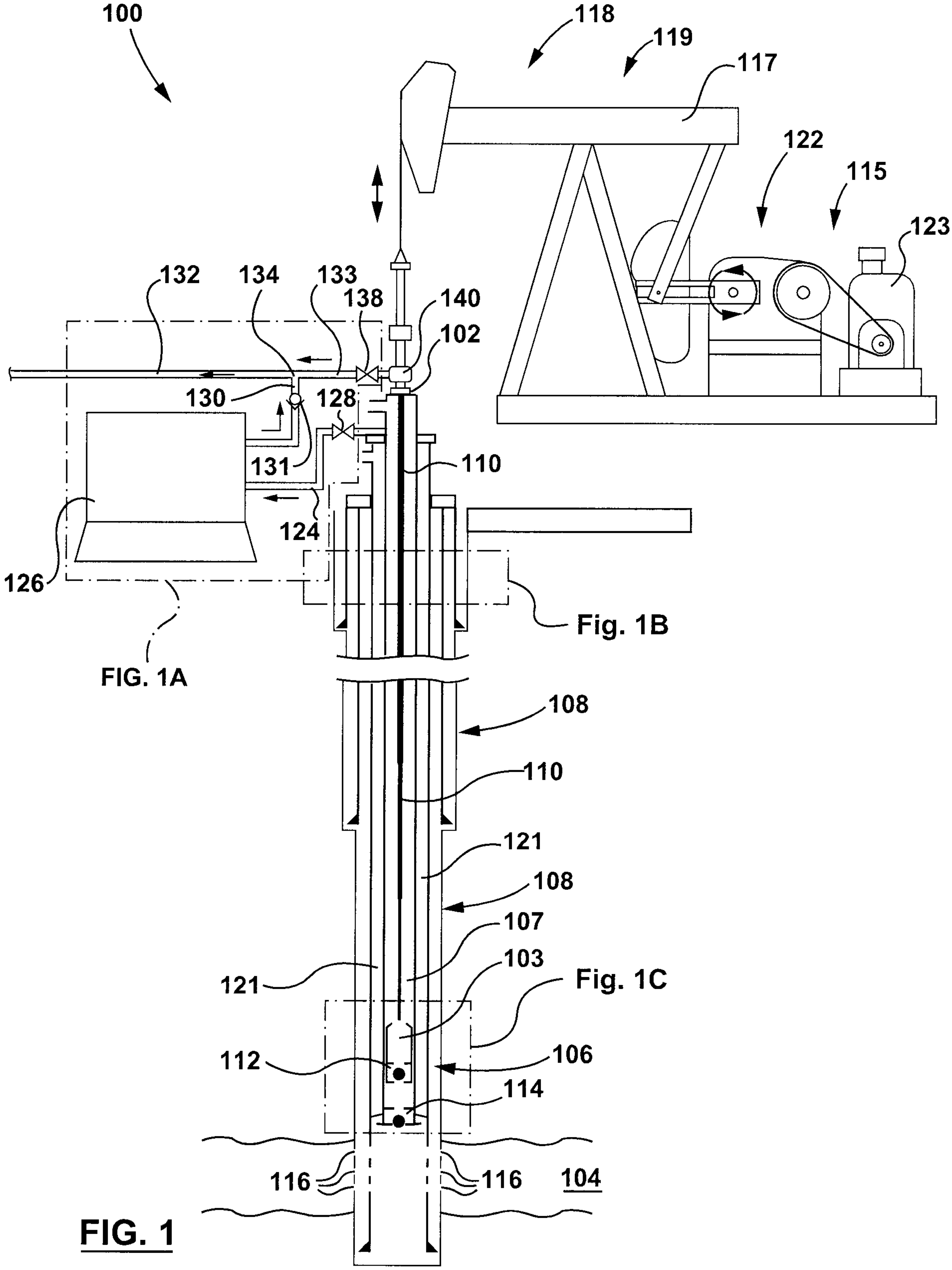
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Fig. 1B
FIG. 1A
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Fig. 1C
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FIG. 1

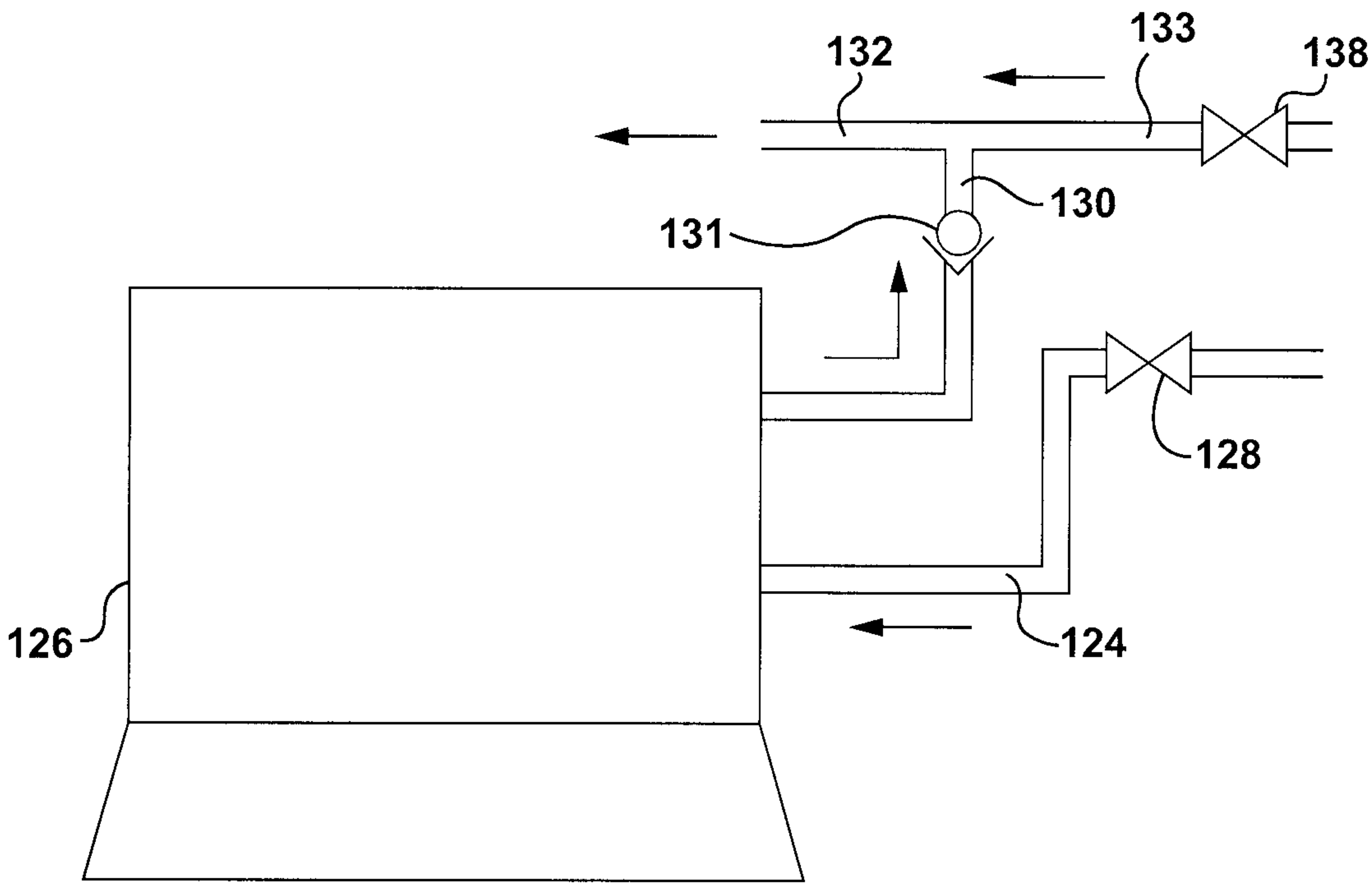

FIG. 1A

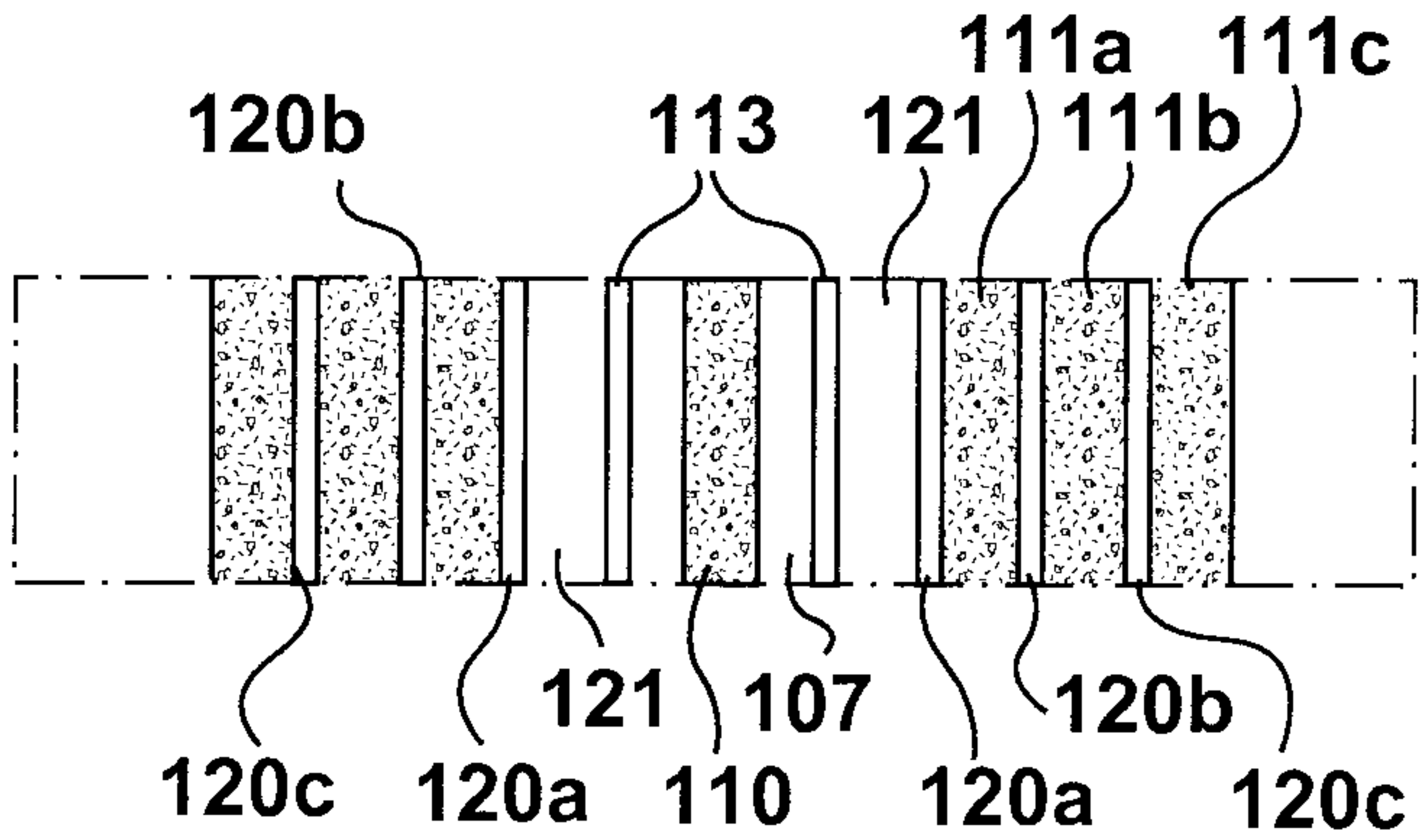
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FIG. 1B

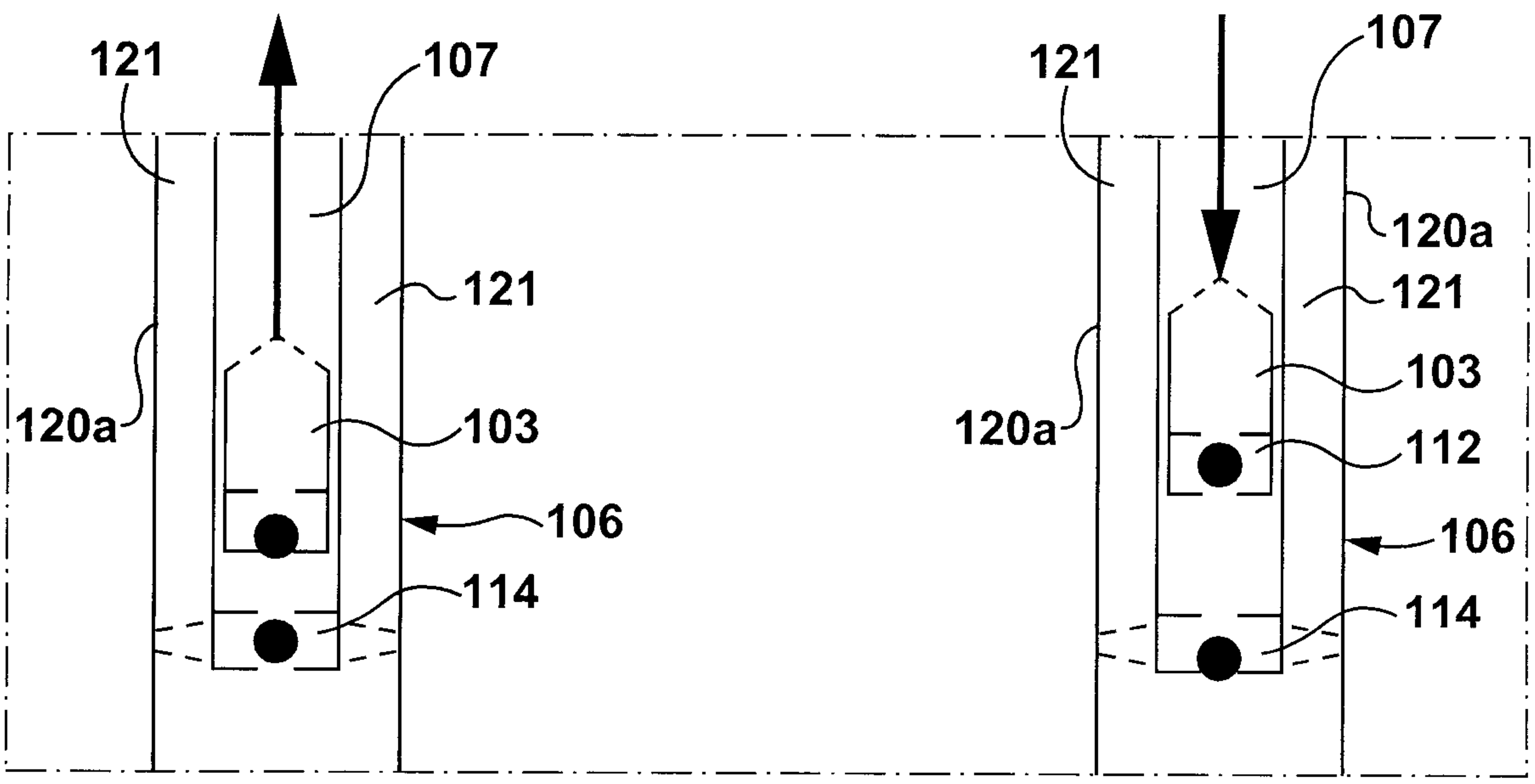
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FIG. 1C

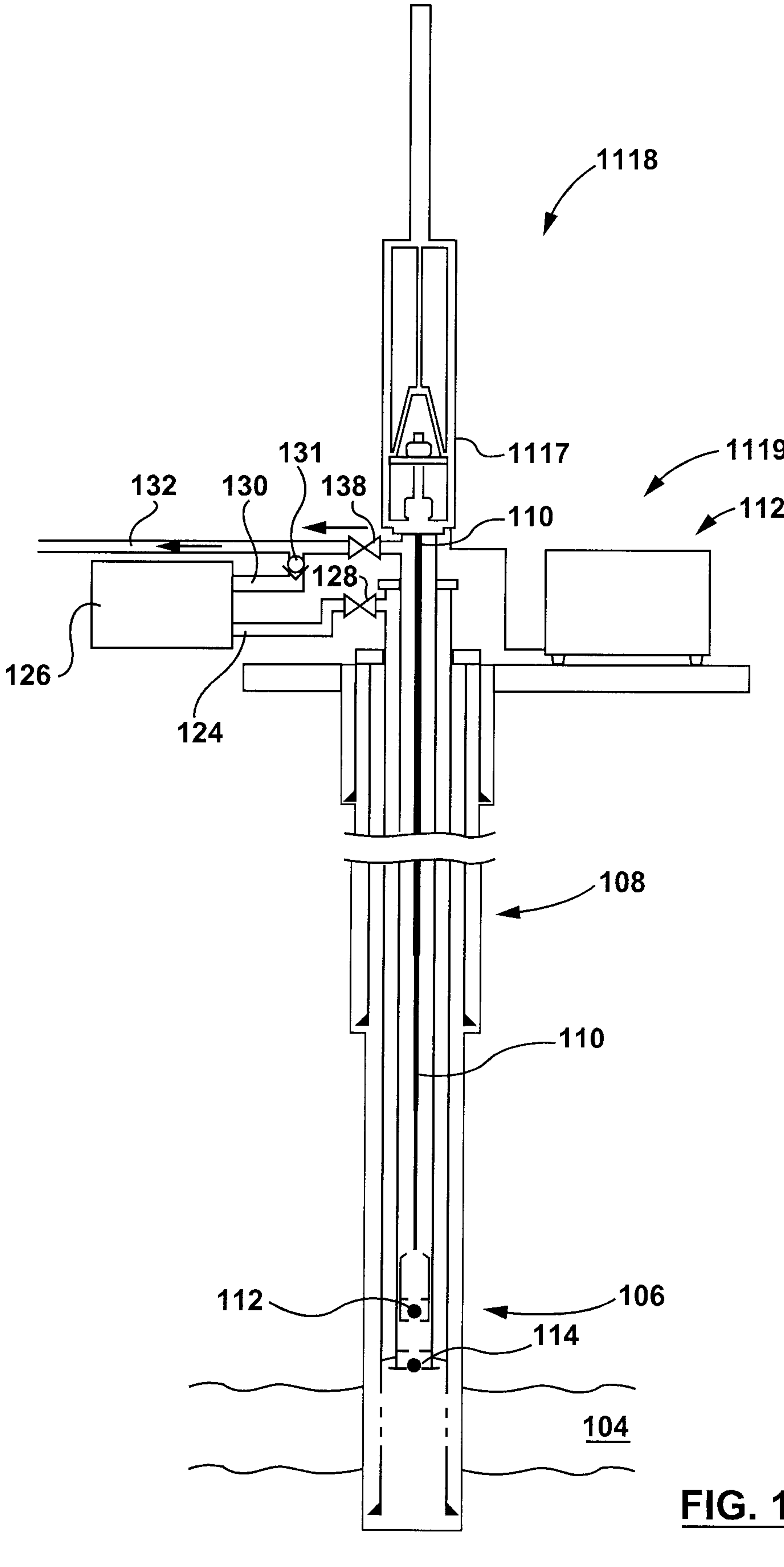
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FIG. 1D

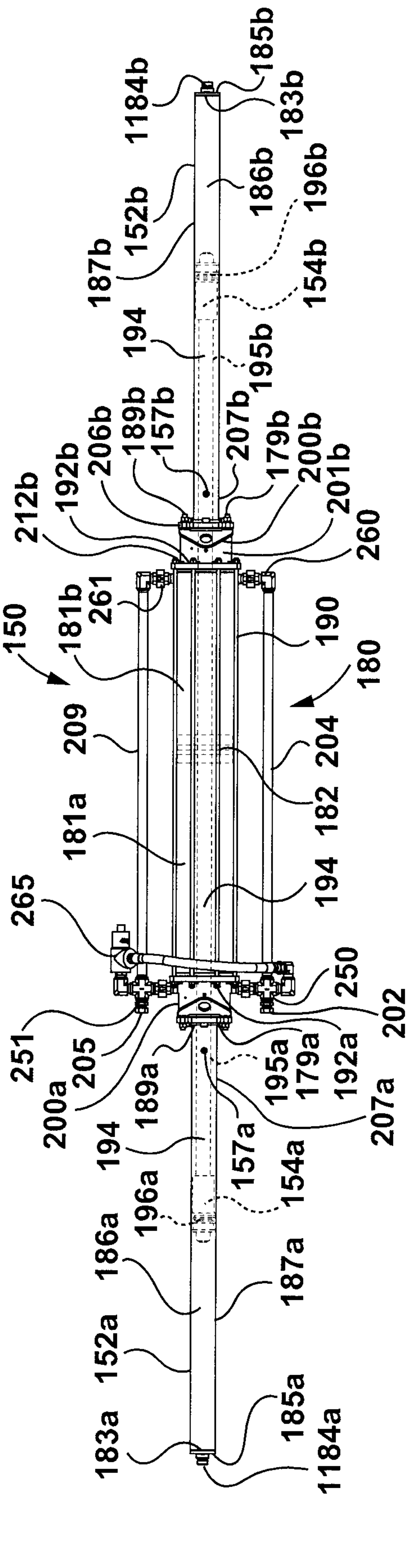

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FIG. 2

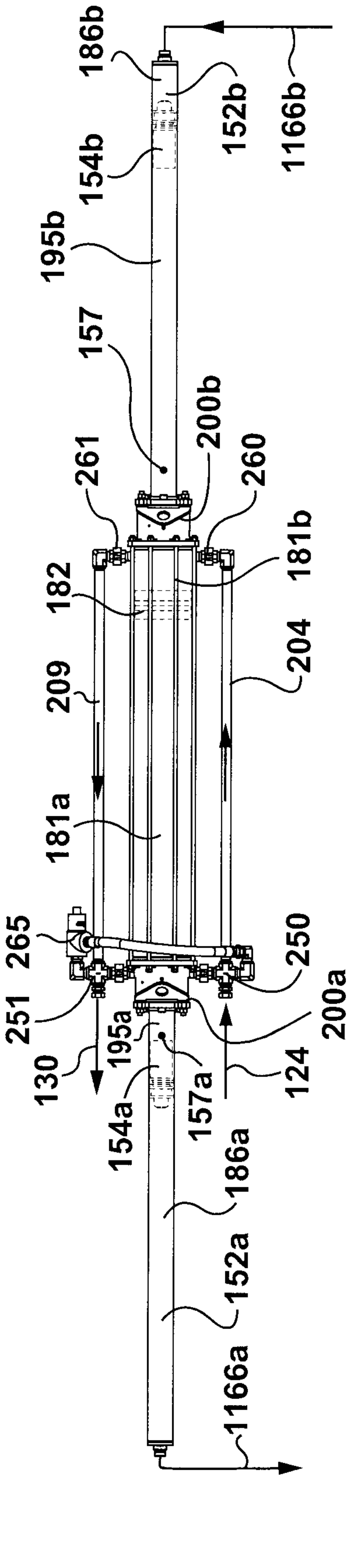
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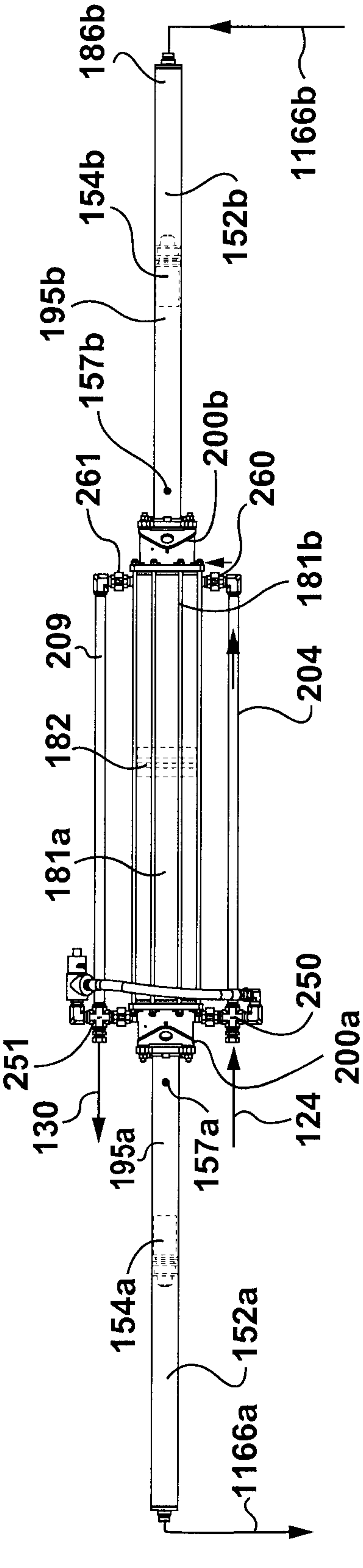
FIG. 3 (i)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200b
261
260
181b
209
204
182
181a
250
251
200a
130
124
195a
157a
154a
152a
1166a

FIG. 3 (ii)

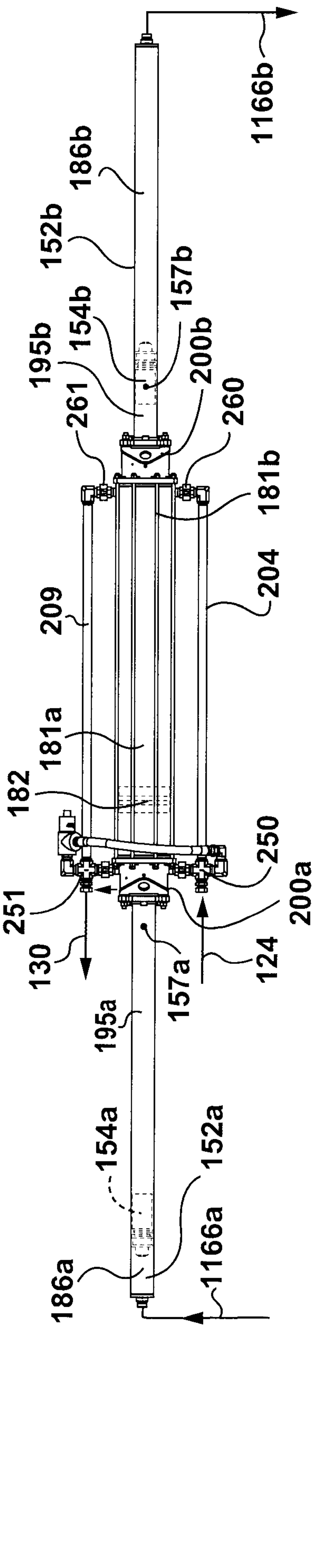

1166b
186b
152b
157b
154b
195b
200b
261
260
181b
204
209
181a
182
250
251
200a
130
124
157a
195a
154a
152a
1166a
186a

FIG. 3 (iii)

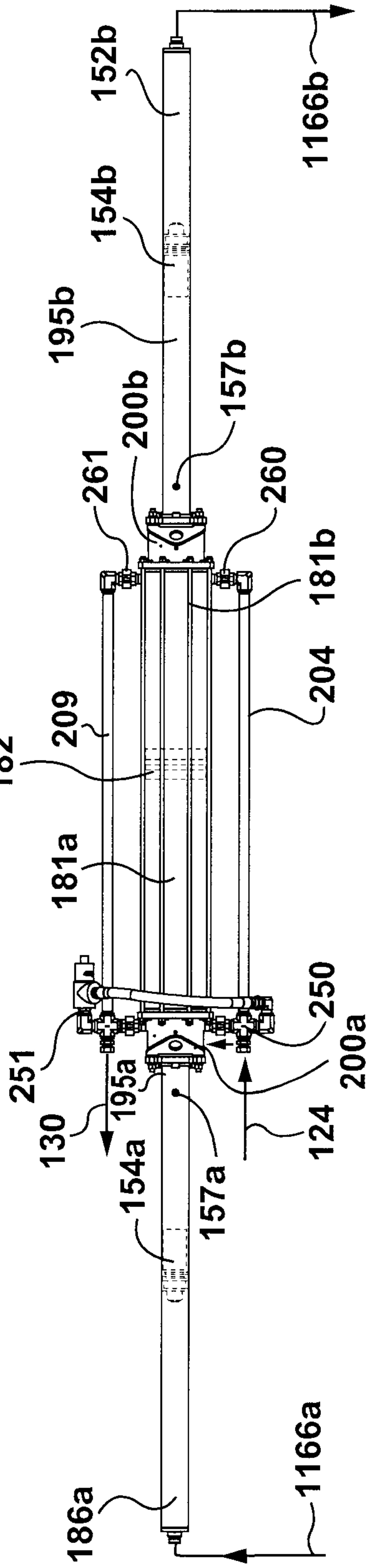

152b
1166b
154b
195b
157b
200b
261
260
181b
204
209
182
181a
250
251
200a
195a
130
124
154a
157a
1166a
186a

FIG. 3 (iv)

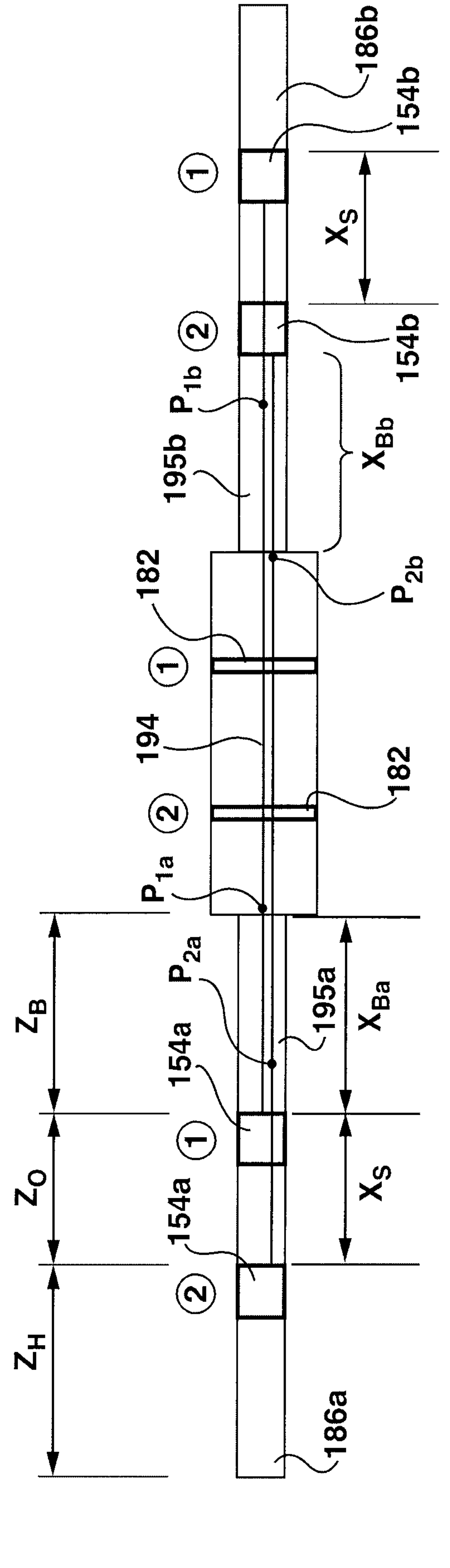

186b
154b
1
X_S
2
154b
P_{1b}
X_{Bb}
195b
P_{2b}
182
1
194
182
2
P_{1a}
Z_B
P_{2a}
195a
X_{Ba}
154a
1
Z_O
X_S
154a
2
Z_H
186a

FIG. 4

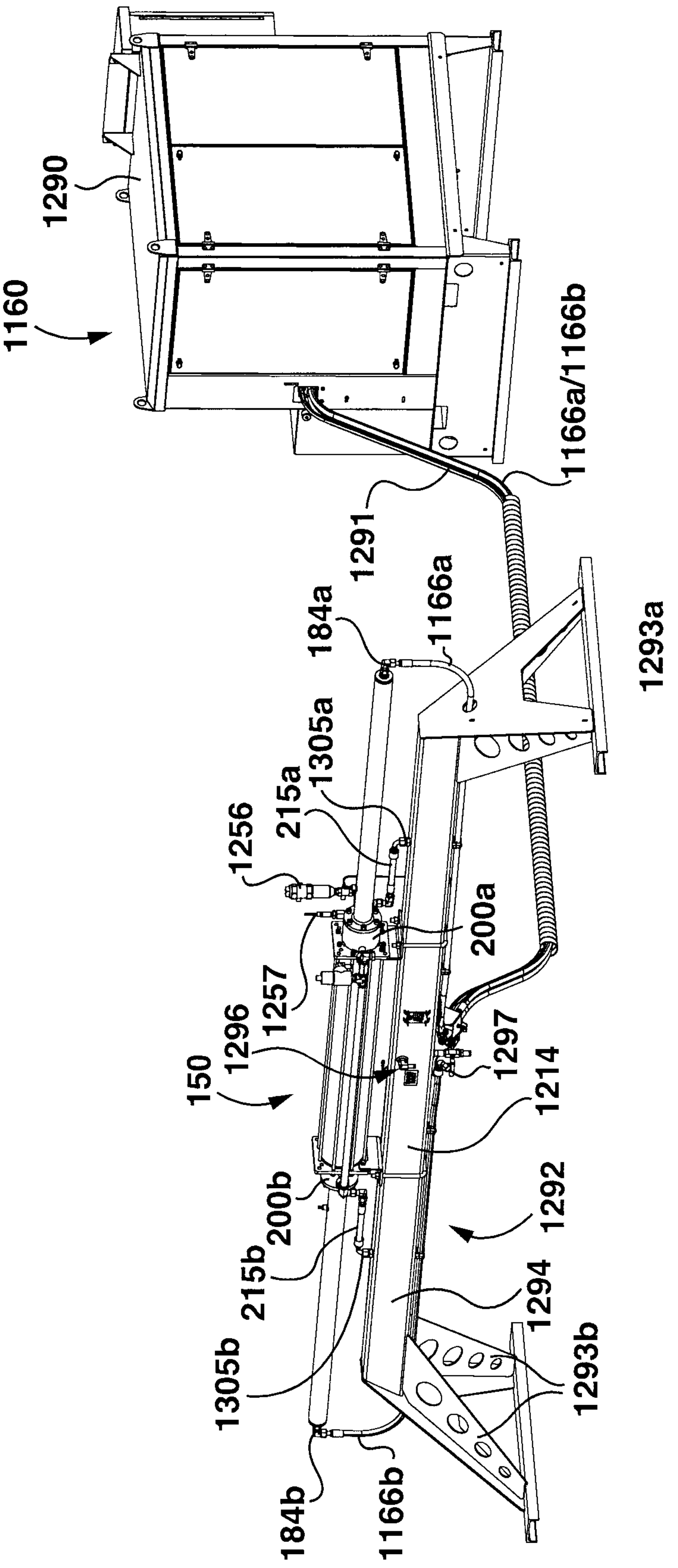

1290
1160
1166a/1166b
1291
1166a
184a
1293a
1305a
215a
1256
200a
1257
1296
150
1297
1214
1292
200b
215b
1294
1305b
1293b
184b
1166b

FIG. 5

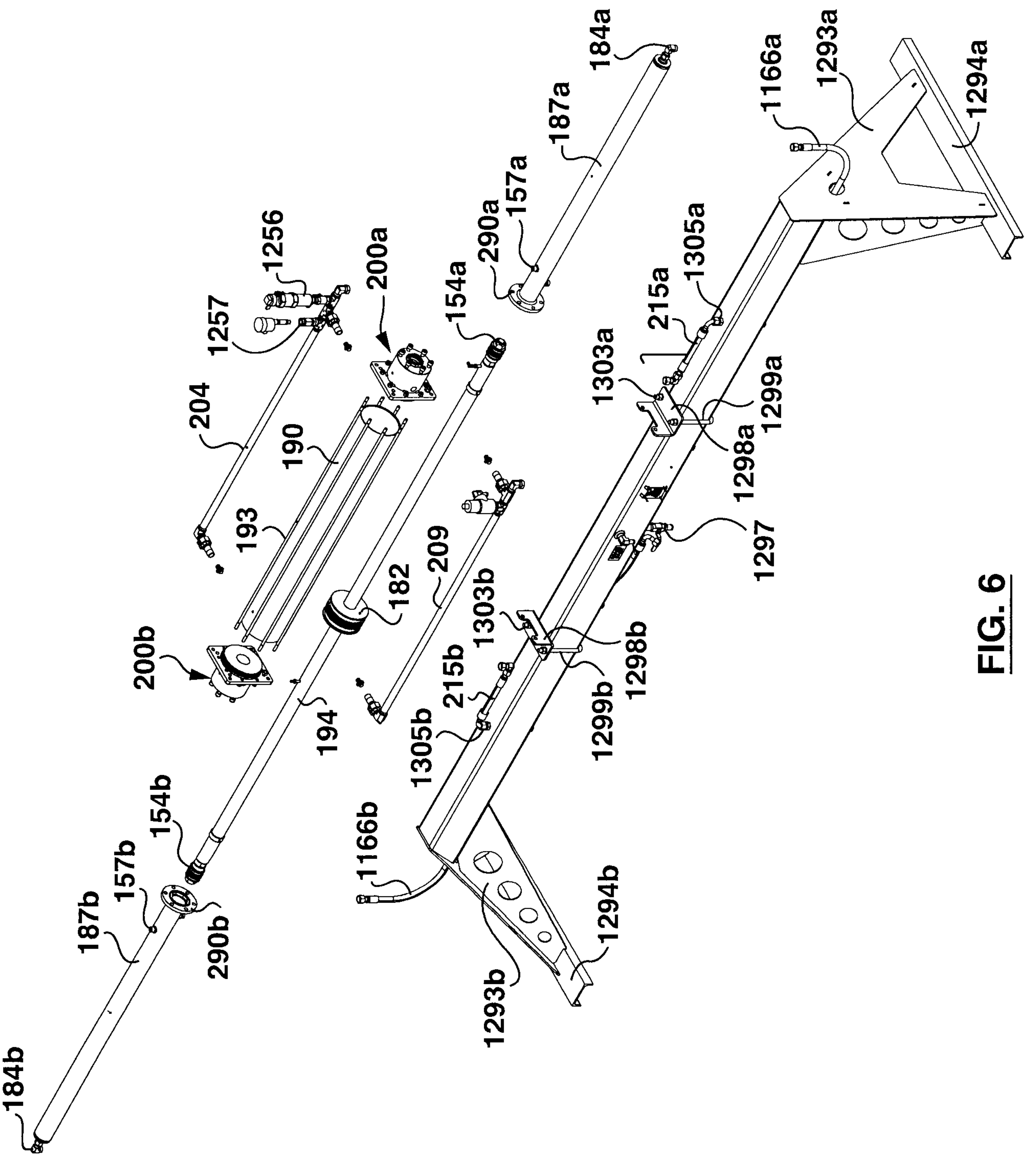

184a
187a
157a
290a
154a
200a
1256
1257
204
190
193
182
209
194
200b
154b
157b
187b
290b
184b
1166a
1293a
1294a
1305a
215a
1303a
1299a
1298a
1297
1303b
1298b
1299b
215b
1305b
1166b
1293b
1294b

FIG. 6

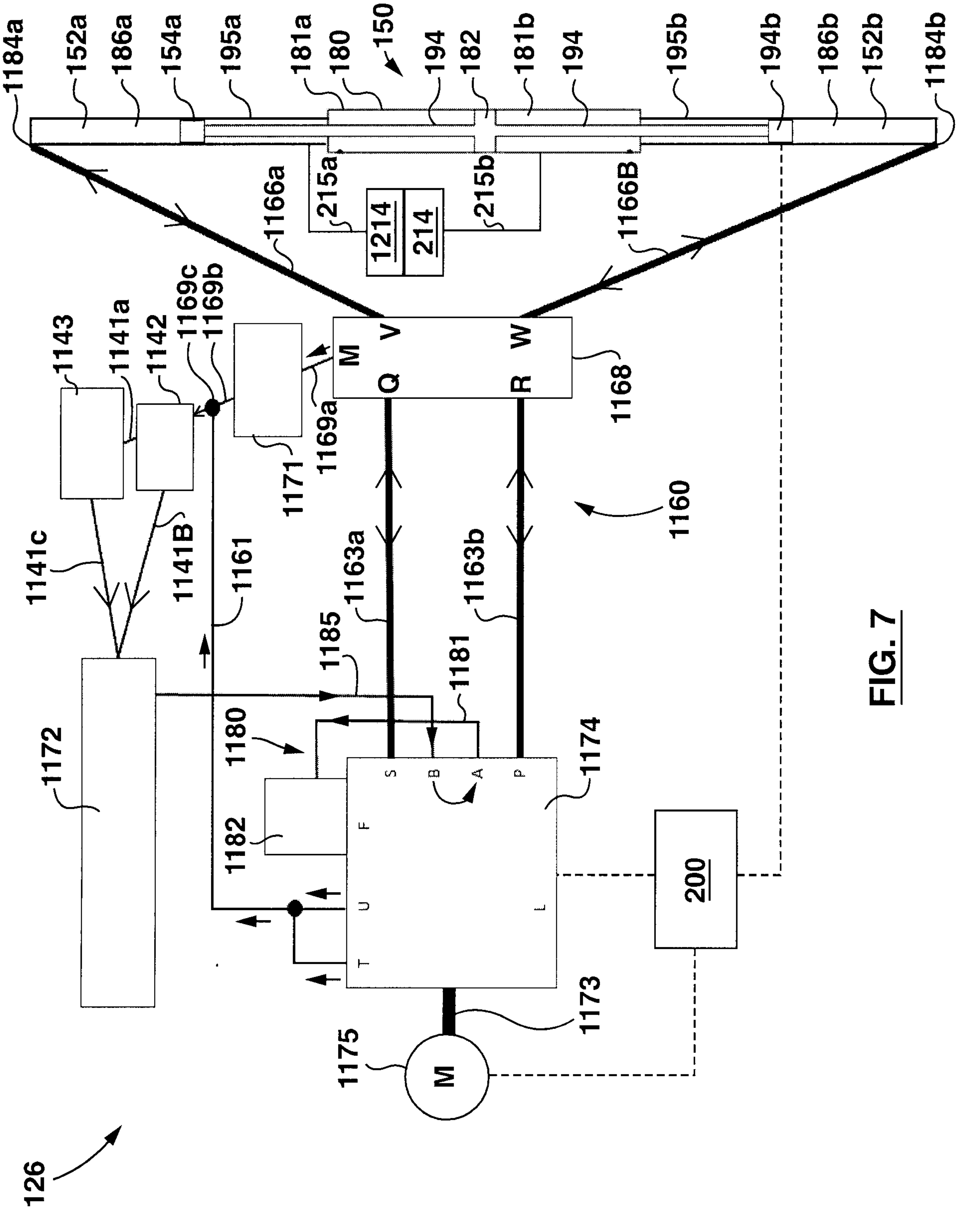

1184a
152a
186a
154a
195a
181a
180
150
194
182
181b
194
195b
194b
186b
152b
1184b
215a
215b
1166a
1166B
1214
214
1143
1141a
1142
1169c
1169b
1171
1169a
M
V
Q
W
R
1168
1160
1141c
1141B
1161
1163a
1163b
1185
1181
1180
S
B
A
P
1174
1172
1182
F
U
T
L
200
1173
1175
126

FIG. 7

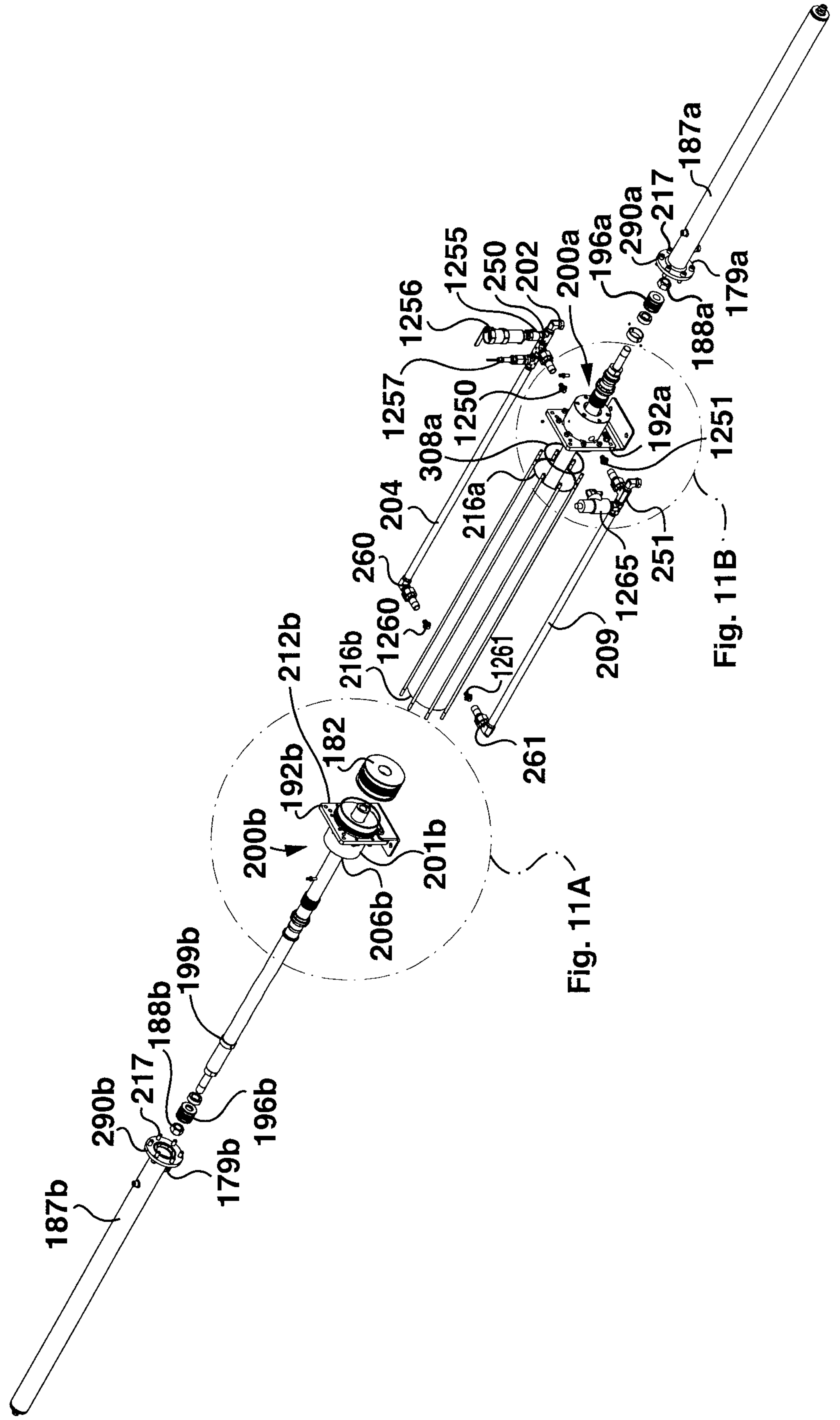

187a
217
290a
179a
188a
196a
200a
202
250
1255
1256
1257
1250
192a
1251
308a
216a
204
260
1260
251
1265
209
1261
261
216b
212b
182
192b
200b
201b
206b
Fig. 11A
Fig. 11B
199b
188b
217
290b
196b
179b
187b

FIG. 8

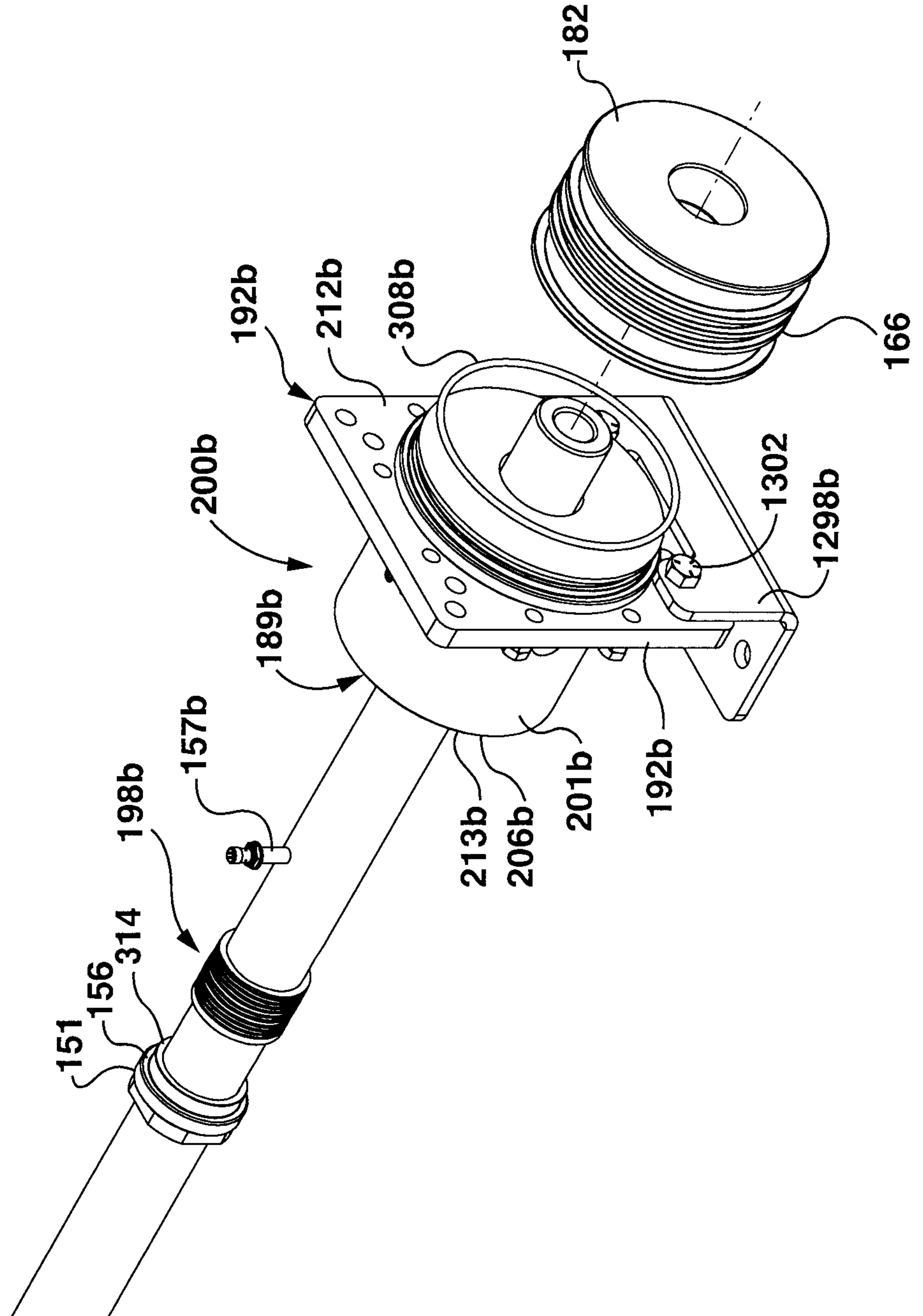

182
166
192b
212b
308b
200b
1302
1298b
189b
157b
198b
192b
201b
206b
213b
314
156
151

FIG. 8A

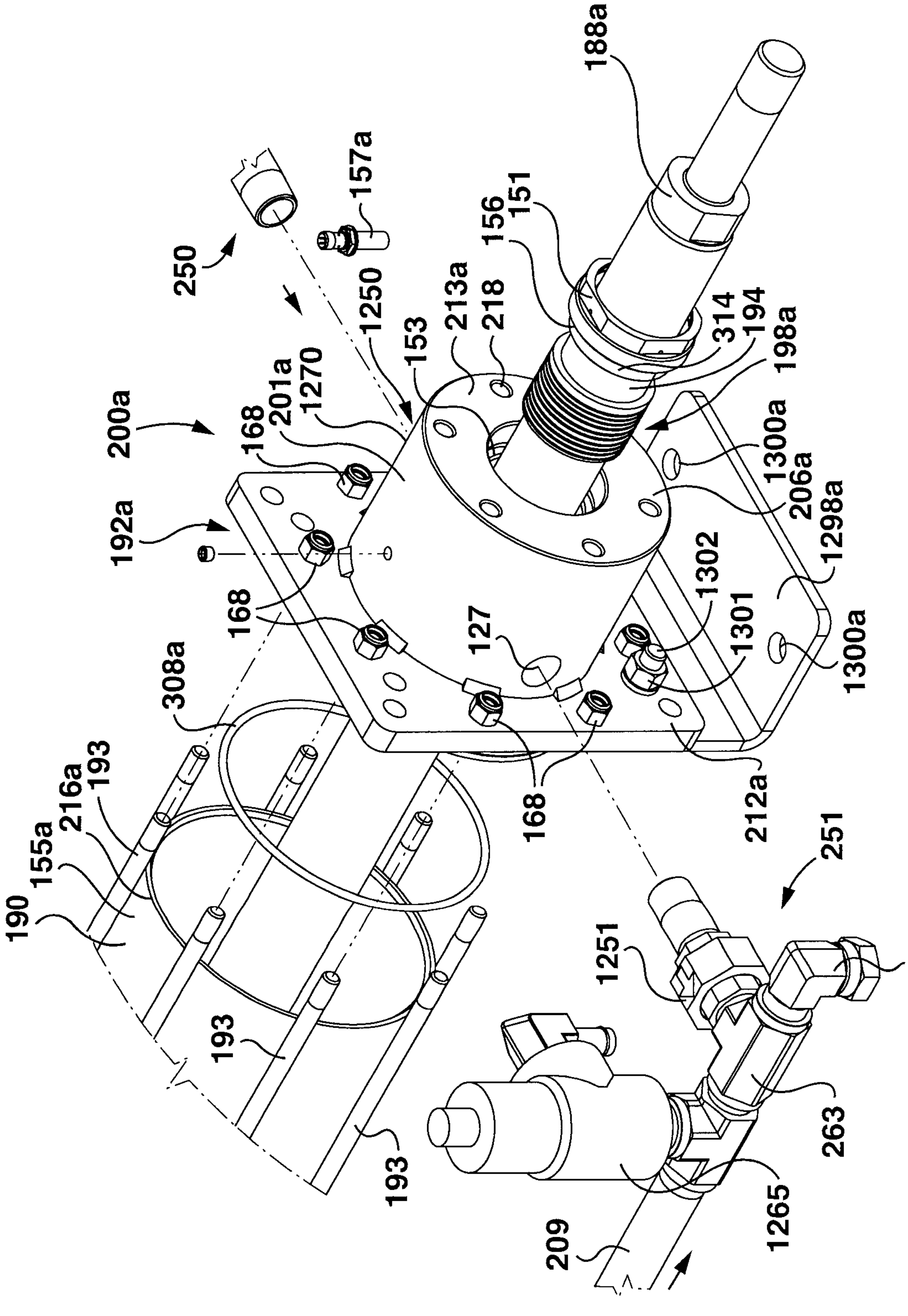

188a
157a
151
156
250
1250
213a
218
314
194
198a
153
200a
168
201a
1270
1300a
206a
1298a
192a
1302
1301
1300a
168
127
308a
168
212a
251
1251
205
190
155a
216a
193
193
263
193
1265
209

FIG. 8B

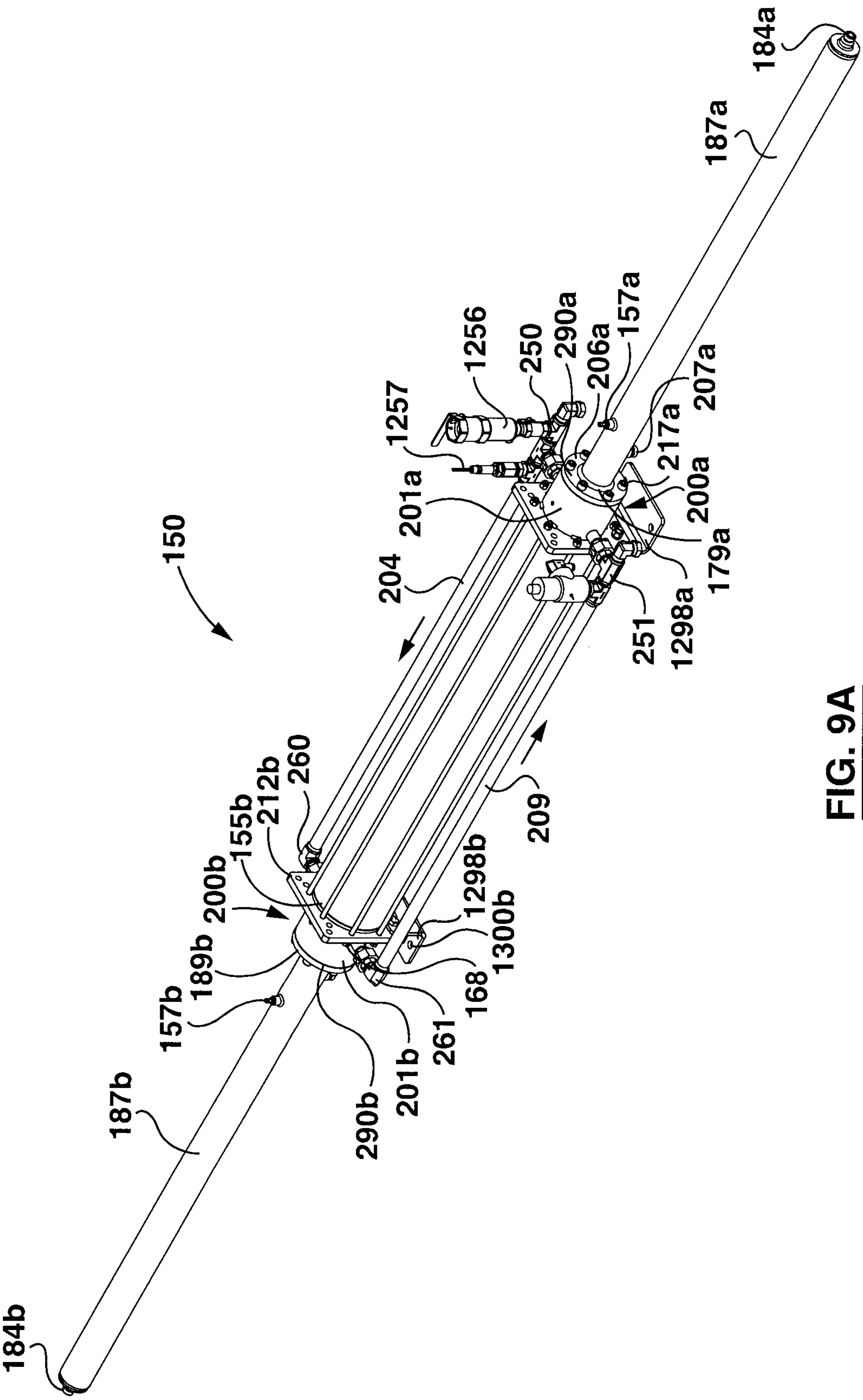

150
184a
187a
157a
206a
290a
250
1256
1257
201a
207a
217a
200a
179a
1298a
251
204
209
260
212b
155b
200b
189b
157b
187b
1298b
1300b
168
261
201b
290b
184b

FIG. 9A

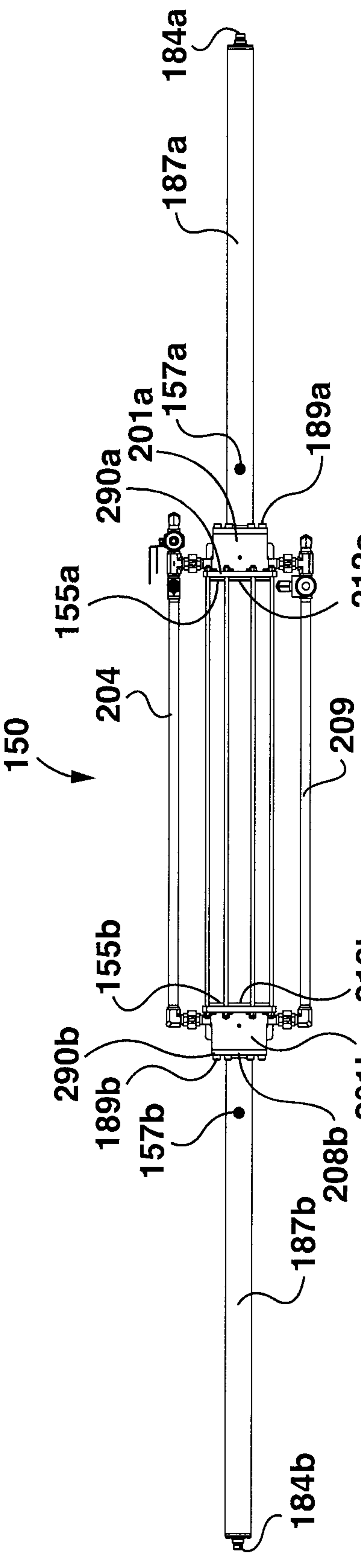

184a
187a
157a
201a
290a
189a
155a
212a
204
150
209
155b
212b
290b
201b
189b
157b
208b
187b
184b

FIG. 9B

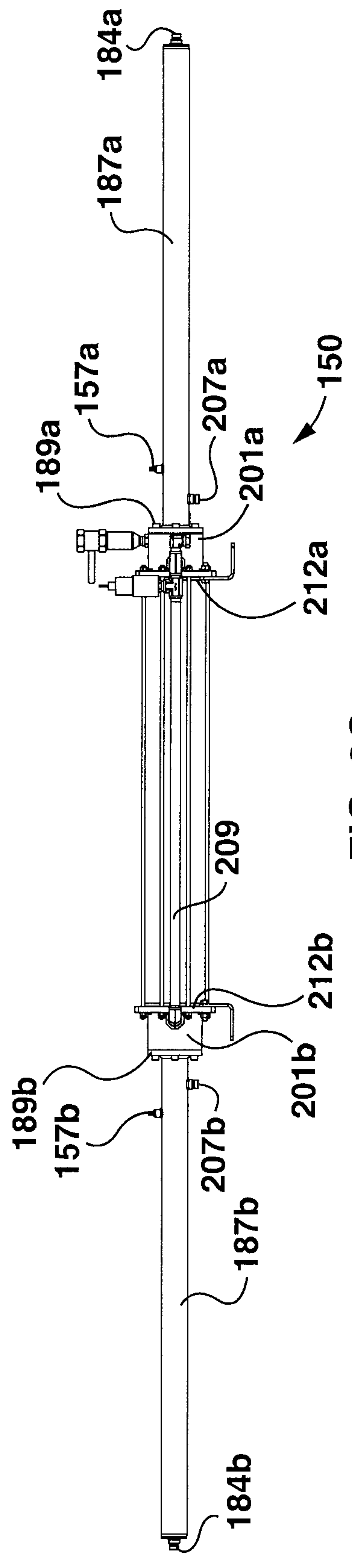
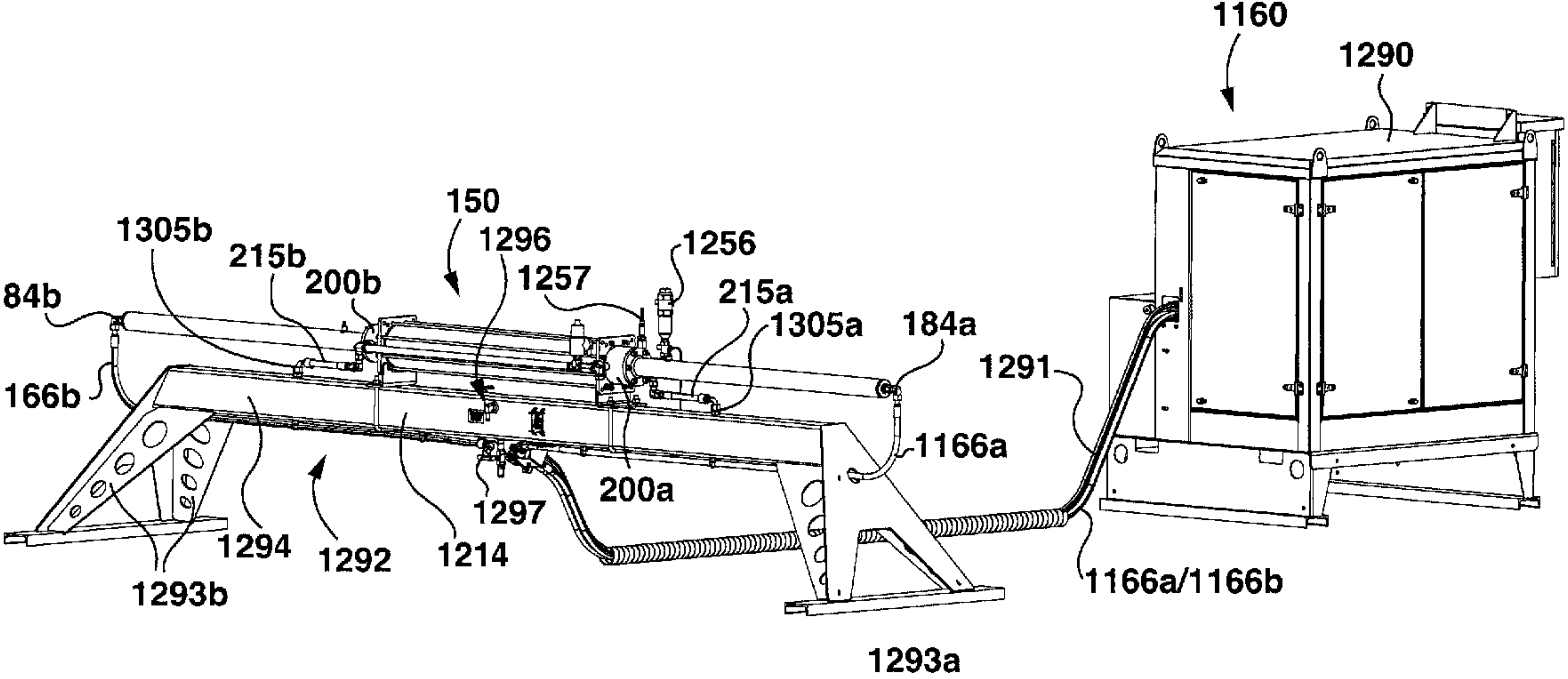

184a
187a
157a
150
207a
189a
201a
212a
209
212b
189b
201b
157b
207b
187b
184b

FIG. 9C


1160
1290
150
1305b
1296
1256
215b
200b
1257
184b
215a
1305a
184a
1291
1166b
1166a
200a
1297
1294
1292
1214
1293b
1166a/1166b
1293a