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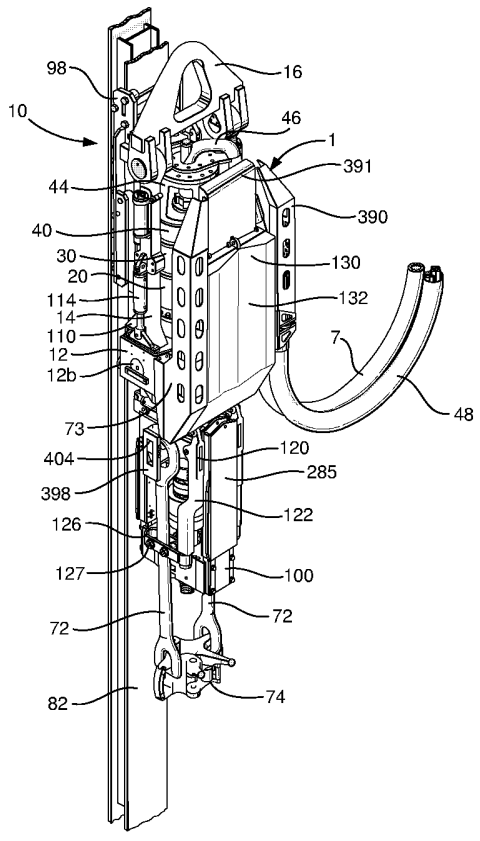

(57) Abstract: A top drive for wellbore operations, the top drive comprising an alternating current permanent magnet motor (30) having a bore therethrough, a planetary gear apparatus (20) coupled to the alternating current permanent magnet motor (30), the planetary gear apparatus (20) having a bore therethrough, the bore through the alternating current permanent magnet motor (30) substantially aligned with the bore through the planetary gear apparatus (20) so that fluid is flowable therethrough, the top drive further comprising a quill (50) drivingly connected to the planetary gear apparatus to rotate the quill.

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TOP DRIVE

The present invention relates to a top drive, particularly but not exclusively, to a top drive for use in drilling, construction, repair and maintenance of an oil or gas well. The present invention also relates to various components in or for use with a top drive.

The prior art discloses a variety of apparatuss which use a DC or AC motor. U.S. Patents 4,458,768; 5,433,279; 6,276,450; 4,813,493; 6,705,405; 4,800,968; 4,878,546; 4,872,577; 4,753,300; 6,536,520; 6,679,333 disclose various apparatuss.

The prior art discloses a Varco Drilling Systems TDS-9S AC Top Drive with an alternating current motor-powered top drive.

In accordance with a first aspect of the present invention, there is provided a top drive for wellbore operations, the top drive comprising an alternating current permanent magnet motor having a bore therethrough, a planetary gear apparatus coupled to the alternating current permanent magnet motor, the planetary gear apparatus having a bore therethrough, the bore through the alternating current permanent magnet motor substantially aligned with the bore through the planetary gear apparatus so that fluid is flowable therethrough, the top drive further comprising a quill drivingly connected to the planetary gear apparatus to rotate the quill.

Preferably, the alternating current permanent magnet motor is arranged above the planetary gear apparatus. Preferably, directly on top of, perhaps spaced by a spacer and/or means for inhibiting ingress of oil and

lubricants. Advantageously, the top drive further comprises a support arrangement for supporting the alternating current permanent magnet motor and the planetary gear apparatus, the support arrangement comprising a swivel body, a suspension member above the permanent magnet motor, at least one link arranged between the swivel body and the suspension member. Preferably, the swivel body is located below the planetary gear apparatus. Advantageously, two links are arranged between the swivel body and the suspension member. Preferably, the at least one link is provided with an opening therethrough for receiving a pin or ear, the opening oversized to allow a degree of vertical movement. Preferably a non-circular opening, most preferably elongate.

Advantageously, the suspension member comprises a block having sheaves and a becket rigidly fixed thereto, the sheaves connectable to a rope to a derrick of a rig and the becket connected to the at least one link. Preferably, rotatably fixed thereto and advantageously fixable a various angles and advantageously, releasably fixed thereto. Preferably, the becket is selectively securable to the travelling block in a plurality of positions.

Advantageously, the top drive further comprises a weight compensation device arranged between the becket and the swivel body for compensating for the weight of the top drive and a tubular to be stabbed during a stabbing operation to inhibit damage to tubulars. Preferably, the weight compensation device comprises a hydraulic piston and cylinder and an accumulator.

Preferably, the swivel body has an interior, a main bearing disposed within the interior, the quill having a

flange resting on and rotatable on the main bearing.

Advantageously, the top drive further comprises a load sleeve retained by the swivel body, the quill rotatable within the load sleeve, a load collar positioned around the load sleeve and supported thereby, at least one bail depending from the load collar and an elevator for selectively receiving and holding a tubular, the elevator supported by the at least one bail. Preferably, two bails depend from the load collar from ears and support the elevator on opposing sides of the elevator. Preferably, the top drive further comprises a tilt apparatus for tilting the at least one bail, the tilt apparatus arranged to rotate the bails about the load collar for tilting the at least one bail central line extending down through a centre of the permanent magnet through a centre of the planetary gear apparatus, through a centre of the quill, the centres aligned. Advantageously, the tilt apparatus comprises a clamp on the at least one bail,the clamp having two roller pins between which a portion of the at least one bail movable to facilitate movement of the bail with respect to the clamps.

Preferably, the two roller pins are mounted with mounting plates having offset holes for mounting the roller pins so that reversing the mounting plates changes the distance between the roller pins to accommodate a bail of different widths.

Advantageously, the top drive further comprises a clamping apparatus rotatably arranged on the top drive, the clamping apparatus for selectively clamping a tubular.

Preferably, the load collar is freely rotatably disposed, the clamping apparatus disposed between the two

bails, such that the load collar, bails and elevator can rotate with the clamping mechanism. Advantageously, the clamping apparatus comprises at least one two jaw for selective receipt therebetween of a tubular to be clamped therebetweeen. Preferably at least two jaws. The tubular to be gripped or clamped in the clamping apparatus may be a saver sub, a pipe, casing or a tool. Advantageously, the at least one jaw comprises a piston movable within a cylinder toward and away from a tubular to be clamped. Preferably, the clamping apparatus further comprises at least one telescopic leg. Preferably, the at least one leg depends from the load collar. Advantageously, the clamping apparatus comprises at least two spaced-apart telescopic legs. Preferably, the top drive further comprises at least one further motor.

Preferably, the top drive further comprises electrical power generating apparatus connected to the clamping apparatus for providing electrical power. Advantageously, the top drive further comprises a hydraulic manifold, a plurality of directional control valves for control hydraulic fluid flow in a plurality of corresponding flow lines, the plurality of corresponding flow lines including flow lines for providing hydraulic fluid to power apparatus below the clamping system. Preferably, the hydraulic manifold and the plurality of directional control valves are arranged on the at least one telescopic leg.

Preferably, the load sleeve has fluid conducting channels and the apparatus further comprises a rotating head connected to the load sleeve for receiving fluid from the load sleeve's fluid conducting channels and for conveying the fluid to the lower hydraulic manifold, and the rotating head rotatable with the clamping apparatus.

Advantageously, the top drive further comprises a selective locking mechanism secured to the swivel body for selectively locking the clamping apparatus preventing its rotation while the quill is allowed to rotate. Preferably, the clamping apparatus depends from a gear collar, which is movable or brakeable in response to the locking mechanism. Most preferably, the clamping apparatus is in rotational communication with the gear collar and the load collar. The load collar and gear collar may be integral and may be cast in a single unit. Preferably, the top drive further comprises a mud saver apparatus releasably connected to the quill. Preferably, the top drive further comprises a saver sub. Preferably, releasably connected to and below the mud saver apparatus. Advantageously connected with a non-rotating connecting means. Preferably, first connection locking apparatus locks the quill to the mud saver apparatus, and second connection locking apparatus locks the mud saver apparatus to the saver sub.

Advantageously, a spacer plate is arranged between the alternating current permanent magnet motor and the planetary gear apparatus, the spacer plate having a bearing recess, and a bearing in the bearing recess for facilitating rotation of the quill.

Preferably, the top drive further comprises an access platform pivotably connected at a lower end to the swivel body, the access platform with a platform portion pivotable to a generally horizontal position so that personnel on the access platform can access components of the top drive.

Advantageously, the top drive further comprises an extension mechanism for moving the top drive horizontally. Preferably the extension mechanism

comprises a plurality of piston and cylinders and a frame. Preferably, the extension mechanism has an opening through which a tubular stand is movable while the extension mechanism with the top drive connected thereto moves with respect to the tubular stand.

* * *

A second aspect of the present invention provides apparatus for use in a top drive for releasably holding a tubular, the apparatus comprising at least two opposed clamping apparatuses, spaced-apart for selective receipt of a tubular to be clamped therebetweeen, each of the two opposed clamping apparatuses having a mount and a piston movable within the mount, the piston selectively movable toward and away from a tubular to be clamped,

two spaced-apart telescopic legs which in use depend from a part of the top drive, the telescopic legs for moving the at least two opposed clamping apparatus in a substantially vertical plane. Preferably, the tubular comprises one of: pipe, casing, tubing, saver sub, and quill of a apparatus.

Preferably, the two opposed clamping apparatuses are releasably connected together with connection apparatus so that either or both connection apparatuses are disconnectible. Preferably, the two halves openable to receive a tubular to be clamped upon disconnection of one of the two connection apparatuses, the two halves separable and movable apart upon disconnection of both connection apparatuses. Advantageously, each connection apparatus comprises a plurality of spaced-apart intermeshing lugs with holes therein and a pin removably insertable through the holes. Preferably, such that a hinge is formed. Advantageously, the two telescopic legs have a non-circular cross-section. Preferably,

rectangular, oblong or square in cross-section. Preferably, the apparatus further comprises a spring apparatus within each telescopic leg for compensating for movement of a tubular clamped by the apparatus. Preferably, the compensation facilitates stabbing, in that damage is less likely to occur in mating threads when at least the majority of the weight of the tubular to be connected to a string is compensated for. Advantageously, the apparatus further comprises a piston and cylinder in each telescopic leg, the cylinder with a vacuum therein and as a piston extensible from and retractable within the hollow cylinder, the piston and providing compensation for movement of the member clamped by the clamping apparatus.

Preferably, the telescopic legs each comprise an outer leg portion and an inner leg portion further comprising a chain connection structure on each outer leg portion and each inner leg portion to which a chain is connectible to prevent separation of the outer leg portion from the inner leg portion. Advantageously, the apparatus further comprises guide apparatus secured to and below the two opposed clamping apparatuses for guiding a tubular between the two opposed clamping apparatuses. Preferably, the guide apparatus is releasably connected to at least one of the two opposed clamping apparatuses. Preferably, chained or pinned.

Advantageously, the apparatus further comprises generator apparatus connected to one of the two legs for generating electrical power. Preferably, the apparatus further comprises electrical distribution apparatus. Advantageously, the generator apparatus converts hydraulic power from fluid flow and/or pressure into electricity. Thus providing a top drive with an

electrical power generator which is rotatable with pipe handling apparatus

Preferably, the further comprises a hydraulic fluid manifold connected to at least one of the two telescopic legs for receiving hydraulic fluid from an hydraulic fluid source and for providing hydraulic fluid for releasably clamping and holding a member for wellbore operations. Preferably, for supplying hydraulic fluid to another item below the apparatus. Advantageously, the hydraulic fluid manifold includes a plurality of hydraulic fluid conduits and a plurality of controllable valves for selectively controlling fluid flow in each hydraulic fluid conduit. Preferably, the apparatus further comprises generator apparatus connected to at least one of the two legs for generating electrical power, and controller apparatus on one of the two legs in communication with the controllable valves for controlling the controllable valves.

Preferably, controller apparatus includes digital signal processing apparatus and an antenna for communicating with the controller apparatus from a location spaced-apart from the apparatus for releasably clamping and holding a tubular for wellbore operations.

Advantageously, each piston comprises a die holder and die apparatus for engaging the tubular member. Preferably, each housing has a cylinder lining the housing, the piston slideably arranged in the cylinder.

Preferably, the apparatus further comprises a connection structure on each of the two telescopic legs for connecting the apparatus to the top drive. Preferably, to a rotation apparatus for rotation thereby. Advantageously, the connection structure provides a pivotable connection of each telescopic leg at its upper

end for pivoting the two telescopic legs apart from each other.

Preferably, the two legs further comprise an anti-rotation structure for receiving part of an adjacent apparatus and releasably holding the part so that the adjacent apparatus is rotatable simultaneously with the apparatus for releasably clamping and holding a member for wellbore operations.

The second aspect of the invention also provides a top drive comprising a drive motor and an apparatus of the invention.

The second aspect of the invention also provides a method for gripping an item, the method comprising the steps of positioning the item within a main body of an apparatus, the apparatus comprising a main body, two opposed clamping apparatuses in the main body, the two opposed clamping apparatuses spaced-apart for selective receipt therebetween of a member to be clamped therebetweeen, each of the two opposed clamping apparatuses having a mount and piston apparatus movable within the mount, the piston apparatus selectively movable toward and away from a member to be clamped, two legs, the legs spaced-apart and each leg with an upper end and a lower end, each lower end connected to the main body, each leg comprising an outer leg portion and an inner leg portion, the inner leg portion having part thereof movable within the outer leg portion to provide a range of up/down movement for the main body, wherein the member for wellbore operations is a tubular member, and each piston apparatus including a piston and a die holder secured to an outer end of the piston, and die apparatus on the die holder for engaging the tubular member, each mount having a liner removably disposed therein, each

piston movable within a corresponding liner, and moving the pistons so that the die apparatus engages the item to be gripped thereby gripping the item.

Preferably, the method further comprises the step of rotating the apparatus thereby rotating the item gripped by the apparatus.

* * *

A third aspect of the present invention provides a top drive comprising a drive motor, and a support apparatus and tubular handling apparatus connected to and below and supported by the support apparatus, the tubular handling apparatus including hydraulic-fluid-powered apparatus on or below the tubular handling apparatus, provision apparatus connected to the tubular handling apparatus for providing hydraulic fluid to power the hydraulic-fluid-powered apparatus, the provision apparatus including flow line apparatus for providing hydraulic fluid to the hydraulic-fluid-powered apparatus and electrically-operable control apparatus for controlling fluid flow to and from the flow line apparatus, and electrical power generating apparatus connected to the tubular handling apparatus for providing electrical power to the electrically-operable control apparatus.

Preferably, the top drive further comprises a gear apparatus, a drive quill coupled to the gear apparatus and a suspension arrangement. Preferably, the tubular handling apparatus includes clamping apparatus for clamping an item, the clamping apparatus powered by hydraulic fluid from the provision apparatus. Advantageously, the clamping apparatus is rotatable with respect to the drive motor, the support apparatus including a locking mechanism for selectively locking the

tubular handling apparatus in position, the locking mechanism comprising driving apparatus for rotating the clamping apparatus, the drive quill rotatable by the gear apparatus with the clamping apparatus locked in position by the locking mechanism.

Preferably, the electrically-operable control apparatus includes a plurality of selectively operable control valves which selectively control flow of hydraulic fluid to apparatuses below the support apparatus. Advantageously, the apparatuses below the lower support apparatus include clamping apparatus for clamping an item, elevator for supporting an item, and link-tilt apparatus for moving the elevator at an angle to the support apparatus. Preferably, the clamping appapratus comprises at least two opposed clamping apparatuses, spaced-apart for selective receipt of a tubular to be clamped therebetweeen, each of the two opposed clamping apparatuses having a mount and a piston movable within the mount, the piston selectively movable toward and away from a tubular to be clamped,

two spaced-apart telescopic legs which in use depend from a part of the top drive, the telescopic legs for moving the at least two opposed clamping apparatus in a substantially vertical plane.

Preferably, the top drive further comprises a piston and cylinder in each telescopic leg with a first part thereof connected to the upper end and a second part thereof connected to the lower end, each piston and cylinder wherein the cylinder has a vacuum therein and the piston is extensible from and retractable within the cylinder, the piston and cylinder providing compensation for movement of the tubular clamped by the clamping apparatus, fluid to power the piston and cylinder

provided by the provision apparatus.

Advantageously, the generator apparatus for generating electrical power is connected to one of the two telescopic legs. Preferably, the provision apparatus comprises a hydraulic fluid manifold connected to one of the two telescopic legs for receiving hydraulic fluid from an hydraulic fluid source and for providing hydraulic fluid to the generator apparatus to power the generator apparatus. Advantageously, the hydraulic fluid manifold includes a plurality of hydraulic fluid conduits and a plurality of controllable valves for selectively controlling fluid flow in each hydraulic fluid conduit. Preferably, the top drive further comprises a rotating head connected to and between the two telescopic legs, the rotating head for receiving hydraulic fluid from a fluid supply and for providing the hydraulic fluid to power the generator. Advantageously, the rotating head provides hydraulic fluid for the plurality of controllable valves.

Preferably, the drive motor is an alternating current permanent magnet motor having a bore therethrough, a planetary gear apparatus coupled to the alternating current permanent magnet motor, the planetary gear apparatus having a bore therethrough, the bore through the alternating current permanent magnet motor substantially aligned with the bore through the planetary gear apparatus so that fluid is flowable therethrough, the top drive further comprising a quill drivingly connected to the planetary gear apparatus to rotate the quill.

Preferably, the suspension arrangement comprises a swivel body, a suspension member above the permanent magnet motor, at least one link arranged between the

swivel body and the suspension member. Preferably, the swivel body is located below the planetary gear apparatus. Advantageously, two links are arranged between the swivel body and the suspension member. Preferably, the at least one link is provided with an opening therethrough for receiving a pin or ear, the opening oversized to allow a degree of vertical movement. Preferably a non-circular opening, most preferably elongate. Advantageously, the suspension member comprises a block having sheaves and a becket rigidly fixed thereto, the sheaves connectable to a rope to a derrick of a rig and the becket connected to the at least one link. Preferably, rotatably fixed thereto and advantageously, releasably fixed thereto. Advantageously, the becket is selectively securable to the travelling block in a plurality of positions. Preferably, the top drive further comprises a weight compensation device arranged between the becket and the swivel body for compensating for the weight of the top drive and a tubular to be stabbed during a stabbing operation to inhibit damage to tubulars. Preferably, the weight compensation device comprises a hydraulic piston and cylinder and an accumulator. Advantageously, the swivel body has an interior, a main bearing disposed within the interior, the quill having a flange resting on and rotatable on the main bearing. Preferably, the top drive further comprises a load sleeve retained by the swivel body, the quill rotatable within the load sleeve, a load collar positioned around the load sleeve and supported thereby, at least one bail depending from the load collar and an elevator for selectively receiving and holding a tubular, the elevator supported by the at least one bail.

Preferably, the top drive further comprises an access platform pivotably connected at a lower end to the swivel body, the access platform with a platform portion pivotable to a generally horizontal position so that personnel on the access platform can access components of the top drive.

Advantageously, the top drive further comprises an extension mechanism for moving the top drive horizontally. Preferably the extension mechanism comprises a plurality of piston and cylinders and a frame. Preferably, the extension mechanism has an opening through which a tubular stand is movable while the extension mechanism with the top drive connected thereto moves with respect to the tubular stand.

* * *

A fourth aspect of the present invention provides a containerized apparatus comprising a container, top drive removably disposed within the container, an extension mechanism for moving the top drive generally horizontally within a derrick, the top drive secured to the extension mechanism, the extension mechanism removably disposed within the container with the top drive, a track for the top drive to move in a vertical plane in use in a derrick, the track comprised of multiple track parts connectible together, a skid for retaining the top drive during transit, a part of the skid forming at least one track part. Alternatively or preferably, the skid forms a torque frame, such that the skid forms part of the top drive in use to help react the torque of the drive motor. Preferably, the container is an ISO container, preferably a 40′x8′x8,5′ ISO container.

Preferably, the track further comprises at least one first compartment for removably storing the multiple

track parts, the multiple track parts removably located in the at least one first compartment, and the multiple track parts assembleable outside the container to include the multiple track parts and the at least one skid track part with the extension mechanism movable along the track with the top drive. Advantageously, the multiple track parts include at least one length-adjustable track part so that the track is installable in derricks of different height. Preferably, the top drive apparatus includes a motor, a gear system, and tubular handling apparatus, the tubular handling apparatus including an elevator for selective holding a tubular and links to connect the elevator to the top drive apparatus, the motor, gear system and tubular handling apparatus removably disposed within the container.

Preferably, the skid track part has fork lift pockets for receiving fork lift projections. Advantageously, at least one of the multiple track parts has fork lift pockets for receiving fork lift projections. Preferably, all of the multiple track parts have fork lift pockets for receiving fork lift projections.

Advantageously, the top drive includes an access platform pivotably connected to a part of the top drive, the access platform having a top end releasably connected to the top drive, upon release of the top end of the access platform the access platform pivotable from a position generally aligned with the apparatus to a position generally normal thereto so that the access platform provides a platform on which a person can stand to access part of the apparatus, the access platform removably located within the container with the apparatus.

Preferably, the containerized apparatus further comprises a suspension apparatus removably located within the container, the suspension apparatus connected to the top drive, the suspension apparatus for suspending the top drive apparatus in a derrick. Preferably, the suspension apparatus includes a travelling block, a hook connectable to the travelling block, and a becket connectable to the top drive apparatus and to the hook. Advantageously, the suspension apparatus includes a block and a becket, the becket directly connected to the block. Preferably, the becket is selectively rotatable with respect to the block and is securable to the block in a chosen non-rotating position.

Advantageously, the track is connectible to a derrick and is suitable for reacting torque generated by the top drive apparatus to the derrick.

Preferably, the containerized apparatus further comprises a control system in the container operable by personnel in the container to control the apparatus when the apparatus is removed from the container and located in a derrick for operation.

Preferably, the containerized apparatus a further comprises a power system within the container for providing power to operate at least part of the top drive. Preferably, the power system provides hydraulic power.

Advantageously, the containerized apparatus further comprises a reservoir within the container holding hydraulic fluid used by the power system for providing hydraulic power to the apparatus. Preferably, the containerized apparatus further comprises a cooling system within the container for providing cooling to the apparatus.

Preferably, the containerised apparatus has an alternating current permanent magnet motor having a bore therethrough, a planetary gear apparatus coupled to the alternating current permanent magnet motor, the planetary gear apparatus having a bore therethrough, the bore through the alternating current permanent magnet motor substantially aligned with the bore through the planetary gear apparatus so that fluid is flowable therethrough, the top drive further comprising a quill drivingly connected to the planetary gear apparatus to rotate the quill.

Advantageosuly, wherein the extension mechanism has an opening through which a tubular stand is movable while the extension mechanism with the top drive connected thereto moves with respect to the tubular stand.

* * *

A fifth aspect of the present invention provides an apparatus for wellbore operations, the apparatus comprising a derrick, a guide beam connected to the derrick, a top drive movable on the guide beam, a torque reaction structure connected to the guide beam, and skid apparatus held by the torque reaction structure, the skid apparatus movable vertically with respect to the torque reaction structure to inhibit a vertical load from passing from the skid apparatus to the torque reaction structure.

Preferably, the derrick comprises a rig floor, the guide beam has a topmost part, the topmost part comprising an outer part and an inner part movable within the outer part, and the inner part and outer part selectively connectible at a plurality of different locations to provide length adjustability to the guide beam so that position of the guide beam with respect to

the rig floor is adjustable. Advantageously, the apparatus further comprises a first shackle connected to the derrick, a second shackle connected to the first shackle and to the inner part of the topmost part of the guide beam to inhibit torque transfer between the topmost part and the derrick. Preferably, the apparatus further comprises at least one secondary shackle connected to the outer part of the topmost part for providing an attachment for a cable, the cable connectible to the derrick.

Advantageously, the wellbore operations are done at a well, the well having a well centre, and wherein the torque reaction structure includes a frame movable with respect to the guide beam toward and away from the well centre.

Preferably, the top drive comprises a load collar, an elevator, two bails each with upper ends connected to the load collar and lower ends connected to the elevator, each bail comprising an outer body with an end eye and an inner body with an end eye, the inner body movable within the outer body to adjust length of the bail, and the inner body selectively connectible to the outer body at a plurality of locations to provide length adjustability of the bails. Advantageously, the top drive comprises a gear apparatus and a gear collar wherein the gear collar and the load collar are a single integral piece.

Preferably, the top drive includes a top drive motor and a quill, and a brake apparatus for braking the quill, the brake apparatus having a brake hub about the quill, the apparatus further comprising seal apparatus within the brake hub for sealing a quill/brake hub interface, the seal apparatus comprising a body with a first part

and a second part, the first part rotatable with the quill, the second part with the top drive motor, and an absorbent seal member between the first part of the seal apparatus and the second part of the seal apparatus, the absorbent seal member located so that force on it during rotation forces lubricating fluid out of the absorbent seal member, the absorbent seal member sealing an interface between the first part and the second part.

Advantageously, the top drive has a drive motor and includes a gear apparatus with a sun gear, the gear apparatus located beneath the drive motor, the apparatus further comprising a seal apparatus for selectively engaging the sun gear to seal off a pathway from the gear apparatus to the drive motor. Preferably, the seal apparatus including a seal, a seal support supporting the seal movably disposed within or on a body such that the seal engages the sun gear to seal off the pathway, the seal support movable by fluid under pressure applied to the seal support, and resilient apparatus urging the seal support so that the seal contacts the sun gear to seal off the pathway when insufficient or no fluid under pressure is applied to the seal support. Advantageously, the resilient apparatus comprises a spring.

Preferably, the top drive comprises an alternating current permanent magnet motor having a bore therethrough, a planetary gear apparatus coupled to the alternating current permanent magnet motor, the planetary gear apparatus having a bore therethrough, the bore through the alternating current permanent magnet motor substantially aligned with the bore through the planetary gear apparatus so that fluid is flowable therethrough, the top drive further comprising a quill drivingly connected to the planetary gear apparatus to rotate the

quill.

Advantageously, the top drive comprises a suspension arrangement having a swivel body, a suspension member above the permanent magnet motor, at least one link arranged between the swivel body and the suspension member. Preferably, the top drive further comprises a load sleeve retained by the swivel body, the quill rotatable within the load sleeve, a load collar positioned around the load sleeve and supported thereby, at least one bail depending from the load collar and an elevator for selectively receiving and holding a tubular, the elevator supported by the at least one bail.

Preferably, the top drive further comprises an access platform pivotably connected at a lower end to the swivel body, the access platform with a platform portion pivotable to a generally horizontal position so that personnel on the access platform can access components of the top drive.

Preferably, the apparatus further comprises an extension mechanism for moving the top drive horizontally. Preferably the extension mechanism comprises a plurality of piston and cylinders and a frame. Advantageously, the extension mechanism has an opening through which a tubular stand is movable while the extension mechanism with the top drive connected thereto moves with respect to the tubular stand.

* * *

A sixth aspect of the present invention provides an apparatus for wellbore operations, the apparatus comprising a guide beam connectible to a derrick with a rig floor, the guide beam including a topmost part, the topmost part comprising an outer part and an inner part movable within the outer part, and the inner part and

outer part selectively connectible at a plurality of different locations to provide length adjustability to the guide beam so that position of the guide beam with respect to the rig floor is adjustable.

Preferably, the apparatus further comprises a first shackle connected to the derrick, a second shackle connected to the first shackle and to the inner part of the topmost part of the guide beam to inhibit torque transfer between the topmost part and the derrick.

Advantageously, the apparatus further comprises at least one secondary shackle connected to the outer part of the topmost part for providing an attachment for a cable, the cable connectible to the derrick.

* * *

A seventh aspect of the present invention provides an apparatus for wellbore operations, the apparatus comprising a derrick, a top drive movably connected to the derrick, a connector below the top drive, elevator, two bails each with upper ends connected to the connector and lower ends connected to the elevator, each bail comprising an outer body with an end eye and an inner body with an end eye, the inner body movable within the outer body to adjust length of the bail, and the inner body selectively connectible to the outer body at a plurality of locations to provide length adjustability of the bails.

* * *

An eighth aspect of the present invention provides a top drive comprising drive motor and a quill, and a brake apparatus for braking the quill, the brake apparatus having a brake hub about the quill, the apparatus further comprising seal apparatus within the brake hub for sealing a quill/brake hub interface, the seal apparatus

comprising a body with a first part and a second part, the first part rotatable with the quill, the second part with the top drive motor, and an absorbent seal member between the first part of the seal apparatus and the second part of the seal apparatus, the absorbent seal member located so that force on it during rotation forces lubricating fluid out of the absorbent seal member, the absorbent seal member sealing an interface between the first part and the second part.

* * *

A ninth aspect of the present invention provides a top drive comprising a drive motor and includes a gear apparatus with a sun gear, the gear apparatus located beneath the drive motor, the apparatus further comprising a seal apparatus for selectively engaging the sun gear to seal off a pathway from the gear apparatus to the drive motor.

Preferably, the seal apparatus including a seal, a seal support supporting the seal movably disposed within or on a body such that the seal engages the sun gear to seal off the pathway, the seal support movable by fluid under pressure applied to the seal support, and resilient apparatus urging the seal support so that the seal contacts the sun gear to seal off the pathway when insufficient or no fluid under pressure is applied to the seal support. Advantageously, the resilient apparatus comprises a spring.

For a better understanding of the present invention, reference will now be made, by way of example, to the accompanying drawings, in which:

Figure 1A is a perspective view of an apparatus in accordance with the present invention, the apparatus comprising a top drive having a motor, a gearbox, a brake system, a quill and a bonnet, the top drive slidably arranged on a torque track, a becket and links connected to a swivel body for suspending the top drive, an elevator depending from a load collar on mechanically movable bails, a clamping apparatus for clamping tubulars, a gear collar, a locking mechanism and connection lock member for selectively rotating the clamping mechanism to facilitate the spinning and torquing of connections between tubulars in a string, an extension mechanism for moving the top drive in relation to the torque track, a brake system for slowing and halting rotation of the quill, and a mud saver apparatus, a cross over sub and a saver sub;

Figure 1B is an exploded view of the apparatus shown in Figure 1A;

Figure 1C is a front view in cross-section of the apparatus shown in Figure 1A, not showing the torque tube or the clamping apparatus;

Figure 1D is a side view of the apparatus shown in Figure 1A, not showing the torque tube;

Figure 1E is a top view of the apparatus shown in Figure 1A;

Figure 1F is a front view of part of the apparatus shown in Figure 1A;

Figure 1G is a side view of the quill of the top drive shown in Figure 1A;

Figure 1H is a perspective view of the quill shown

in Figure 1G;

Figure 1I is a cross-sectional view of an end of the quill shown in Figure 1G;

Figures 1J and 1K are perspective views of the load sleeve of the top drive shown in Figure 1A;

Figure 1L is a cross-sectional view of the load sleeve of Figure 1J taken along line 1L-1L of Figure 1M;

Figure 1M is an end view of the load sleeve of Figure 1L;

Figures 1N is a perspective view of a swivel body of the top drive shown in Figure 1A;

Figure 1O is a top view of the swivel body shown in Figure 1N;

Figure 1P is a cross-sectional view of the swivel body shown in Figure 1N;

Figure 1Q is a bottom view of the swivel body shown in Figure 1N;

Figure 1R is a perspective view, partially cutaway, of the swivel body shown in Figure 1N;

Figures 1S is a perspective view of a swivel body of the top drive shown in Figure 1A;

Figure 1T is an end view of a pin for use in the swivel body shown in Figure 1N;

Figure 1U is a cross-section view of the pin shown in Figure 1T;

Figure 2A is a side view of part of a rig incorporating the apparatus shown in Figure 1A;

Figure 2B is a top view of the part of the rig shown in Figure 2A, also showing further pipe storage areas;

Figure 2C is a perspective view of an extension mechanism of the apparatus shown in Figure 1A, shown in a retracted position;

Figure 2D shows the extension mechanism shown in

Figure 2C, shown in an extended position;

Figure 2E is a top view of the extension mechanism shown in Figure 2D in the extended position;

Figure 2F is a side view of part of the torque tube shown in Figure 2C;

Figure 2G is a schematic view of an apparatus in accordance with the present invention;

Figure 3 shows the layout of Figures 3A to 3E, which combine to show a schematic view of a control system for the apparatus shown in Figure 1A;

Figure 3F is a schematic view of a coolant circuit for a system in accordance with the present invention.

Figure 4A is a perspective view of part of the top drive shown in Figure 1A;

Figure 4B is a cross-sectional view of what is shown in Figure 4A;

Figure 4C is an exploded view of part of the top drive shown in Figure 1A;

Figure 4D is an enlargement of a gear arrangement of the top drive shown in Figure 1A;

Figure 4E is a perspective view of part of the apparatus shown in Figure 1A;

Figure 4F is an exploded view of the part of the apparatus shown in Figure 4E;

Figure 5A is a perspective view of the gear collar of the apparatus shown in Figure 1A showing the top of the gear collar;

Figure 5B is a perspective view of the gear collar shown in Figure 5A showing the underside of the gear collar;

Figure 5C is a top view of the gear collar shown in Figure 5A;

Figure 5D is a front view of the gear collar of

Figure 5A;

Figures 5E and 5F are perspective views of part of the apparatus shown in Figure 1A;

Figure 6A is a perspective view of the load collar of the apparatus shown in Figure 1A showing the top of the load collar;

Figure 6B is a perspective view of the load collar shown in Figure 6A showing the underside of the load collar;

Figure 6C is a front view of the load collar shown in Figure 6A;

Figure 6D is a top view of the load collar shown in Figure 6A.

Figure 7A is a cross-sectional view of part of the locking mechanism for the apparatus shown in Figure 1A;

Figures 7B is a perspective view of part of the locking mechanism shown in Figure 7A showing the top of the part;

Figure 7C is a perspective view of the part of the locking mechanism shown in Figure 7A showing the underside of the part;

Figure 7D is a perspective view of a splined member of the locking mechanism shown in Figure 7A;

Figure 7E is a perspective view of a gear of the locking mechanism shown in Figure 7A;

Figure 7F is a perspective view of a pinion gear of the locking mechanism shown in Figure 7A;

Figure 7G is a perspective view showing part of the locking mechanism shown in Figure 7A showing the rear of the locking member;

Figure 7H is a perspective view showing part of the locking mechanism shown in Figure 7A in place in the top drive shown in Figure 1A;

Figure 7I is an exploded view of the locking mechanism shown in Figure 7G;

Figure 8A is a front view of the clamping apparatus of the apparatus shown in Figure 1A;

Figure 8B is a top view of the apparatus shown in Figure 8A;

Figure 8C is a perspective view, partially cutaway, of the clamping apparatus shown in Figure 8A;

Figure 8D is a perspective view of an upper leg of the clamping apparatus shown in Figure 8A;

Figure 8E is a front view of the upper leg shown in Figure 8D;

Figure 8F is a perspective view of an inner leg of the clamping apparatus shown in Figure 8A;

Figure 8G is a perspective view, partially cutaway, of the clamping apparatus shown in Figure 8A;

Figure 8H is a perspective view of part of the clamping apparatus shown in Figure 8G;

Figure 8I is a perspective view of part of the clamping apparatus shown in Figure 8G;

Figure 8J is a top view in cross-section of the clamping apparatus shown in Figure 8H;

Figure 8K is a perspective view of a die holder of the clamping apparatus shown in Figure 8G;

Figure 8L is a perspective view of a liner of the clamping apparatus shown in Figure 8G;

Figure 8M is a cross-section view of the liner of Figure 8L;

Figures 8N and 8O are perspective views of a piston of the clamping apparatus shown in Figure 8G;

Figures 8P is an end view and 8Q is a view in cross-section of the piston shown in Figure 8N;

Figures 8R and 8S are perspective views of parts of

a pipe guide of the clamping apparatus shown in Figure 8;

Figure 8T illustrates alternative cross-sectional shapes for the legs of the clamping apparatus shown in Figure 8A (and for corresponding holes receiving such legs);

Figure 8U is a perspective view of a spring holder of the clamping apparatus shown in Figure 8A;

Figure 8V is a top view of an inner leg of the apparatus shown in Figure 8A;

Figure 8W to 8Y are perspective views showing various positions of a torque wrench clamping apparatus in accordance with the present invention;

Figure 8Z is an exploded view of parts of the torque wrench clamping apparatus shown in Figure 8W;

Figure 9A is a side view of part of the apparatus shown in Figure 1A showing an elevator and mechanically movable bails in a first position;

Figure 9B is a side view of the part of the apparatus shown in Figure 9A showing an elevator and mechanically movable bails in a second position;

Figure 9B is a side view of the part of the apparatus shown in Figure 9A showing an elevator and mechanically movable bails in a third position;

Figure 10A is a perspective view of a brake drum of the brake system of the apparatus shown in Figure 1A;

Figure 10B is a perspective view of a brake disc of the brake system of the apparatus shown in Figure 1A;

Figures 11A is a perspective view of the connection lock member showing the top of the connection lock member;

Figures 11B is a perspective view of a connection lock member showing the underneath of the connection lock member;

Figure 11C is a top view of the connection lock member shown in Figure 11A;

Figure 11D is a view in cross-section of the connection lock member shown in Figure 11A;

Figure 11E is a perspective view of the mud saver apparatus and saver sub of the apparatus shown in Fig. 1A;

Figure 11F is an exploded view of the mud saver apparatus and saver sub shown in Figure 11E;

Figure 12A is a perspective view of the crossover sub of the apparatus shown in Figure 1A;

Figure 12B is a top view of the crossover sub shown in Figure 12A;

Figure 12C is a view in cross-section of the crossover sub shown in Figure 12A taken along line 12C-12C of Figure 12B;

Figure 13 is a perspective view of the bonnet of the apparatus shown in Figure 1A;

Figure 14A is a perspective view of a load nut of the apparatus of Figure 1A showing a top side of the load nut;

Figure 14B is a perspective view of the load nut shown in Figure 14A showing the underneath of the load nut;

Figures 15A is a perspective view of an inner barrel of the rotating head of the apparatus shown in Figure 1A;

Figure 15C is a view in cross-section of the inner barrel shown in Figure 15A taken along line 15C-15C of Figure 15E;

Figure 15D is a view in cross-section of the inner barrel shown in Figure 15A taken alone line 15D-15D of Figure 15E;

Figure 15E is a view in cross-section of the inner

barrel shown in Figure 15A;

Figure 15F is a view in cross-section of the inner barrel shown in Figure 15A taken along line 15F-15F of Figure 15E;

Figure 15G is a perspective view of an outer barrel of the rotating head;

Figure 15H is a side view in cross-section of part of the apparatus shown in Figure 1A;

Figure 16A is a perspective view of a washpipe assembly of the apparatus shown in Figure 1A;

Figure 16B is a side view, partially in cross-section, of the washpipe assembly shown in Figure 16A;

Figure 17A is a side view of an access platform of the apparatus shown in Figure 1A;

Figure 17B is a front view, Figure 17C is a front perspective view, Figure 17D is a rear perspective view, Figure 17E is a bottom view, and Figure 17F is a top view of the access platform shown in Figure 17A;

Figures 17G and 17H are side views of the access platform shown in Figure 17A connected to the top drive shown in Figure 1A in a first and second positions respectively;

Figure 17I is a perspective view of a guard member shown in Figure 17A showing the front of the guard member;

Figure 17J is a perspective view of the guard member shown in Figure 17I showing the rear of the guard member;

Figure 18A is a perspective view of a motor dam for use with the motor of the top drive shown in Figure 1A;

Figure 18B is a view in cross-section of the motor dam shown in Figure 18A;

Figure 19A is a perspective view of a slinger for

use with the apparatus shown in Figure 1A;

Figure 19B is a view in cross-section of the slinger shown in Figure 19A;

Figure 20A is a perspective view of a slinger for use with the apparatus shown in Figure 1A;

Figure 20B is a view in cross-section of the slinger shown in Figure 20A;

Figure 21 is a top view of a wear guide for use with the apparatus shown in Figure 1A;

Figure 22 is a view in cross-section of the wear guide shown in Figure 21;

Figure 23A is a side view of a connection apparatus for use in suspending the apparatus shown in Figure 1;

Figure 23B is a view in cross-section of the connection apparatus shown in Figure 23A;

Figure 23C is a perspective view of a connection apparatus of the connection apparatus shown in Figure 23A;

Figure 23D is a perspective view of a part of the connection apparatus shown in Figure 23A;

Figure 23E is a side view in cross-section of the part of the travelling connection apparatus shown in Figure 23D;

Figure 23F is a front (or rear) view in cross-section of the part of the connection apparatus shown in Figure 23D;

Figure 23G is a bottom view of the part of the connection apparatus shown in Figure 23D;

Figure 23H is a perspective view of the part of the connection apparatus shown in Figure 23D showing the underneath of the part;

Figure 24A is a perspective view of a spacer plate of the apparatus shown in Figure 1A;

Figure 24B is a view in cross-section of the spacer plate shown in Figure 24A;

Figure 25 is a perspective view of the spacer plate shown in Figure 24A showing the underneath of the spacer plate;

Figures 26A and 26B are perspective views of a link for use with a system as in Figure 1A;

Figure 26C is a side view and Figure 26D is a front view of the link shown in Figure 26A;

Figure 26E is a top view and Figure 26F is a bottom view of the link shown in Figure 26A;

Figures 27A to 27C are side views of part of the apparatus shown in Figure 1A indicating steps in a method of operation;

Figures 27D to 27F are top views in cross-section of the parts of the apparatus shown in Figure 27A to 27C indicating the steps in the method shown in Figures 27A to 27C respectively;

Figures 28A and 28B are perspective views of a building for use with the apparatus shown in Figure 1A;

Figure 28C is an end view of the building shown in Figure 28A with doors of the building open;

Figure 28D is a top view of the building shown in Figure 28A with a roof of the building removed;

Figure 28E is a perspective view of a carrier skid for use with the building shown in Figure 28A;

Figure 29A is a perspective view of a guard for use in the apparatus as shown in Figure 1A showing a front and a first side of the guard;

Figure 29B is a perspective view of the guard shown in Figure 29A showing the rear and the first side of the guard;

Figure 29C is a perspective view of the guard shown

in Figure 29A showing the rear and second side of the guard;

Figure 29D is a plan view of the guard shown in Figure 29A taken from the first side of the guard;

Figure 29E is a plan view of the guard shown in Figure 29A taken from the rear of the guard;

Figure 29F is a plan view of the guard shown in Figure 29A taken from the second side of guard;

Figure 29G is a top plan view of the guard shown in Figure 29A;

Figure 29H is a bottom view of the guard shown in Figure 29A;

Figure 30A is a perspective view of a guard for use in the apparatus shown in Figure 1A showing the front and a first side.

Figure 30B is a perspective view of the guard shown in Figure 30A showing the front and a second side of the guard;

Figure 30C is a perspective view of the guard shown in Figure 30A showing the first and second sides and the rear of the front of the guard;

Figure 30D is a plan view of the guard shown in Figure 30A taken from the first side of the guard;

Figure 30E is a plan view of the guard shown in Figure 30A taken from the rear of the guard;

Figure 30F is a plan view of the guard shown in Figure 30A taken from the second side of the guard;

Figure 30G is a top view of the guard shown in Figure 30A;

Figure 30H is a bottom view of the guard shown in Figure 30A;

Figure 31A is a top view of the top drive shown in Figure 1A and a reaction frame in a first step of

operation;

Figure 31B is a top view of the top drive shown in Figure 1A and the reaction frame shown in Figure 31A in a second step of operation;

Figure 31C is a side view of part of the reaction frame shown in Figure 31A;

Figure 31D is a perspective view of a stand/support for use with the top drive shown in Figure 1A;

Figure 31E is a perspective view of part of the reaction frame shown in Figure 31A;

Figure 31F is a perspective view of part of the reaction frame shown in Figure 31C showing the rear of the part;

Figure 31G is a perspective view of the part of the reaction frame shown in Figure 31F showing the front of the part;

Figure 31H is a perspective view of part of the reaction frame shown in Figure 31C;

Figure 32A is a front view of part of the apparatus shown in Figure 2A shown in a first position;

Figure 32B is a front view of the part of the apparatus shown in Figure 32A shown in a second position;

Figure 32C is a side view of the part of the apparatus shown in Figure 32B;

Figure 32D is a perspective view of part of the apparatus shown in Figure 32A;

Figure 32E is a perspective view of part of the apparatus shown in Figure 32A;

Figure 33A is a top view of a seal assembly for use in the apparatus shown in Figure 1A;

Figure 33B is a side view in cross-section of the seal assembly shown in Figure 33A;

Figure 33C is an enlarged side view in cross-section

of part of the seal assembly shown in Figure 33B;

Figure 34A is a front view with some hidden parts shown a seal assembly;

Figure 34B is an enlargement of part of the seal assembly shown in Figure 34A;

Figure 35A is a side view of a link for use in the apparatus shown in Figure 1A in a first position of use;

Figure 35B is a front view of the link shown in Figure 35A;

Figure 35C is a front view of the link shown in Figure 35A in a second position of use;

Figure 35D is a top view of the link shown in Figure 35A;

Figure 35E is a perspective view of the link shown in Figure 35A in a first position of use;

Figure 35F is a perspective view of the link shown in Figure 35A in a second position of use; and

Figure 35G is a bottom view of the link shown in Figure 35A.

Figs 1A to 1D show an apparatus generally identified by the reference numeral 10. The apparatus 10 has a swivel body 12 suspended on links 14 from a becket 16. The becket 16 is connected to a travelling block, or a connection apparatus of the type shown in Figure 23 could be used to suspended the top drive from a part of a derrick in which the apparatus is situated in use. A gear system 20 is mounted on a spacer plate 22 which is supported by the swivel body 12. Optionally, a dehumidifier system (not shown) dehumidifies the apparatus.

A hollowbore alternating current permanent magnet motor 30 is coupled to the gear system 20. Any suitable permanent magnet motor may be used; for example, but not

limited to, a commercially available alternating current hollow bore permanent magnet motor model TERA TORQ (TM) from Comprehensive Power Ltd., Boston, Massachusetts (which motor is supplied with a control system and which has associated computer system software and controls; and which can be programmed so that the motor itself can serve as a brake). A brake system 40 connected to the motor 30 is within or covered or protected by a bonnet 44 through which extends a gooseneck 46 connected to a kelly hose 7 which forms part of a service loop 48. Drilling fluid flows through Kelly hose 7 in certain stages of use. An extension mechanism 98 provides substantially horizontal displacement of the top drive 1 (see Figures 2C, 2D, 2E). The emergency brake system 40 can operate either selectively or automatically, for example, the driller has an emergency brake button on the driller's panel 141.

Referring to Figure 1C and 1H, the motor 30 has a splined output shaft 32 which drivingly meshes with a splined portion 26 of the gear system 20 which has a splined portion 224 that mates with a splined portion 52 of a quill 50. A flange 54 of the quill 50 bears string load weight and rotates on a main bearing system 56 in the swivel body 12. The quill 50 extends through the motor 30, the gear system 20, the spacer plate 22, the swivel body 12, a locking mechanism 60, a load collar 70, and a rotary seal 80. A lower end 58 of the quill 50 is threadedly connected to a mud saver apparatus 90 which itself is connected to a saver sub 92. A clamping apparatus 100 for selectively gripping or clamping tubulars is suspended from a load collar 70 which is attached to a static part of the top drive 1. Bails 72 suspend an elevator 74 from the load collar 70. Keys 395

in key slots 396 (see Figure 1I) releasably connect the end of the quill 50 to a connection lock member 340 (Figure 11A) as described below to insure a connection between the quill 50 and mud saver apparatus 90 is maintained.

A counterbalance system 110, which can hold the weight of the entire top drive 1 and associated tubulars to be stabbed during stabbing of tubulars, includes two load compensators 112 each with an upper end connected to a link 14 and with a lower end connected to the swivel body 12. Lower ends of the links 14 have elongate openings 14c which are sized and configured to permit a range of movement in a vertical plane (for example about 15cm (6 inches)) with respect to pins 13 that maintain the links 14 in the swivel body 12. The load compensator cylinders 112 may be hydraulic, and preferably comprises an accumulator 116 which allows stabbing to be load balanced to match the load of the top drive and tubular or stand of tubulars to be stabbed, to facilitate stabbing into a box of a tubular in a string held in a spider in the rig floor. The weight is preferably counterbalanced and thus the chances of the thread on the pin of the tubular to be stabbed colliding and with the thread of the box being stabbed into is minimised. Thus when the swivel body 12 supports the brakes, motor, gear system and bonnet counter balancing can be conducted. Retainer plates 399 secured to the swivel body 12 with bolts 399a releasably retain the pins 13 in place in the recesses 12b (i.e. the pins 13 do not take up all the space within the link openings). Each load compensator 112 includes a piston/cylinder assembly 114. The cylinders are balanced using charged accumulators 116 located on the links.

A movable bail apparatus 120 provides selective tilting of the bails 72 and thus selective movement and of the elevator 74 and movement of a tubular or stand of tubulars supported by the elevator 74 to and away from a wellbore centerline. A shaft 120a passes through the load collar 70 and the bails 72 (see Figure 7I). Bail retainers 404 retain the bails 72 on the load collar 70 (Figure 8A). The movable bail apparatus 120 has hydraulic cylinders 128 interconnected pivotably between ears 128a of the load collar 70 and arms 122. Each connector 124 is pivotably connected to a lower end of an arm 122 and to a clamp 126 which is clamped to a bail 72. Optionally, roller pins 127 extend through the clamps 126 to facilitate movement of the bails 72 within the clamps 126.

Guards 73 and 390 are on sides of an access platform 130 (see also Figures 29A - 29H and 30A - 30H). The access platform 130 is releasably connected to a rear guard 454 at its top and pivotably at its lower portion to the guards so that it can pivot and be lowered to provide a platform on which personnel can stand to access various components on the rear guard. Optionally, the access platform 130 may have an indented portion 132 for facilitating the placement of tubulars thereon and for facilitating movement of tubulars on the exterior of the access platform 130.

The top drive 1 can be movably mounted on a beam 82 (or "torque tube"). Horizontal displacement is provided by the extension mechanism 98 which includes a torque bushing 98a. The extension mechanism 98 with the top drive 1 attached thereto is movable vertically on the beam 82. Optionally, the motor is a four quadrant drive so it can be used to regenerate power.

Figures 1J to 1M show a load sleeve 170 with four channels 170a therethrough. These channels extend to a lower end of the load sleeve 170. At the bottom, each of the four channels is in fluid communication with corresponding channels in a rotating head 80 (see, for example Figure 15A). The rotating head 80 is connected on the lower end of the load sleeve 170. Via the fluid channels in the load sleeve and the corresponding channels in the rotating head 80, hydraulic fluid under pressure provides power and/or lubricating for apparatuses below the rotating head; including, for example movable bail apparatus, the clamping of the clamping apparatus 100, the up/down movement of the clamping apparatus 100, the elevator 74 when it is hydraulically powered, and the mud saver apparatus 90. This fluid also flows via appropriate channels to a generator system 240 located at or near the level of pipe handling apparatus, as described below, which produces electrical power for directional valves that control flow in the various channels. In one aspect the generator system 240 is a minigenset. The minigenset in one aspect is hydraulically powered (with pressurized hydraulic fluid or water/glycol mixture). A flange 170c is connected to or formed integrally of a body 170d. A threaded end 170e threadedly mates with corresponding threads in a load nut. The flange 170c is bolted to the swivel body 12. In one aspect when the movable bail apparatus elevator 74 has received and is holding a tubular or a stand, the cylinder assemblies 128 are under a relatively heavy load. A directional valve 260 allows fluid to flow from the lines connected to the cylinder assemblies 128 thereby relieving the pressure therein and allowing the bails 72 to move block ("float" to vertical,

see "LINK TILT FLOAT," Figure 3, "link tilt" in Figure 3 refers to the mechanically movable bails.

Figures 1N to 1P show one embodiment for a swivel body 12. Figure 1N shows one side and end (the other side and end are like the side and end shown). The swivel body 12 has two holes 12a for ends of the links 14 and two holes 12b for the removable pins 13. The holes 12b may have bushings 12e. In one particular aspect the bushings 12e are phenolic bushings, but they may be made of any suitable material, including, but not limited to, brass, bronze, zinc, aluminum and composite materials. The bushings 12e facilitate pin 13 emplacement and removal and the bushings 12e are easily replaced. A channel 12c extends through the swivel body 12 and receives and holds a main bushing 56. As shown the pins 13 are stepped with portions 13a, 13b, 13c and phenolic bushings 13d and 13e may be used with the pins 13 (see also Figure 4F). Drain port or outlet ports 12s, 12t (plugged with removable plugs) permit lube oil flow through and permit the draining of oil from the system. Port 12t allows lube oil through to lubricate the lower quill stabilizer bearing 57 via access via the load sleeve 170. Figure 1T shows a pin 13p useful as a pin 13 in Figure 1R. The pin 13p has a body with a hole 13h leading to a channel 13f for introducing air into and through the pin 13p, for example to assist in insertion of the pin 13p into a swivel body and to facilitate removal of the pin 13p from a swivel body. The pin 13p has a hole 13i leading to a channel 13g for introducing grease into and through the pin 13p to facilitate its insertion into and removal from a swivel body. Figure 1T shows a pin 13p useful as a pin 13 in Figure 1R. The pin 13p has a body with a hole 13h leading to a channel 13f

for introducing air into and through the pin 13p, for example to assist in insertion of the pin 13p into a swivel body and to facilitate removal of the pin 13p from a swivel body. The pin 13p has a hole 13i leading to a channel 13g for introducing grease into and through the pin 13p to facilitate its insertion into and removal from a swivel body.

The holes 12a may be circular, but are shown as rectangular to inhibit turning of the links 14 in the holes. The holes may be any suitable shape to inhibit link turning.

Figures 2A and 2B illustrate one installation of the apparatus 10 in accordance with the present invention in a derrick 140. The top drive 1 is suspended from a connection apparatus 18, which is suspended from the derrick 140 in a typical manner. Although it is within the scope of the present invention to use a standard block and hook for hooking a standard becket, the connection apparatus 18 dispenses with the common swiveling hook. As shown in Figure 2A, the elevator 74 is supporting a tubular stand 142 which includes two pieces of drill pipe 143. The stand 142 has been moved from a monkey board 145 with multiple made-up stands 149 to a position axially aligned with a wellbore 147. A mousehole 144 may be used, for example to make stands. A driller controls drilling from a driller's panel 141. Optionally, the system includes an emergency brake system and/or an emergency shut down device and, optionally, either or both are controllable from the panel 141. In one aspect, if power to the system is lost, a valve (in the system of Figure 17I; see "SHUT-OFF VALVE", Figure 3) opens and pressure in a corresponding accumulator is released thereby closing the system brakes.

Figure 2G shows schematically a top drive 10a in accordance with the present invention (which may be any top drive in accordance with the present invention as disclosed herein, but without a connection apparatus in accordance with the present invention) with a travelling block T, hook H, and becket B (each of which may be a suitable known block, hook, and/or becket, respectively).

The flange 54 of the quill 50 rests on the main bearing 56, a thrust bearing, for example a V flat type thrust bearing which has multiple tapered rollers 57. The upper surface of the flange 54 abuts an upper thrust bearing 59 located in a suitable recess 24 of the spacer plate 22 (see for example Figures 1C, 1D, 1G, 1H). The quill 50 has an upper part 51 in fluid communication with the gooseneck 46 via a wash pipe 374. In one particular aspect the main bearing 56 is a V-type thrust bearing which accommodates eccentricity, if present, in the quill 50 and is self-cleaning.

The swivel body 12 and associated structures provide dual load paths (which is desirable for reducing maintenance requirements. Drilling loads through the quill 50 travel through the main bearing 56, through the swivel body 12, to the links 14, to the becket 16 and then to the connection apparatus 18. Tripping loads (or "string loads" imposed on the system by tubulars being supported by the apparatus) are imposed on the bails 72 through the elevator 74, then onto the load collar 70 and the load sleeve 170, to the swivel body 12, to the links 14 and to the becket 16. This dual-load path allows for rotation of the clamping apparatus 100 whether the quill 50 is rotating or not. The tripping loads are not imposed on the quill 50, but are transferred via the tripping load path around the quill 50 through the swivel

body 12 and links 14. In certain aspects the gear system and motor are not subjected to loads (for example the drill string load). Thus in scaling up the system (for example from a 150 ton unit to a 1500 ton unit) the swivel housing (body) is scaled up to accommodate a larger load while the identical gear system (which is not in the swivel housing) and motor are employed.

In one particular aspect the permanent magnet motor 30 is a Model 2600 TERA TORQ (TM) motor commercially available from Comprehensive Power Ltd. which is a liquid-cooled AC permanent magnet hollow bore motor which generates 700 HP and operates at a maximum speed of 2400 RPM. The motor has axial bearings and a splined output shaft and is designed to hold drill string torque at full stall (at "full stall" motor RPM's are zero) or while engaged in jarring (for example using shock loads for various purposes). A central hollow bore 30a extends through the motor 30 from top to bottom through which fluid, for example drilling fluid, can flow through the motor. In one particular aspect such a motor is supplied with a Variable Frequency Drive control system (in one aspect, drive system 531, Figure 28D) which is a liquid-cooled modular electronic unit with modules that can be changed in about five minutes. Such a system can translate generator horsepower at over 90% efficiency and can run in temperatures of -40 C to 60 C and in high (for example up to 100%) humidity.

In one particular aspect the gear system 20 includes a single speed planetary gear reduction system with gear combinations providing a 9.25:1 ratio (or a 12:1 ratio) and with a liquid-cooled gear box which is fully lubricated down to 0 RPM. The system has a splined input shaft 26 for mating with the splined motor output shaft

32 for transmitting power to the quill 50.

The compensator system 110 permits a soft landing for a tubular when the top drive is lowered to stab the tubular into a connection.

In one particular aspect the mud saver apparatus 90 is a commercially available double ball internal blowout preventer system from R Folk Ventures of Calgary, Canada which has two internal blowout preventers and which is rated to 15,000 psi. An upper valve is hydraulically actuated by an actuator mounted on the valve and a lower valve is manually opened and closed. Alternatively, a Hi-Kalibre mud saver apparatus (commercially available) can be used instead of this mud saver apparatus.

Figures 4A to 4F show, among other things, the interconnection of the motor 30 and gear system 20 and the respective position of these items, the bonnet 44, the brake system 40, the spacer plate 22, the swivel body 12, the quill 50, and the load sleeve 170. Within the lower part of the bonnet 44 are three calliper disc brakes 180 (for example commercially available systems) which act on a brake disc 183 (see Figure 10B) which is secured to a brake hub 41 (see Figure 10A) secured to the motor 30. Shims preload the bearing 59, a pre-load that does not need to be re-set due to a shoulder structure of the spacer plate 22.

Figure 4D shows a gear system 20 which has a housing 480 from which extends a sight glass apparatus 481 for checking fluid level in the system 20 which includes a breather apparatus 482 that allows atmospheric pressure above the lube system to encourage downward gravitational flow. The sight glass apparatus 481 may be located at any suitable desired level (for example, but not limited to, coming out of a spacer plate 22 on top of the gear

box). An input spline 26 drivingly meshes with the correspondingly splined output shaft 32 of the motor 30. A first sun gear 483 rotates, for example at 2400 rpm and three planet gears 484 on stubs 485a of an upper carrier 485 rotate around the first sun gear 483. Five lower planet gears 486 rotatably mounted on stubs 487a of a lower carrier 487 encircle a second sun gear 488. An output spline 489 drivingly meshes with the splined portion 52 of the quill. In one aspect the output spline rotates at 259 rpm when the first sun gear 483 rotates at 2400 rpm. An optional seal 491 seals an interface between the gear system 20 and the motor 30. Bolts through holes 492 connect the system 20 to the spacer plate 22. The first sun gear 483, driven by the motor 30, drives the planet gears 484 which drive the upper carrier 485, which rotates the second sun gear 488 which drives the five lower planet gears 486, which drive the lower carrier 487, which drives the output spline 489. The output spline 489 rides on bearings 493. Magnetic plugs 494 (one shown) collect metal debris. An upper bearing 495 is lubricated through a port 496 and a top mechanical seal 497 (which prevents oil from going up into the motor 3D) is located in a top member 498 connected to and rotatable with the sun gear 483. Bolts in bolt holes 499 (one shown; twenty four bolts used in one aspect) connect the gear system 20 to the motor 30. An oil path 501 allows oil to lubricate the planet gears and their bearings. The gear system may be a 3 stage/2 speed system or, as shown, a 2 stage/1 speed system.

The locking mechanism 60, described in detail below with reference to Figure 7A to 7E, is bolted beneath the swivel body 12, supported on the load collar 70, and provides releasable locking of the clamping apparatus 100

in a desired position. In one particular aspect the clamping apparatus 100 is operable throughout a full 360° in both directions, at about 4 RPM. In one particular aspect the clamping apparatus 100 is driven by four low speed high-torque motors 190 which are fixed to a movable toothed lock plate 191 which is suspended by two hydraulic cylinders 192 which selectively move the lock plate 191 up and down (for example in one aspect with a range of motion of about 4.5cm (1.75 inches)) to engage and disengage a rotate gear 193 whose rotation by pinion gears 69 located in pinion gear recesses 69c (driven by the motors 190) results in a rotation of the clamping apparatus 100. Shafts of the motors 190 are in channels 69d of the pinion gears 69. The rotate gear 193 is bolted to the top of a gear collar 194 which itself is bolted on top of the load collar 70. A lock guide 62 (Figure 7D), bolted to and beneath the swivel body 12, has a splined portion 63 which is always in mating engagement with a corresponding splined portion 195 of the lock plate 191, so that lowering of the lock plate 191 results in engagement of the rotate gear 193 with the locking plate 191 and thus in locking of the clamping apparatus 100 preventing its rotation when the hydraulic cylinders 192 have lowered the lock plate 191 so that its inner teeth 196 engage teeth 197 of the rotate gear 193. The pinion gears 69 (Figure 7F) are in contact with the rotate gear 193 whether the clamping apparatus 100 is locked or not and rotation of the pinion gears 69 by the motors 190 results in rotation of the clamping apparatus 100. Figure 7A shows the lock engaged in a locked position, i.e. the clamping apparatus 100 cannot rotate. When the locking mechanism 60 is unlocked, the pinion gears 69, turned by the motors 190, turn the rotate gear

193, for example to reposition the clamping apparatus 100 or the elevator 74. In the locked position the quill 50 can still rotate, but the clamping apparatus 100 cannot. Optionally, to facilitate tooth engagement, the teeth 195 can have tapered lead-ins 195a and the teeth 197 can have tapered lead-ins 197a. These profiles insure synchronization between the gear 196 and the rotate gear 193. The gear 196 has teeth for the great majority of its circumference providing more structure and more strength to hold the clamping apparatus 100 and the movable bail apparatus 120 and prevent rotation of the clamping apparatus 100 in a locked position. Cups 69a maintain the pinion gears 69 in recesses 69c. The lock guide 62 has four ports 62q to 62t each aligned with a channel 170a of the load sleeve 170 so that hydraulic fluid from the upper hydraulic manifold 452 can flow to and through the load sleeve 170 to the rotating head 80. Suitable hoses and/or tubing conduct fluid from the upper hydraulic manifold 452 to the lock guide ports 62q to 62t.

The gear collar 194 (Figures 5A, 5B) is bolted on top of the load collar 70 with bolts 194a. Grease to lubricate the wear sleeve 62 and the load collar bearing 67 is introduced into grease ports 194d. When the lock plate 191 has been lowered to engage the rotate gear 193 to prevent rotation of the clamping apparatus 100 and elevator 74, the quill 50 can still rotate. Optionally the hydraulic cylinders 192 can have springs and/or spring washers 198 to provide a fail safe lock, for example when there is a loss of power to the hydraulic cylinders 192. Depending on the size, configuration, and disposition of interengaging teeth, the clamping apparatus 100 can be locked at desired circumferential

increments. In one particular aspect, for example with components as shown in Figures 7A to 7E, the clamping apparatus 100 can be locked every 4 degrees. Such a range of movement - a full 360° - allows the lower pipe handling equipment to thread tubulars together. In one aspect (see Figures 5E, 5F) the load collar 70 and the gear collar 194 are a single integral piece 194p (for example made by casting).

A rotating head 80 provides hydraulic power to the rotatable clamping apparatus 100. This hydraulic power operates a generator 240 mounted in a lower electrical junction box 250 and valves 260 (see, for example Figure 8A). In one aspect the generator 240 is a mini generator, for example, but not limited to, a commercially available mini generator set from Comprehensive Power Ltd. of Boston, Massachusetts. In one aspect the junction box 250 is a zone 0 rated junction box. The generator 240 provides electric power to directional valves 260 on the lower hydraulic manifold 400 mounted on an upper leg of the clamping apparatus 100. The generator 240 is powered by hydraulic fluid from the rotating head which powers the generator. Also, optionally, the clamping apparatus 100 includes digital signal processor card systems 256a, 256b, 256c (lower electrical junction box 250), 256d, each with its own RF antenna. A Digital Signal Processing (DSP) system 256a (shown schematically in Figure 2A), is located in the driller's panel 141; a DSP system 256b, is on the rear guard 454 in the upper electrical box 450; and a DSP system is in the lower electrical junction box 250 on a lower leg of the clamping apparatus 100; and/or a DSP system 256d in the building 160. These DSP systems provide communication between the top drive's components

[for example the mud saver apparatus 90, extension mechanism 98, motor 30, clamping apparatus 100, elevator 74, (when powered), brake system 40, lock system 60] and the driller; and, in one aspect, with personnel in the building 160.

Figures 8A to 8C and 8W to 8Z illustrate one embodiment of the clamping apparatus 100 for selectively clamping tubulars, for example pipe or casing. Top ends of the outer legs 285 of the clamping apparatus 100 are connected to connection structures 194b and 194c of the gear collar 194 with pins 285a and with pins 285b to connection structures 70a of the load collar 70; and the bottom ends of the inner legs 283 are bolted to a body 284 (including mounts 293). The inner leg 283 and outer leg 285 are made from box section, which may be steel or a plastics or composite material. The box section facilitates torque transfer when spinning and torquing joints with the clamping apparatus. Bolts 283a bolt plates 284a and ends of leg 283 to the mounts 293. Each leg has two parts, an inner (lower) part 283 and an outer (upper) part 285. The inner parts 283 move within the outer parts 285 to provide a telescoping action that permits upward and downward motion of the clamping apparatus 100 (for example in one aspect with an up/down travel range of 72cm (28.5")). A spring or springs 286 within each leg on a spring mount 289 so that when breaking a connection the springs compensate for thread travel; and when making a connection the vacuum in assemblies 282 compensates for upward travel of the threads. In one particular aspect (see Figure 8C) stacks of belleville springs 286 in each leg are mounted on rods 289a of the spring mount 289 which is connected to the inner leg.

The body 284 has dual opposed halves 288, 289 pinned together with removable pins 291 so that the body 284 can be opened from either side with the structure on the unopened side serving as a hinge. Also, both halves can be unpinned (removing the pins 291) permitting the legs to be moved apart (following removal of the pins 285b) allowing access to items on the legs (for example the lower electrical junction box 250 and the lower hydraulic manifold 400) and to other components of the apparatus. In certain aspects the two halves are identical facilitating replacement and minimizing required inventory. Each inner leg has a piston/cylinder assembly 282 which receives hydraulic power fluid via an inlet 282c from the lower hydraulic manifold 400. Each assembly 282 has a hollow cylinder 282a and an extensible rod 282b which provides the range of movement for the legs. Figures 8W to 8Y show different positions of the clamping apparatus 100.

A pair of jaws 280 of the clamping apparatus 100 (see Figures 8G to 8Q) are provided for selectively and releasably clamping a tubular. Each jaw 280 has a piston 281 movably disposed in a liner 292 in a housing 293. Each housing 293 has a plurality of ears 294 with holes 295 therethrough for receiving the pins 291. Connected to each piston 281 with bolts 299c (in holes 299d of the pistons 281) is a die holder 297 with recesses 298 for releasably receiving and holding die mounts 299 with dies 301. In one aspect the liner 292 is made of steel or other suitably hard material and is replaceable. Lubricating grease is applied through grease fittings 299a (one shown) and pins 299b (one shown) limit rotation of the die holders 297. The gear collar 194 is connected to the legs 285 with connectors 285g and the load collar

is connected to the legs 285 with connectors 2851. Optionally, a groove or grooves are provided on the interior surface of the housing 293 for seals to seal the housing 293/liner 292 interface instead of or in addition to the grooves for carrying seals on the liner 292 (see Figure 8M).

Hydraulic fluid under pressure from the rotating head 80 supplied from the lower hydraulic manifold 400 at a rear 302 of each piston 281 flows into a "CLOSE" port 304 to clamp a tubular. To release a tubular, hydraulic fluid is supplied to an "OPEN" port 306. Dotted lines 687 indicate the lines between the rotating head 80 and the lower hydraulic manifold 400. One of the lines 687 may be a spare line which is plugged shut until needed. Power cables 688 convey electrical power to the lower electrical junction box 250. Gland connectors may be used for connections. This fluid pushes against a piston opening surface 307 to move the piston 281 and its associated die apparatus away from a tubular resulting in unclamping and release of the tubular. Fluid enters (or leaves) the ports 304, 306 and fills behind the pistons to clamp onto a tubular or other item. As fluid enters one port, fluid leaves the other port. Also, in one aspect fluid flows to (and from) both pistons simultaneously for balanced clamping and unclamping. Directional valves 260 in the lower hydraulic manifold 400 control flow to and from the ports 304, 306. A recess 285m receives and holds a corresponding projection member (not shown) of the mud saver apparatus 90 to insure that the mud saver apparatus 90 rotates with the clamping apparatus 100.

In one aspect the clamping apparatus 100 develops sufficient torque to break connections involving the

quill 50 and the mud saver 90 and a saver sub 290; and to make/break tubular connections between the saver sub 290 and tubulars. In one particular aspect a clamping apparatus 100 as shown in Figures 1C and 8A has a downward thread feed of about 15cm (6") against the springs 286; an upward range of movement of about 18cm (7") against an hydraulic cylinder vacuum in the cylinders 282; and an up-down travel range when unclamped of about 72cm (28.5"). By using two spaced-apart legs instead of a single support to support the clamping apparatus 100, relatively thinner legs may be used to accommodate the same amount of torque as a prior art single-leg support and, with the present invention, twisting is inhibited and decreased as compared to a single-leg support (for example in certain aspects a single leg of a single-leg prior art system is more than twice the thickness of each of the two legs disclosed herein), but the two legs are sufficient to handle the makeup/breakout torques produced (for example up to 81,300 Nm (60,000 ft. lbs) in some embodiments). Providing relatively thinner legs also means that the overall area occupied by the clamping apparatus 100 is reduced, thus permitting the clamping apparatus 100 in rotation to require a smaller compact space for operation. By pulling both pins 291, the halves of the gripper system can be separated and moved apart from each other. The range of clamping apparatus up/down movement with corresponding clamping locations allows the clamping apparatus 100 to clamp onto the mud saver apparatus 90, or the saver sub 290 to assist in the breaking of the quill/mud-saver-system connection, the mud-saver-system/saver sub connection or a connection between a tubular and the saver sub.

In one particular aspect a clamping apparatus 100 as shown in Figure 1C and 8A with a die holder 297 that is about 3cm (1.25 inches) wide and dies 301 measuring 15cm (5 3/4") long x 1.6cm (5/8") thick, a range of pipe between 9cm (3.5") (for example tool joints) and 24cm (9.5") (for example collars) can be handled. In one particular aspect the die mounts 299 are swivel die mounts which facilitate the system's ability to accommodate a range of tubular diameters; but it is within the scope of this invention to use non-swivelling die mounts.

A pipe guide 310 is connected to the bottom of the body 284. In one aspect the pipe guide 310 includes two halves 311 (see Figures 8R, 8S) with tapered surfaces 312 to facilitate tubular entry into the clamping apparatus 100. Pins 313a through holes 313 in the halves 311 and through holes 316 in ears 315 of the mounts 293 releasably secure the halves 311 to the mounts 293. Safety chains 314 releasably connect to connectors 317 on the mounts 293 and to connectors 317a on the body 284 prevent the clamping apparatus 100 from falling if it is inadvertently released from the legs, grabbed, pulled on, or pulled up with the top drive. Legs 283, 285 may be chained together at connections 283d, 285d. Safety chains 314a secure top leg parts to bottom leg parts.

It is within the scope of this invention for the legs 282 to have a circular cross-sectional shape. In one aspect, as shown in Figures 8A to 8F, the inner legs 283 have a rectangular cross-sectional shape 322 which prevents them from rotating within correspondingly shaped openings 321 in the outer legs 285. This non-rotation feature is desirable because it inhibits twisting of the legs and, thereby twisting of the clamping apparatus 100.

It is within the scope of the present invention to achieve this non-rotation function with legs of non-circular cross-section, for example inner legs with non-circular shapes 323-329 as illustrated in Figure 8T.

Figure 9A shows the bails 72 suspending the elevator 74 beneath the clamping apparatus 100. The movable bails apparatus known as a "link tilt system" 120 is not actuated. As shown in Figure 9B, the movable bails apparatus 120 has been actuated with hydraulic fluid from the rotating head 230 applied to the piston/cylinder assemblies 128 to extend the piston 121 moving the arms 122 to move the bails 72 and elevator 74 away from the clamping apparatus 100. As shown in Figure 9C, the piston 121 has been retracted, resulting in the arms 122 moving the bails 72 and elevator 74 in a direction opposite to the direction of movement shown in Figure 9B. Roller pins 127 within the clamps 126 facilitate link movement with respect to the clamps 126. In one particular aspect such a bi-directional link tilt system can be tilted in one direction toward a V-door of a rig to more easily accept a stand of pipe from a monkey board, and in the other direction toward the rig, moving the elevator out of the way of a drill string and top drive, to permit drill down closer to a rig floor since the elevator is moved out of the way. In one particular aspect, the link tilt system 120 can move the bails 72 and elevator 74 thirty degrees toward the V-door and, in the other direction, fifty degrees toward the mast. The bails 72 and the arms 122 lie external to the clamping apparatus 100 and the bails 72 preferably are arranged at the sides and the legs 285 are arranged at right angles thereto at the front and back.

Figures 8A and 11A to 11F show a pair of connection

lock members 340. Corresponding connection lock member pairs (like the members 340) have corresponding teeth 341 that mesh to lock together: the quill 50 and the mud saver apparatus 90; and the mud saver apparatus 90 and the saver sub 290. Keys 395 on the quill 50, keys 395a on the mud saver apparatus 90, and keys 395b on the saver sub 290 are received and held in corresponding keyways 344 of the connection lock members 340 (keys labelled "K" in Figure 11F). The connection lock members 340 are secured with set screws 402 extending through holes 342. Clamps 401 clamp around the quill 50, the mud saver apparatus 90, and the saver sub 290 (see Figure 8A and Figures 11E, 11F) to maintain the connection lock members in position with keys in their respective keyways. Use of the connection lock members 340 provides a positive releasable lock of the quill 50 to the mud saver apparatus 90 and of the mud saver apparatus 90 to the saver sub 290 so that the top drive cannot unscrew the mud saver apparatus 90 from the quill 50 or the mud saver apparatus 90 from the saver sub 290. Thus joints can be made and broken with the system 10 without the mud saver apparatus 90 separating from the saver sub and without the quill 50 separating from the mud saver apparatus 90.

Optionally, a connection apparatus apparatus 18 (see Figures 23A - 23G is used instead of a becket 16 as in Figure 1A and a travelling block/hook combination, for example as in Figure 2G) used in the apparatus 10 which, in one particular embodiment, adds only 43cm (17 inches) to the apparatus's height and which eliminates the need for a standard block/hook combination which can be over 2.7m (9' high). Pin holes 303a in a becket 303 are alignable with pin holes 420a (four of them equally spaced apart in the block 420) in a block 420 to permit

selective positioning of the becket 303 with respect to the block 420. This allows selective orientation which can, for example be beneficial in some smaller rigs with crown sheaves oriented differently from those in other rigs. The connection apparatus 18 comprises a plurality of sheaves 420. It is within the scope of the present invention to use any desired number of becket and block pin holes to provide any desired number of positions. The becket 303 has ears 305, 307 with holes 305a, 307a respectively through which extend pins 309 to releasably connect to corresponding structure of the top drive 1. Plates 311 bolted with bolts 313 to the becket 303 releasably hold the pins 309 in place. A shaft 422 of the block 420 is received on a channel 315 of the becket 303. Plates 424 bolted to the shaft 422 with bolts 426 and bolted to a bushing or retainer 428 with bolts 432 retain the becket 303 on the shaft 422. The channel 315 and the shaft 422 may be threaded for threaded connection of the block 420 and the becket 303. Typical lines or cables (not shown) are disposed around sheaves 434 which rotate around a shaft 436 of the block 420. The connection apparatus 18 can be lifted and lowered using the eyes 442.

In one particular aspect, the height of a system 10 with a connection apparatus 18 is about 5.8m (19') from the becket throat down to a tool joint in an elevator using upper links which are about 2.4m (96") long and a hook is used which may be, for example 3m (10') long. Using an integrated connection apparatus becket system in accordance with the present invention this overall height is about 6.25m (20'6").

Using the hollowbore permanent magnet motor 30, planetary gear system 20 and a standard swivel packing

assembly mounted on top of the motor 30, a fluid course is provided through the entire top drive from the gooseneck 46 down to the saver sub 290 and then to a tubular or tubular stand connected to the saver sub 290. In certain aspects, this fluid course is rated at 345 bars (5000 psi) working pressure (for example a fluid course of about 3" in diameter from the wash pipe down to the saver sub). The swivel packing assembly (see Figures 16A, 16B) includes a standard wash pipe assembly 370 with a wash pipe 374, unitized packing 381, 385 and union-type nuts 371, 372 which allow the assembly to be removed as a unit.

Figures 12A to 12C illustrate an optional crossover sub 350 with a body 351 which has interior threads 352 for selective releasable connection of the sub 350 to the lower end of the quill 50. Upper teeth 353 mesh with corresponding teeth of a connection lock member on the quill 50. Lower teeth 354 can mesh with teeth of a connection lock member on the mud saver apparatus 90 located below a quill 50. These mesh teeth prevent unwanted disconnection. A smaller diameter threaded end 355 can threadedly mate with a correspondingly-threaded mud saver apparatus.

Figure 13 shows the bonnet 44 with its lower housing 361 which houses the brake system 40 and with an upper plate 362 with a hole 362a for the gooseneck 46. Hatches 363 provide access to the brake apparatuses 180 and permit their removal from within the bonnet 44.

A load nut 366 is shown in Figures 14A and 14B. As shown in Figure 1F, the load nut 366 holds the load collar 70 on the load sleeve 170. The load collar 70 rotates on a bearing 367 housed within a recess 368 of the load nut 366. Threads 369 mate with threads 170e on

the load sleeve 170 to secure the load nut 366 to the load sleeve 170.

The rotating head 80 shown in Figure 1C and Figures 15A to 15H at the bottom of the load sleeve 170 has an inner barrel 230 with a body 82 with an upper flange 83 and an outer barrel 372 with rotating ears 373 which are received in recesses 374 (see Figure 8D) in the outer legs 285 of the clamping apparatus 100 to insure that the rotating head 80 rotates with the clamping apparatus 100. A recess 84 in the inner barrel 230 provides space for a stabilizing bearing 85 which stabilizes the bottom end of the quill 50. A bearing retainer 560 retains the bearing 85 in place. Bolts 561 (eight; one shown) bolt the inner barrel 230 to the load sleeve 170. A gap 562 (for example between 0.75cm (0.30 inches) and 0.25cm (0.10 inches)) between the inner barrel 230 and the load nut 366 prevents a load from being transmitted from the load nut to the inner barrel. Bolts 563 prevent the load nut 366 from rotating.

The inner barrel 230 has three ports and (channels) 230a and lubricating channel port 230a-1 which correspond to and are aligned with the four channels 170a of the load sleeve 170 and fluid flows down through the channels 170a into the ports 230a - 230d. Three of the channels 230a are in fluid communication with corresponding paths 372a, 372b, 372c of the outer barrel 372 and one of the channels 230a-1, a lubrication channel provides lubrication to items below the rotating head 80 (for example the lower quill stabilizing bearing 85). Four seals 372s isolate the paths 372a-c.

The location and function of the rotating head 80 (which rotates with items like the clamping apparatus 100 below the top drive gear and motor components which are

rotated by the motors 190) makes it possible to have a lower hydraulic manifold 400 with flow-controlling directional valves which also rotates when the motors 190 rotate the clamping apparatus 100. By locating the generator 240 at this level, electrical power is provided for the directional valves by the generator 240.

Figures 16A and 16B illustrate the wash pipe assembly 370 which is located at the top of the quill 50 within the bonnet 44. In use the nut 372 does not rotate and is remains stationary with the goose neck 46 which is connected thereto so that fluid is flowable through the gooseneck 46 into a central fluid channel of the nut 372. The nut 371 has a female threaded end for threaded connection to the top of the quill 50. The nut 371 rotates with the quill 50 about the wash pipe 374.

Figures 17A to 17H show the access platform 130 of the top drive 1 (see, for example also Figures 1A, 1B, 1D). Upon release, the access platform 130 is pivotable from a position as shown in Figure 17G to a position as shown in Figure 17H, supported by one or more cables 134. In the position of Figure 17H, a person can stand on the access platform 130 to access the motor 30, and/or items connected to an inner guard member 135 (shown in Figures 17H, 17I), for example items including items on a rear guard 454 including a heat exchanger 455, pump 458, upper electric junction box 450, extend accumulators 451, filter 457 for hydraulic fluid, motor 459, pump 458, flow meter 456, upper hydraulic manifold 452 with electrically powered directional valves 453 (one or which is a shut off valve for shutting off pressurized fluid flow to the rotary seal which is activated upon rotation of the pipe handler so that the rotary seal is not damaged by pressurized fluid). Connectors 136 are bolted to the

swivel body 12 and a stabilizer member 137 is connected to a motor flange 30f. Connectors 130a of the access platform 130 are hingedly connected to connectors 136a of the rear guard 454, for example with a pin or pins 130c. Bolts 130b through holes 130d releasably secure the access platform 130 to the top of the rear guard 454. An optional brace 138 extends across the interior of the access platform 130. Optionally, bevelled, tapered, rounded, or chamfered edges 139a, 139b, 139c, 139d, 139e are used and/or with a tapered bottom portion 139d to inhibit items catching onto part of the access platform 130. The access platform 130 can be lifted using an eye member 130e.

Figures 18A and 18B illustrate a motor dam 31 emplaced on the motor 30 to inhibit drilling mud or other fluid from getting into the motor 30.

Two slingers, slingers 76 and 77, inhibit fluid (for example drilling mud) from contacting the brake system 40, Figures 19A and 19B show an upper slinger 76 with a recess 76b for accommodating a lip of the bonnet 44 and a groove 76c for an O-ring seal to seal the slinger/quill interface. Figures 20A and 20B show a lower slinger 77 with an O-ring groove 77a for an O-ring seal to seal the slinger/quill interface. These slingers prevent drilling fluid from getting on the brake disc.

Figures 21 and 22 show a wear sleeve locking guide 62. This wear sleeve lock guide acts as a bearing on which the rotate gear 193 rotates and also maintains a desired gap between the rotate gear 193 and the lock guide 62. In one aspect the guide 62 is made of phenolic material.

Figures 24A, 24B, and 25 show the spacer plate 22 with its recess 22a for receiving the bearing 59. The

gear system 20 sits in a recess 22b. An extension 22c fits into the channel 12c in the swivel body 12. Through a hole 22d passes lubricating fluid coming from the gear system 20 which flows down into the swivel body 12 and then downward to lubricate items below the swivel body 12. From the swivel body 12 this lubricating fluid flows into the lubricating path of the load sleeve 170 and from there to the rotary seal 80, then to the lower stabilizer bearing 85. A shoulder 22s inhibits bearing deflection, for example while jarring, and makes it unnecessary to re-set bearing pre-load.

Figures 26A to 26E show arms 430 which is for facilitating movement of the bails 72. Each arm 430 has a body member 432 with an upper connector 434 at the top and a lower connector 435. A slot 436 extends through the body member 432.

A lower portion 437 of the arm 430 is disposed outwardly (for example to the right in Figure 26C) from the arm's upper part. A hole 438 permits connection to the link. Holes 439 permit connection to the load collar. This disposition of the lower portion 437 facilitates movement of the link with respect to system components adjacent this portion of the link.

Figures 27A to 27F illustrate how clamp 126 of the movable bale apparatus (link tilt system) 120 can accommodate bails of different cross-sectional diameters. The clamps 126 have two roller pins 127a, 127b each with a roller 127d and roller mounts 127c. Holes 127e are offset in each roller mount 127c providing two positions for the rollers 127d. As shown in Figures 27A and 27D, a bail A (like the bail 72) moves between the rollers 127d and is, for example about 7.3cm (2 7/8") wide. As shown in Figures 27B and 27E, with the rollers 127d in the same

position as the rollers 127d in Figure 27D, a bail B (like the bail 72) is accommodated, for example a bail B with a width of 8.9cm (3.5"). As shown in Figures 27C and 27F, the roller mounts 127c have been repositioned in holes 127f, moving the rollers 127d further apart so that the clamp can accommodate a wider link, for example the link C (like the link 72) which is 4.5" wide. A grease nipple 127g is provided for each pin 127a, 127b. Each pin 127a, 127b has a threaded end (a top end as viewed in Figure 27D) which is threadedly engaged in corresponding threads in the roller mounts 127c (top roller mounts 127c as viewed in Figures 27D, 27E, 27F). Holes in the other roller mounts (lower ones as viewed in Figures 27D, 27E, 27F) may be unthreaded. In one aspect, bails A are 250 ton bails; bails B are 350 ton bails; and bails C are 500 ton bails.

Figure 3 (3A to 3E) show schematically a control system 150 with an hydraulic circuit 150a and a coolant circuit 150b (Figure 3F) for the a top drive 152 (such as any top drive disclosed herein) with a building 160 adjacent a location of the top drive 152. The building 160 houses various circuits and controls, among other things, as discussed in detail below. For parts of the apparatus disclosed herein using hydraulic fluid, either a hydraulic fluid may be used or a water/glycol mixture may be used.

Figures 28A to 28C and 28E show the building 160 on a skid 540 in accordance with the present invention which has four walls 161a to 161d, a floor 161e, and a roof 161f (which in one aspect comprise a typical ISO container). A carrier 169 (see Figure 28E) with a skid 169a with fork lift pockets 169b is mounted on top of the roof 161f for holding and storing of the service loop

and/or of hoses. Doors 541 are at both ends of the building 160 and doors 541a and 541b (optionally vented with vents 541f) are on a side. Windows 541c are on a side and vent openings 541d, 541e are on another side. Pieces 82b of the beam 82 or ("torque track") are housed within compartments 162 in the wall 161d. A space 163 within the building 160 is sufficiently large to hold the major components of an apparatus like the apparatus 10 shown in Figure 1A. In certain aspects, the building 160 contains a 600 volt panel PL for running motor starters, Variable Frequency Drive (VFD) controls, transformers (for example 100 kva and 10 kva), and fuses for all 600 volt equipment. There is a 120 volt panel PN and a 24 volt panel PE that supplies 24 volt control power for the drive system for a pre-charge circuit; and a battery back-up BB to maintain control power alive when rig power is lost to control various items, for example, flow meters, flow switches, tank heater, unwind, lights, circulating engine heater and/or A/C, building heaters and/or A/C, temperature transducers, emergency shut down apparatus (ESD), fuses and motor control starter circuits. Panels PL, PN, PE, emergency shut down apparatus ESD, and battery back-up BB are shown schematically in Figure 28E.

The building 160 also houses electrical power generator 530 (for example diesel powered); variable frequency drive system 531 for providing electrical power for the motor 30; a temperature/humidity control system 531a for controlling temperature and humidity of the system 531 and of a coolant system 532; an hydraulic fluid tank 533; an electrical junction box 534; an optional control system 535; pumps 536 and radiators 537 of the coolant system 532; and furniture and furnishings,

for example item 538. An optional vacuum system 688 will remove drilling fluid from the system in the event of a shut-down so the fluid will not freeze in the lines. The coolant system (see Figure 3A) 532 provides cooling fluid via the service loop 48 to the gear system 20 of the top drive 152 and to the swivel body 12. A motor 150c drives a pump 150d which pumps cooling fluid through a filter 150e and a heat exchanger 150f. Whenever the pump 150d is on, the gear box 150g of the gear system 20 is provided with full lubrication at whatever speed, for example 1 rpm or full speed. Cooling fluid (lubricating oil) flows from a top bearing 150h to the gear box 150g.

In certain aspects the beam 82 serves as a "torque tube" through which torque generated by the top drive is reacted from the top drive, to the extension mechanism 98, to the beam 82 and then to the derrick. In one particular aspect part 82a of this beam 82 is used as a skid or support on which the top drive is mounted to facilitate transport of the top drive; and this part 82a of the beam 82, with a skid portion 82d, is removably housed in the building 160 with the top drive in place thereon. In one particular aspect (see Figure 2F), a top piece 82f (Figure 2D) of the beam 82 is length adjustable to accommodate different derrick conditions. In one aspect one, some or all of the pieces are length adjustable, for example two telescoping pieces 82g, 82h which can be pinned through one hole 82j and one hole 82k with a pin (or pins) 82i at a number of different lengths depending on the holes selected; and/or such pieces can be threadedly connected together with threads 82m, 82n for length adjustability. Pieces that make up the beam 82 may have holes or pockets 82e for receiving a fork of a fork lift.

In one aspect as shown in Figures 31A to 31H, the top drive is mounted on a skid 620 which is removably emplaceable within a mount 622 of a reaction frame 600. The skid 620 (like the skid 82d, Figure 2A) and reaction frame 600 once installed, with the skid 620 connected to the beam 82, remain in position while the top drive is movable up and down on the beam 82. In one aspect the reaction frame 600 is welded to the skid 620. Torque generated by the top drive is reacted through the skid 620, through the reaction frame 600, into and through the beam 82, and then into the derrick 140 (and into other structure connected to the derrick and/or into substructure or derrick substructure). Thus reacted torque is passed through the skid rather than to the derrick structure alone.

The reaction frame 600 has a rear beam 606 with a lifting eye 608. Side beams 602 move within holders 610, 612 on the rear beam 606. Clamps 604 releasably clamp the reaction frame 600 to the beam 82. Clamps 605 adjustably clamp the side beams 602 to the rear beam 606. Piece 614 is a piece of a torque track welded to the skid 620. The side beams 602 extend into and are held within corresponding holes 624 in the mount 622. The skid 620 with the top drive 1 is located on the mount 622. The skid 620 with the top drive 1 connected to it is held by and is movable vertically with respect to slide members 623 (see, for example Figure 31E). Thus the skid 620 and top drive can mate vertically with respect to the reaction frame 600 to isolate the reaction frame 600 (and the derrick) from vertical loads. The skid 620 and reaction frame can be sized and configured so that the skid 620 with the top drive 1 can move any desired vertical distance with respect to the reaction frame, for

example, but not limited to, from 2cm to 215cm (one to sixty inches), and in one particular aspect, movable vertically about 1.3cm (one-half inch).

Figures 31A and 31B illustrate the range of motion of the reaction frame 600 (with the top drive attached thereto) toward and away from a well centre. A transport stand/support 630, Figure 31D encloses a top drive for shipping on the skid 620 and pins 630a are pinned into corresponding holes on a beam 82. The stand/support secures the top drive for shipping.

As shown in Figures 2C to 2D, an opening 375 between members of the extension mechanism 98 provides a passageway through which can pass a tubular stand 376 once a top drive 1 supported by the extension mechanism 98 is extended so that the top drive is no longer over the stand. This can be beneficial in a variety of circumstances, for example, when pipe is stuck in the well or the top drive needs to be accessed, for example for inspection or repair. The saver sub is disconnected from the stand; the top drive is moved further outwardly so it is no longer directly over the stand; and the extension mechanism 98 is lowered with the stand moving through the opening 375. This permits access to the top drive at a lower level, for example at or near the rig floor. The source of power for the cylinder assemblies 392 of the system 98 is the accumulators 451 (see Figure 17D). The assemblies 392 are pivotably connected to support structure 393 with top drive mount 394 which is secured with bolts to the swivel body 12.

Control of the various components of the apparatus is provided by a control system that includes: the driller's panel 141; a digital signal processor ("DSP") system 256a in the driller's panel 141; a DSP system 256b

in the upper electrical junction box 450; a DSP system 256c in the lower electrical junction box 250; and/or a DSP system 256d with the control system 531. Each DSP system has an RF antenna so that all DSP systems can communicate with each other. Thus a driller at the driller's panel 141 and/or a person at the control system 531 can control all the functions of the apparatus 10.

Lubrication oil (hydraulic fluid) flows in the service loop 48 (see also Figure 3F) to the plugboard 391; into the upper hydraulic manifold 452 and heat exchanger on the rear guard 454, behind the access platform 130; through the filter 457 with flow metered by the flow meter 456; out to the gear system 20 (cleaned by the magnetic plugs 494) with level indicated in the sight glass 481; out the bottom of the gear system 20, lubing the splined portion 52 of the quill 50 and the upper bearing 59; into the swivel body 12 and out its drain 12s; into the load sleeve lubrication port and down a channel 170a of the load sleeve; into and through the rotating head 80 through the lubrication port of the inner barrel 230; to the lower quill stabilizing bearing 84; up through a space 405 between the load sleeve 170 and the quill 50 through the self cleaning main bearing 56; then back to an out line in the plugboard 391 and into an exit line in the service loop 48. Optionally, an oil lube pump OLP for the system's lubricating system may be located in the guard 73 for pumping lubricating fluid to the various parts of the system that are lubricated. Hydraulic fluid flows through the other three ports (other than the lube port/channels) in a similar fashion. Appropriate lines, hoses, cables, and conduits from the service loop 48 (including electrical lines etc. to the upper electrical junction box 450) are connected to the

plugboard 391 and from it: control cables to the upper electrical junction box 450 and to an upper junction box (not shown) of the motor 30; hydraulic lines to the upper hydraulic manifold 452 and to the lubrication system; coolant fluid lines to the motor 459 and heat exchanger 455. Power cables from the service loop 48 are connected to the junction box of the motor 30.

Cables from the service loop 48 are connected to corresponding inlets on the plugboard 391; for example, in one aspect, three hydraulic fluid power lines are used between the plug board 391 and the upper hydraulic manifold 452 - an "in" fluid line, and "out" fluid line, and a spare line for use if there is a problem with either of the other two lines. Also in one aspect there are three lines from the plug board 391 to the motor 459. The motor 459 powered by hydraulic fluid under pressure, drives a pump 458 which pumps fluid to items below the rear guard 454. The fluid that is provided to the pump 458 is a coolant fluid (for example glycol and/or water; ethylene glycol) provided in one of the lines of the service loop 48. The pump 458 pumps the coolant fluid to and through the heat exchanger 455 and then, from the heat exchanger 455, the fluid is pumped to items below the access platform 130 for lubrication and for cooling. The fluid that flows through the motor 459 returns in a line back to the service loop 48 (for example back to a fluid reservoir, for example the fluid reservoir 533, Figure 28D). Optionally, the fluid from the motor 459 can first go through the heat exchanger 455 then to the service loop 48. Appropriate lines with flow controlled by the directional control valves 260 provide hydraulic power fluid to each of the items powered thereby.

Figures 32A to 32E illustrate various embodiments of

top pieces of a torque track for use with top drives as disclosed herein. (The beam 82, Figure 1A, can be referred to as "guide Beam" or "torque track".) A top piece 630 of such a torque track has a body 632 within which is connected a receiver 634 having a plurality of connection holes 636. One end of safety cables can be attached to shackles 638 with the other end attached to any suitable structure, for example part of a derrick, for example part of the crown of a derrick. Any suitable number of torque track pieces are used at a given installation to adjust the distance of the torque track skid with respect to a rig floor. Moving a member 640 in and with respect to the receiver 634 provides adjustability of the height of the torque track in its entirety with respect to the derrick 140 and the rig floor. A system 696, like the items in Figures 32A to 32E, shown in Figure 2A may be used to suspend the apparatus in a derrick and to provide height adjustability for the apparatus. One or more pins 642 is used to releasably connect the member 640 to the receiver 634. Optionally, two shackles 644, 646 are used to connect member 640 and the top piece 630 (and thus the entire torque track) to the derrick 140. Such a free two-shackle connection prevents torque from being transferred to the derrick 140 through the top piece 630, preventing such torque from being reacted through the torque track to the derrick, particularly to and through the top of the derrick. Apparatuss in accordance with the present invention have a "pull down" capability, i.e. Weight On Bit (WOB) can be added using cables, winches, etc. to pull down on the top drive while rotating the top drive.

Figures 33A - 33C illustrate a structure for sealing

between a brake hub (for example of the brake apparatus 40, Figure 1B) and a quill (as the quill 50, Figure 4B). A seal bearing isolator 650 has a body 651 with one, two or more static O-ring seals 652 in corresponding grooves 652a which seal an isolator/quill interface. Such seals also seal this interface when the system is non-vertical, for example during transit. An O-ring 653 seals an isolator/brake-hub interface. A ring 654 partially in a recess 654a in a body part 651a and partially in a recess 654b in a body part 651b holds the two body parts 651a, 651b together. A snap ring 655 in a recess 655a in the body part 651b acts as a slinger slinging oil outwardly. A felt seal 660 is disposed between the two body parts 651a, 651b and seals the interface of these parts at the location of the seal 660. Body part 651a moves at the speed of the quill, for example from 0 to 2400 rpm's. The body part 651b rotates at the speed of the top drive motor, for example 200 rpm's when the quill is rotating at 200 rpm's. The body part 651 sits in the brake hub held therein with a friction fit (for example as shown in Figure 4B). The felt seal 660 is grease or oil filled. When the seal is rotated (for example when the quill is rotated), the seal has forces on it tending to move grease or oil out of the seal.

Figures 34A and 34B illustrate an embodiment of a seal system 661 in accordance with the present invention for sealing between a gear system and a motor of a apparatus. The seal system 660 has a lift seal 662 which seals against a surface of a rotating sun gear 680 of a gear system 690 (for example, but not limited to, a sun gear as in any gearing system described above). The lift seal 662 includes a mechanical seal 664 bolted with a bolt 665 to a part 667 of a piston rod 668. The piston

rod 668 is movable with respect to a non-rotating seal housing 670 (top plate of gear box). A spring 672 urges the piston rod 668 upwardly, thus urging the seal 664 against the sun gear 680. The piston rod 668 moves in a piston cylinder 677 which has a lower side 676. A seal 674 seals the rod/cylinder interface. Seals 671a seal the cylinder/seal housing interface. A lock member 677b holds the cylinder 677 in place (or it may be bolted in place). A bottom flange 678 of the motor is on top of the seal housing 670.

The pathway that is sealed by the seal 664 is a pathway through which oil from the gear system can flow from the gear system to a motor 692 of the top drive. When the top drive is operational oil flowing into an oil supply port 679 from an oil supply and through a channel 681 into a cylinder housing 677a pushes down on the piston rod 668 and the seal 664 is disengaged from the sun gear 680. When the apparatus is off (oil is not flowing through the channel 681) the spring 672 urges the piston rod 668 upwardly so that the seal 664 engages the sun gear 680, thus closing off the oil flow path and preventing oil from leaking from the gear system into the motor (for example, in one aspect, if the apparatus is in a non-vertical orientation). A brake hub is secured to a top 692a of the motor's rotor.

Figures 35A to 35F illustrate a length adjustable link 700 useful as a support link for supporting any item or equipment and which, in certain aspects, is useful as any of the links described above, for example bails 72 or links 14. Each link 700 has a hollow first part 701 in which is movably disposed a portion of a second part 702. The first part 701 has an eye 703 and the second part 702 has an eye 704. Bolts 705 through holes 706 in the first

part 701 and through holes 707 (or holes 708) in the second part 702 releasably secure the parts 701, 702 together. Any desired number of holes at any desired location may be provided in the first part 701 and/or in the second part 702 for link length adjustability. The resulting length of the link as shown in Figures 35C and 35F. As shown the link parts (outer and inner) have a generally square or rectangular cross-section, but this cross-section may be any desired shape, for example, but not limited to, circular, oval, elliptical, triangular, pentagonal, or hexagonal. The rear views of the links as shown in Figures 35B, 35C, 35E and 35F are like the views of Figures 35B, 35C, 35E and 35F, respectively. The side view opposite the side shown in Figure 35A is like the view of Figure 35A.

CLAIMS

1. A top drive for wellbore operations, the top drive comprising an alternating current permanent magnet motor (30) having a bore therethrough, a planetary gear apparatus (20) coupled to the alternating current permanent magnet motor (30), the planetary gear apparatus (20) having a bore therethrough, the bore through the alternating current permanent magnet motor (30) substantially aligned with the bore through the planetary gear apparatus (20) so that fluid is flowable therethrough, the top drive further comprising a quill (50) drivingly connected to the planetary gear apparatus to rotate the quill.

2. A top drive as claimed in Claim 1, wherein the alternating current permanent magnet motor (30) is arranged above the planetary gear apparatus (20).

3. A top drive as claimed in Claim 1 or 2, further comprising a support arrangement (12,14,16,18) for supporting the alternating current permanent magnet motor (30) and the planetary gear apparatus (20), the support arrangement (12,14,16,18) comprising a swivel body (12), a suspension member (16,18) above the permanent magnet motor, at least one link arranged between the swivel body (12) and the suspension member (16,18).

4. A top drive as claimed in Claim 3, wherein two links are arranged between the swivel body (12) and the suspension member (16,18).

5. A top drive as claimed in Claim 3 or 4, wherein said at least one link is provided with an opening (14c) therethrough for receiving a pin or ear (13), said opening (14c) oversized to allow a degree of vertical movement.

6. A top drive as claimed in Claim 3, 4 or 5, wherein

the suspension member comprises a block (420) having sheaves (434) and a becket (303) rigidly fixed thereto, the sheaves connectable to a rope to a derrick of a rig and the becket connected to said at least one link.

7. A top drive as claimed in Claim 6, wherein the becket (303) is selectively securable to the travelling block in a plurality of positions.

8. A top drive as claimed in any of Claim 3 to 6, further comprising a weight compensation device (114,116) arranged between the becket (16,18) and the swivel body (12) for compensating for the weight of the top drive and a tubular to be stabbed during a stabbing operation to inhibit damage to tubulars.

9. A top drive as claimed in Claim 8, wherein the weight compensation device (114,116) comprises a hydraulic piston and cylinder (114) and an accumulator (116).

10. A top drive as claimed in any of Claim 3 to 9, wherein the swivel body (12) has an interior, a main bearing (57) disposed within the interior, the quill (50) having a flange (54) resting on and rotatable on the main bearing (57).

11. A top drive as claimed in any of Claim 3 to 10, further comprising a load sleeve (170) retained by the swivel body (12), the quill (50) rotatable within said load sleeve (170), a load collar (70) positioned around the load sleeve (170) and supported thereby, at least one bail (72) depending from the load collar (70) and an elevator (74) for selectively receiving and holding a tubular, the elevator (74) supported by the at least one bail.

12. A top drive as claimed in Claim 11, further comprising a tilt apparatus (120) for tilting the at

least one bail (72), the tilt apparatus (120) arranged to rotate the bails about the load collar (70) for tilting the at least one bail (72) central line extending down through a centre of the permanent magnet (30) through a centre of the planetary gear apparatus (20), through a centre of the quill (50), said centres aligned.

13. A top drive as claimed in Claim 12, wherein the tilt apparatus (120) comprises a clamp (126) on said at least one bail, the clamp (126) having two roller pins (127) between which a portion of the at least one bail (72) movable to facilitate movement of the bail (72) with respect to the clamps (126).

14. A top drive as claimed in Claim 13,wherein said two roller pins (127) are mounted with mounting plates having offset holes for mounting the roller pins (127) so that reversing the mounting plates changes the distance between the roller pins (127) to accommodate a bail (72) of different widths.

15. A top drive as claimed in any preceding claim, further comprising a clamping apparatus (100) rotatably arranged on the top drive, the clamping apparatus (100) for selectively clamping a tubular.

16. A top drive as claimed in Claim 15 when dependent on claim 11 or 12, wherein the load collar (70) is freely rotatably disposed, the clamping apparatus (100) disposed between the two bails (72).

17. A top drive as claimed in Claim 16, wherein the clamping apparatus (100) comprises at least one two jaw (293) for selective receipt therebetween of a tubular to be clamped therebetweeen.

18. A top drive as claimed in Claim 17, wherein said at least one jaw comprises a piston movable within a cylinder toward and away from a tubular to be clamped.

19. A top drive as claimed in Claim 15, 16 or 17, wherein the clamping apparatus (100) further comprises at least one telescopic leg (283,285).

20. A top drive as claimed in Claim 19, wherein the clamping apparatus (100) comprises at least two spaced-apart telescopic legs.

21. A top drive as claimed in Claim 16, further comprising at least one further motor

22. A top drive as claimed in any of Claims 15 to 21, further comprising electrical power generating apparatus (240) connected to the clamping apparatus (100) for providing electrical power.

23. A top drive as claimed in any of Claims 15 to 22, further comprising a hydraulic manifold (400), a plurality of directional control valves (260) for control hydraulic fluid flow in a plurality of corresponding flow lines, the plurality of corresponding flow lines including flow lines for providing hydraulic fluid to power apparatus below the clamping system.

24. A top drive as claimed in Claims 19 and 23, wherein the hydraulic manifold (400) and the plurality of directional control valves (260) are arranged on the at least on telescopic leg (283,285).

25. A top drive as claimed in any of dependent on Claim 11 and 24, wherein the load sleeve (170) has fluid conducting channels (170a) and the apparatus further comprises a rotating head (80) connected to the load sleeve (170) for receiving fluid from the load sleeve's fluid conducting channels (170a) and for conveying said fluid to the lower hydraulic manifold, and the rotating head (80) rotatable with the clamping apparatus (100).

26. A top drive as claimed in any of Claims 15 to 25, further comprising a selective locking mechanism (60)

secured to the swivel body (12) for selectively locking the clamping apparatus (100) preventing its rotation while the quill (50) is allowed to rotate.

27. A top drive as claimed in any preceding claim, further comprising a mud saver apparatus (90) releasably connected to the quill (50).

28. A top drive as claimed in any preceding claim, further comprising a saver sub (290).

29. A top drive as claimed in any preceding claim, further comprising a spacer plate (22) between the alternating current permanent magnet motor (30) and the planetary gear apparatus (20), the spacer plate (22) having a bearing recess (22a), and a bearing in the bearing recess for facilitating rotation of the quill (50).

30. A top drive as claimed in any preceding claim, further comprising an access platform (130) pivotably connected at a lower end to the swivel body (12), the access platform (130) with a platform portion (132) pivotable to a generally horizontal position so that personnel on the access platform (130) can access components of the top drive.

31. A top drive as claimed in any preceding claim, further comprising an extension mechanism (98) for moving the top drive horizontally.

32. A top drive as claimed in Claim 31, wherein the extension mechanism (98) has an opening through which a tubular stand is movable while the extension mechanism (98) with the top drive connected thereto moves with respect to the tubular stand.

33. A top drive as claimed in any preceding claim, further comprising a disc brake system (40) arranged above the drive motor (30).

* * *

34. An apparatus for use in a top drive for releasably holding a tubular, the apparatus comprising at least two opposed clamping apparatuses (280), spaced-apart for selective receipt of a tubular to be clamped therebetweeen, each of the two opposed clamping apparatuses having a mount (293) and a piston (281) movable within the mount (293), the piston (281) selectively movable toward and away from a tubular to be clamped, two spaced-apart telescopic legs (283,285) which in use depend from a part of the top drive, the telescopic legs (283,285) for moving the at least two opposed clamping apparatus (280) in a substantially vertical plane.

35. An apparatus as claimed in Claim 34, wherein the two opposed clamping apparatuses (280) are releasably connected together with connection apparatus (291,294) so that either or both connection apparatuses are disconnectible.

36. An apparatus as claimed in Claim 34, wherein each connection apparatus comprises a plurality of spaced-apart intermeshing lugs (294) with holes (295) therein and a pin (291) removably insertable through said holes.

37. An apparatus as claimed in Claim 34, 35 or 36, wherein the two telescopic legs (283,285) have a non-circular cross-section.

38. An apparatus as claimed in any of Claims 34 to 36, further comprising spring apparatus (286) within each telescopic leg (283,285) for compensating for movement of a tubular clamped by the apparatus.

39. An apparatus as claimed in any of Claims 34 to 38, further comprising a piston and cylinder (282,286b) in each telescopic leg (283,285), the cylinder (286b)

with a vacuum therein and as a piston (282) extensible from and retractable within the hollow cylinder (286b), the piston and (282,286b) providing compensation for movement of the member clamped by the clamping apparatus.

40. An apparatus as claimed in any of Claims 34 to 39, wherein the telescopic legs (283,285) each comprise an outer leg portion (283) and an inner leg portion (285) further comprising a chain connection structure (314a) on each outer leg portion (283) and each inner leg portion (285) to which a chain is connectible to prevent separation of the outer leg portion (283) from the inner leg portion (285).

41. An apparatus as claimed in any of Claims 34 to 40, further comprising guide apparatus (312) secured to and below the two opposed clamping apparatuses (293) for guiding a tubular between the two opposed clamping apparatuses (293).

42. An apparatus as claimed in Claim 41, wherein the guide apparatus (312) is releasably connected to at least one of the two opposed clamping apparatuses.

43. An apparatus as claimed in any of Claims 34 to 42 , further comprising generator apparatus (240) connected to one of the two legs for generating electrical power.

44. An apparatus as claimed in any of Claims 34 to 43, further comprising a hydraulic fluid manifold (400) connected to at least one of the two telescopic legs (283,285) for receiving hydraulic fluid from an hydraulic fluid source and for providing hydraulic fluid for releasably clamping and holding a member for wellbore operations.

45. An apparatus as claimed in Claim 44, wherein the hydraulic fluid manifold (400) includes a plurality of hydraulic fluid conduits and a plurality of controllable

valves (260) for selectively controlling fluid flow in each hydraulic fluid conduit.

46. An apparatus as claimed in Claim 41, further comprising generator apparatus (240) connected to at least one of the two legs (283,285) for generating electrical power, and controller apparatus on one of the two legs in communication with the controllable valves (260) for controlling the controllable valves.

47. An apparatus as claimed in Claim 46, wherein controller apparatus includes digital signal processing apparatus and an antenna for communicating with the controller apparatus from a location spaced-apart from the apparatus for releasably clamping and holding a tubular for wellbore operations.

48. An apparatus as claimed in any of Claims 34 to 47, further comprising each piston (281) comprises a die holder (299) and die apparatus (301) for engaging the tubular member.

49. An apparatus as claimed in any of Claims 34 to 47, wherein each housing (293) has a cylinder (292) lining the housing (293), the piston (281) slideably arranged in the cylinder (292).

50. An apparatus as claimed in any of Claims 34 to 49, further comprising a connection structure (285g, 2851) on each of the two telescopic legs (283,285) for connecting the apparatus to the top drive.

51. An apparatus as claimed in Claim 50, wherein the connection structure (285g,2851) provides a pivotable connection of each telescopic leg at its upper end for pivoting the two telescopic legs apart from each other.

52. An apparatus as claimed in any of Claims 34 to 51, wherein the two legs further comprise an anti-rotation structure for receiving part of an adjacent apparatus and

releasably holding said part so that said adjacent apparatus is rotatable simultaneously with the apparatus for releasably clamping and holding a member for wellbore operations.

53. A top drive comprising a drive motor and an apparatus as claimed in any of claims 34 to 52.

54. A method for gripping an item, the method comprising positioning the item within a main body of an apparatus, the apparatus comprising a main body, two opposed clamping apparatuses in the main body, the two opposed clamping apparatuses spaced-apart for selective receipt therebetween of a member to be clamped therebetweeen, each of the two opposed clamping apparatuses having a mount and piston apparatus movable within the mount, the piston apparatus selectively movable toward and away from a member to be clamped, two legs, the legs spaced-apart and each leg with an upper end and a lower end, each lower end connected to the main body, each leg comprising an outer leg portion and an inner leg portion, the inner leg portion having part thereof movable within the outer leg portion to provide a range of up/down movement for the main body, wherein the member for wellbore operations is a tubular member, and each piston apparatus including a piston and a die holder secured to an outer end of the piston, and die apparatus on the die holder for engaging the tubular member, each mount having a liner removably disposed therein, each piston movable within a corresponding liner, and moving the pistons so that the die apparatus engages the item to be gripped thereby gripping the item.

55. A method in accordance with Claim 54, further comprising the step of rotating the apparatus thereby rotating the item gripped by the apparatus.

* * *

56. A top drive comprising a drive motor (30), and a support apparatus (70) and tubular handling apparatus (74,100) connected to and below and supported by the support apparatus (70), the tubular handling apparatus (74,100) including hydraulic-fluid-powered apparatus on or below the tubular handling apparatus (74,100), provision apparatus (400) connected to the tubular handling apparatus (74,100) for providing hydraulic fluid to power the hydraulic-fluid-powered apparatus, the provision apparatus including flow line apparatus for providing hydraulic fluid to the hydraulic-fluid-powered apparatus and electrically-operable control apparatus (250) for controlling fluid flow to and from the flow line apparatus, and electrical power generating apparatus (240) connected to the tubular handling apparatus for providing electrical power to the electrically-operable control apparatus (250).

57. A top drive as claimed in Claims 56, further comprising a gear apparatus (20), a drive quill (50) coupled to the gear apparatus (20) and a suspension arrangement (12,14,16,18).

58. A top drive as claimed in Claims 57, wherein the tubular handling apparatus (74,100) includes clamping apparatus (100) for clamping an item, the clamping apparatus (100) powered by hydraulic fluid from the provision apparatus (400).

59. A top drive as claimed in Claims 57 or 58, wherein the clamping apparatus (100) is rotatable with respect to the drive motor, the support apparatus (70) including a locking mechanism (60) for selectively locking the tubular handling apparatus (74,100) in position, the locking mechanism (60) comprising driving apparatus (190)

for rotating the clamping apparatus (100), the drive quill (50) rotatable by the gear apparatus (20) with the clamping apparatus (100) locked in position by the locking mechanism (60).

60. A top drive as claimed in any of Claims 56 to 59, wherein the electrically-operable control apparatus (250) includes a plurality of selectively operable control valves (260) which selectively control flow of hydraulic fluid to apparatuses below the support apparatus (70).

61. A top drive as claimed in any of Claims 56 to 60, wherein the apparatuses below the lower support apparatus include clamping apparatus (100) for clamping an item, elevator (74) for supporting an item, and link-tilt apparatus (120) for moving the elevator (74) at an angle to the support apparatus (70).

62. A top drive as claimed in any of Claims 56 to 61, wherein the clamping appapratus comprises at least two opposed clamping apparatuses (280), spaced-apart for selective receipt of a tubular to be clamped therebetweeen, each of the two opposed clamping apparatuses having a mount (293) and a piston (281) movable within the mount (293), the piston (281) selectively movable toward and away from a tubular to be clamped, two spaced-apart telescopic legs (283,285) which in use depend from a part of the top drive, the telescopic legs (283,285) for moving the at least two opposed clamping apparatus (280) in a substantially vertical plane.

63. A top drive as claimed in Claim 62, further comprising a piston and cylinder (282,286b) in each telescopic leg (283,285) with a first part thereof connected to the upper end and a second part thereof connected to the lower end, each piston and cylinder

(282,286b) wherein the cylinder (282) has a vacuum therein and the piston (286b) is extensible from and retractable within the cylinder (282), the piston and cylinder (282,286b) providing compensation for movement of the tubular clamped by the clamping apparatus, fluid to power the piston and cylinder (282,286b) provided by the provision apparatus (400).

64. A top drive as claimed in Claim 62 or 63, wherein the generator apparatus (240) for generating electrical power is connected to one of the two telescopic legs (283,285).

65. A top drive as claimed in Claim 64, wherein the provision apparatus (400) comprises a hydraulic fluid manifold (400) connected to one of the two telescopic legs (283,285) for receiving hydraulic fluid from an hydraulic fluid source and for providing hydraulic fluid to the generator apparatus (240) to power the generator apparatus.

66. A top drive as claimed in Claim 65, wherein the hydraulic fluid manifold (400) includes a plurality of hydraulic fluid conduits (688) and a plurality of controllable valves (250) for selectively controlling fluid flow in each hydraulic fluid conduit.

67. A top drive as claimed in any of Claims 62 to 66, further comprising a rotating head (80) connected to and between the two telescopic legs (283,285), the rotating head (80) for receiving hydraulic fluid from a fluid supply and for providing said hydraulic fluid to power the generator (240).

68. A top drive as claimed in Claim 67, wherein the rotating head (80) provides hydraulic fluid for the plurality of controllable valves (250).

69. A top drive as claimed in any of Claims 56 to 68

wherein the drive motor is an alternating current permanent magnet motor (30) having a bore therethrough, a planetary gear apparatus (20) coupled to the alternating current permanent magnet motor (30), the planetary gear apparatus (20) having a bore therethrough, the bore through the alternating current permanent magnet motor (30) substantially aligned with the bore through the planetary gear apparatus (20) so that fluid is flowable therethrough, the top drive further comprising a quill (50) drivingly connected to the planetary gear apparatus to rotate the quill.

70. A top drive as claimed in any of Claims 56 to 68, wherein the suspension arrangement (12,14,16,18) comprises a swivel body (12), a suspension member (16,18) above the permanent magnet motor, at least one link arranged between the swivel body (12) and the suspension member (16,18).

71. A top drive as claimed in Claim 70, wherein two links are arranged between the swivel body (12) and the suspension member (16,18).

72. A top drive as claimed in Claim 70 or 71, wherein said at least one link is provided with an opening (14c) therethrough for receiving a pin or ear (13), said opening (14c) oversized to allow a degree of vertical movement.

73. A top drive as claimed in Claim 70, 71 or 72, wherein the suspension member comprises a block (420) having sheaves (434) and a becket (303) rigidly fixed thereto, the sheaves connectable to a rope to a derrick of a rig and the becket connected to said at least one link.

74. A top drive as claimed in Claim 73, wherein the becket (303) is selectively securable to the travelling

block in a plurality of positions.

75. A top drive as claimed in any of Claim 70 to 74, further comprising a weight compensation device (114,116) arranged between the becket (16,18) and the swivel body (12) for compensating for the weight of the top drive and a tubular to be stabbed during a stabbing operation to inhibit damage to tubulars.

76. A top drive as claimed in Claim 75, wherein the weight compensation device (114,116) comprises a hydraulic piston and cylinder (114) and an accumulator (116).

77. A top drive as claimed in any of Claim 70 to 76, wherein the swivel body (12) has an interior, a main bearing (57) disposed within the interior, the quill (50) having a flange (54) resting on and rotatable on the main bearing (57).

78. A top drive as claimed in any of Claim 70 to 76 further comprising a load sleeve (170) retained by the swivel body (12), the quill (50) rotatable within said load sleeve (170), a load collar (70) positioned around the load sleeve (170) and supported thereby, at least one bail (72) depending from the load collar (70) and an elevator (74) for selectively receiving and holding a tubular, the elevator (74) supported by the at least one bail.

79. A top drive as claimed in any of Claims 56 to 78, further comprising an access platform (130) pivotably connected at a lower end to the swivel body (12), the access platform (130) with a platform portion (132) pivotable to a generally horizontal position so that personnel on the access platform (130) can access components of the top drive.

80. A top drive as claimed in any of Claims 56 to 79,

further comprising an extension mechanism (98) for moving the top drive horizontally.

81. A top drive as claimed in Claim 80, wherein the extension mechanism (98) has an opening through which a tubular stand is movable while the extension mechanism (98) with the top drive connected thereto moves with respect to the tubular stand.

* * *

82. A containerized apparatus comprising a container (160), top drive (1) removably disposed within the container (160), an extension mechanism (98) for moving the top drive (1) generally horizontally within a derrick, the top drive (1) secured to the extension mechanism (98), the extension mechanism (98) removably disposed within the container (160) with the top drive (1), a track (82) for the top drive (1) to move in a vertical plane in use in a derrick, the track comprised of multiple track parts connectible together, a skid (600) for retaining the top drive during transit, a part of the skid (600) forming at least one track part.

83. A containerized apparatus as claimed in Claim 82, the track (82) further comprising at least one first compartment (162) for removably storing the multiple track parts (630), the multiple track parts (630) removably located in the at least one first compartment (162), and the multiple track parts assembleable outside the container (160) to include the multiple track parts and the at least one skid track part with the extension mechanism (98) movable along the track with the top drive (1).

84. A containerized apparatus as claimed in Claim 82 or 83, wherein the multiple track parts (630) include at least one length-adjustable track part (630) so that the

track is installable in derricks of different height.

85. A containerized apparatus as claimed in Claim 84, wherein the top drive apparatus includes a motor, a gear system, and tubular handling apparatus, the tubular handling apparatus including an elevator for selective holding a tubular and links to connect the elevator to the top drive apparatus, the motor, gear system and tubular handling apparatus removably disposed within the container.

86. A containerized apparatus as claimed in any of Claims 82 to 85, wherein the skid track part (82,630) has fork lift pockets (82e) for receiving fork lift projections.

87. A containerized apparatus as claimed in any of Claims 82 to 86, wherein at least one of the multiple track parts (82,630) has fork lift pockets for receiving fork lift projections.

88. A containerized apparatus as claimed in any of Claims 82 to 87, wherein all of the multiple track parts (82,630) have fork lift pockets (82e) for receiving fork lift projections.

89. A containerized apparatus as claimed in any of Claims 82 to 88, wherein the top drive (1) includes an access platform (130) pivotably connected to a part of the top drive (1), the access platform (130) having a top end releasably connected to the top drive (1), upon release of the top end of the access platform (130) the access platform (130) pivotable from a position generally aligned with the apparatus to a position generally normal thereto so that the access platform (130) provides a platform on which a person can stand to access part of the apparatus, the access platform removably located within the container with the apparatus.

90. A containerized apparatus as claimed in any of Claims 82 to 89, further comprising a suspension apparatus (12,14,16,18) removably located within the container (160), the suspension apparatus (12,14,16,18) connected to the top drive, the suspension apparatus for suspending the top drive apparatus in a derrick.

91. A containerized apparatus as claimed in Claim 90, wherein the suspension apparatus includes a travelling block, a hook connectable to the travelling block, and a becket connectable to the top drive apparatus and to the hook.

92. A containerized apparatus as claimed in any of Claims 82 to 91, wherein the suspension apparatus (12,14,16) includes a block (420) and a becket (303), the becket (303) directly connected to the block (420).

93. A containerized apparatus as claimed in Claim 92, wherein the becket (303) is selectively rotatable with respect to the block (420) and is securable to the block (420) in a chosen non-rotating position.

94. A containerized apparatus as claimed in any of Claims 82 to 93, wherein the track (82,630) is connectible to a derrick and is suitable for reacting torque generated by the top drive apparatus to the derrick.

95. A containerized apparatus as claimed in any of Claims 82 to 86, further comprising a control system in the container operable by personnel in the container to control the apparatus when the apparatus is removed from the container and located in a derrick for operation.

96. A containerized apparatus as claimed in any of Claims 82 to 86, further comprising a power system within the container (160) for providing power to operate at least part of the top drive (1).

96. A containerized apparatus as claimed in Claim 95, wherein the power system provides hydraulic power.

97. A containerized apparatus as claimed in Claim 96, further comprising a reservoir within the container holding hydraulic fluid used by the power system for providing hydraulic power to the apparatus.

98. A containerized apparatus as claimed in any of Claims 82 to 97, further comprising a cooling system (532) within the container (160) for providing cooling to the apparatus.

99. A containerized apparatus as claimed in any of Claims 82 to 86, wherein the top drive (1) has an alternating current permanent magnet motor (30) having a bore therethrough, a planetary gear apparatus (20) coupled to the alternating current permanent magnet motor (30), the planetary gear apparatus (20) having a bore therethrough, the bore through the alternating current permanent magnet motor (30) substantially aligned with the bore through the planetary gear apparatus (20) so that fluid is flowable therethrough, the top drive further comprising a quill (50) drivingly connected to the planetary gear apparatus to rotate the quill.

100. A containerised apparatus as claimed in any of Claims 82 to 99, wherein the extension mechanism (98) has an opening through which a tubular stand is movable while the extension mechanism (98) with the top drive connected thereto moves with respect to the tubular stand.

* * *

101. An apparatus for wellbore operations, the apparatus comprising a derrick (140), a guide beam (82,630) connected to the derrick (140), a top drive (1) movable on the guide beam (82,630), a torque reaction structure (600) connected to the guide beam (82,630), and skid

apparatus (620) held by the torque reaction structure (600), the skid apparatus (620) movable vertically with respect to the torque reaction structure (600) to inhibit a vertical load from passing from the skid apparatus to the torque reaction structure.

102. An apparatus as claimed in Claim 101, wherein the derrick (140) includes a rig floor, the guide beam (82,630) has a topmost part, the topmost part comprising an outer part and an inner part movable within the outer part, and the inner part (640) and outer part (632) selectively connectible at a plurality of different locations to provide length adjustability to the guide beam so that position of the guide beam (82,630) with respect to the rig floor is adjustable.

103. An apparatus as claimed in Claim 102, further comprising a first shackle (644) connected to the derrick (140), a second shackle (646) connected to the first shackle and to the inner part (640) of the topmost part of the guide beam (630) to inhibit torque transfer between the topmost part and the derrick.

104. An apparatus as claimed in Claim 103, further comprising at least one secondary shackle connected to the outer part of the topmost part (630) for providing an attachment for a cable, the cable connectible to the derrick (140).

105. An apparatus as claimed in any of Claims 101 to 104, wherein the wellbore operations are done at a well, the well having a well centre, and wherein the torque reaction structure includes a frame (600) movable with respect to the guide beam (82,630) toward and away from the well centre.

106. An apparatus as claimed in any of Claims 101 to 105, wherein the top drive (1) comprises a load collar (70),

an elevator (74), two bails (700) each with upper ends connected to the load collar (70) and lower ends connected to the elevator (74), each bail (700) comprising an outer body (701) with an end eye (703) and an inner body (702) with an end eye (704), the inner body (702) movable within the outer body (701) to adjust length of the bail (700), and the inner body (702) selectively connectible to the outer body (701) at a plurality of locations to provide length adjustability of the bails.

107. An apparatus as claimed in any of Claims 101 to 106, wherein the top drive (1) comprises a gear apparatus (20) and a gear collar (194) wherein the gear collar and the load collar are a single integral piece.

108. An apparatus as claimed in any of Claims 101 to 107, wherein the top drive (1) includes a top drive motor (30) and a quill (50), and a brake apparatus (40) for braking the quill (50), the brake apparatus (40) having a brake hub (41) about the quill (50), the apparatus further comprising seal apparatus (650) within the brake hub (41) for sealing a quill/brake hub interface, the seal apparatus comprising a body with a first part (651a) and a second part (651b), the first part (651a) rotatable with the quill (50), the second part (651b) with the top drive motor (30), and an absorbent seal member (660) between the first part (651a) of the seal apparatus and the second part (651b) of the seal apparatus, the absorbent seal member (660) located so that force on it during rotation forces lubricating fluid out of the absorbent seal member (660), the absorbent seal member (660) sealing an interface between the first part (651a) and the second part (651b).

109. An apparatus as claimed in any of Claims 101 to 108,

wherein the top drive (1) has a drive motor (30) and includes a gear apparatus (20) with a sun gear (690), the gear apparatus (20) located beneath the drive motor (30), the apparatus further comprising a seal apparatus (661) for selectively engaging the sun gear (690) to seal off a pathway from the gear apparatus (20) to the drive motor (30).

110. An apparatus as claimed in Claim 109, wherein the seal apparatus (661) including a seal (664), a seal support (662) supporting the seal (664) movably disposed within or on a body (670) such that the seal (664) engages the sun gear (690) to seal off the pathway, the seal support (662) movable by fluid under pressure applied to the seal support (662), and resilient apparatus (672) urging the seal support (662) so that the seal contacts the sun gear (690) to seal off the pathway when insufficient or no fluid under pressure is applied to the seal support (662).

111. An apparatus as claimed in Claim 110, wherein the resilient apparatus (672) comprises a spring.

112. An apparatus as claimed in any of Claims 101 to 111, wherein the top drive comprises an alternating current permanent magnet motor (30) having a bore therethrough, a planetary gear apparatus (20) coupled to the alternating current permanent magnet motor (30), the planetary gear apparatus (20) having a bore therethrough, the bore through the alternating current permanent magnet motor (30) substantially aligned with the bore through the planetary gear apparatus (20) so that fluid is flowable therethrough, the top drive further comprising a quill (50) drivingly connected to the planetary gear apparatus to rotate the quill.

113. An apparatus as claimed in any of Claims 101 to 112,

wherein the top drive (1) comprises a suspension arrangement (12,14,16,18) having a swivel body (12), a suspension member (16,18) above the permanent magnet motor, at least one link arranged between the swivel body (12) and the suspension member (16,18).

114. A top drive as claimed in Claim 113 further comprising a load sleeve (170) retained by the swivel body (12), the quill (50) rotatable within said load sleeve (170), a load collar (70) positioned around the load sleeve (170) and supported thereby, at least one bail (72) depending from the load collar (70) and an elevator (74) for selectively receiving and holding a tubular, the elevator (74) supported by the at least one bail.

115. An apparatus as claimed in any of Claims 101 to 114, wherein the top drive (1) further comprises an access platform (130) pivotably connected at a lower end to the swivel body (12), the access platform (130) with a platform portion (132) pivotable to a generally horizontal position so that personnel on the access platform (130) can access components of the top drive.

116. An apparatus as claimed in any of Claims 101 to 114, further comprising an extension mechanism (98) for moving the top drive horizontally.

117. A top drive as claimed in Claim 116, wherein the extension mechanism (98) has an opening through which a tubular stand is movable while the extension mechanism (98) with the top drive connected thereto moves with respect to the tubular stand.

* * *

118. An apparatus for wellbore operations, the apparatus comprising a guide beam (630) connectible to a derrick with a rig floor, the guide beam (630) including a

topmost part, the topmost part comprising an outer part (632) and an inner part (640) movable within the outer part (632), and the inner part (640) and outer part (632) selectively connectible at a plurality of different locations to provide length adjustability to the guide beam (630) so that position of the guide beam (630) with respect to the rig floor is adjustable.

119. An apparatus as claimed in Claim 118, further comprising a first shackle (644) connected to the derrick (140), a second shackle (646) connected to the first shackle and to the inner part (640) of the topmost part of the guide beam (630) to inhibit torque transfer between the topmost part and the derrick.

120. An apparatus as claimed in Claim 119, further comprising at least one secondary shackle connected to the outer part of the topmost part (630) for providing an attachment for a cable, the cable connectible to the derrick (140).

* * *

121. An apparatus for wellbore operations, the apparatus comprising a derrick (140), a top drive (1) movably connected to the derrick (140), a connector (70) below the top drive, elevator (74), two bails (700) each with upper ends connected to the connector (70) and lower ends connected to the elevator (74), each bail (700) comprising an outer body (701) with an end eye (703) and an inner body (702) with an end eye (704), the inner body (702) movable within the outer body (701) to adjust length of the bail (700), and the inner body (702) selectively connectible to the outer body (701) at a plurality of locations to provide length adjustability of the bails.

* * *

122. A top drive comprising drive motor (30) and a quill (50), and a brake apparatus (40) for braking the quill (50), the brake apparatus (40) having a brake hub (41) about the quill (50), the apparatus further comprising seal apparatus (650) within the brake hub (41) for sealing a quill/brake hub interface, the seal apparatus comprising a body with a first part (651a) and a second part (651b), the first part (651a) rotatable with the quill (50), the second part (651b) with the top drive motor (30), and an absorbent seal member (660) between the first part (651a) of the seal apparatus and the second part (651b) of the seal apparatus, the absorbent seal member (660) located so that force on it during rotation forces lubricating fluid out of the absorbent seal member (660), the absorbent seal member (660) sealing an interface between the first part (651a) and the second part (651b).

* * *

123. A top drive (1) comprising a drive motor (30) and includes a gear apparatus (20) with a sun gear (690), the gear apparatus (20) located beneath the drive motor (30), the apparatus further comprising a seal apparatus (661) for selectively engaging the sun gear (690) to seal off a pathway from the gear apparatus (20) to the drive motor (30).

124. A top drive as claimed in Claim 123, wherein the seal apparatus (661) including a seal (664), a seal support (662) supporting the seal (664) movably disposed within or on a body (670) such that the seal (664) engages the sun gear (690) to seal off the pathway, the seal support (662) movable by fluid under pressure applied to the seal support (662), and resilient apparatus (672) urging the seal support (662) so that

the seal contacts the sun gear (690) to seal off the pathway when insufficient or no fluid under pressure is applied to the seal support (662).

125. A top drive as claimed in Claim 110, wherein the resilient apparatus (672) comprises a spring.

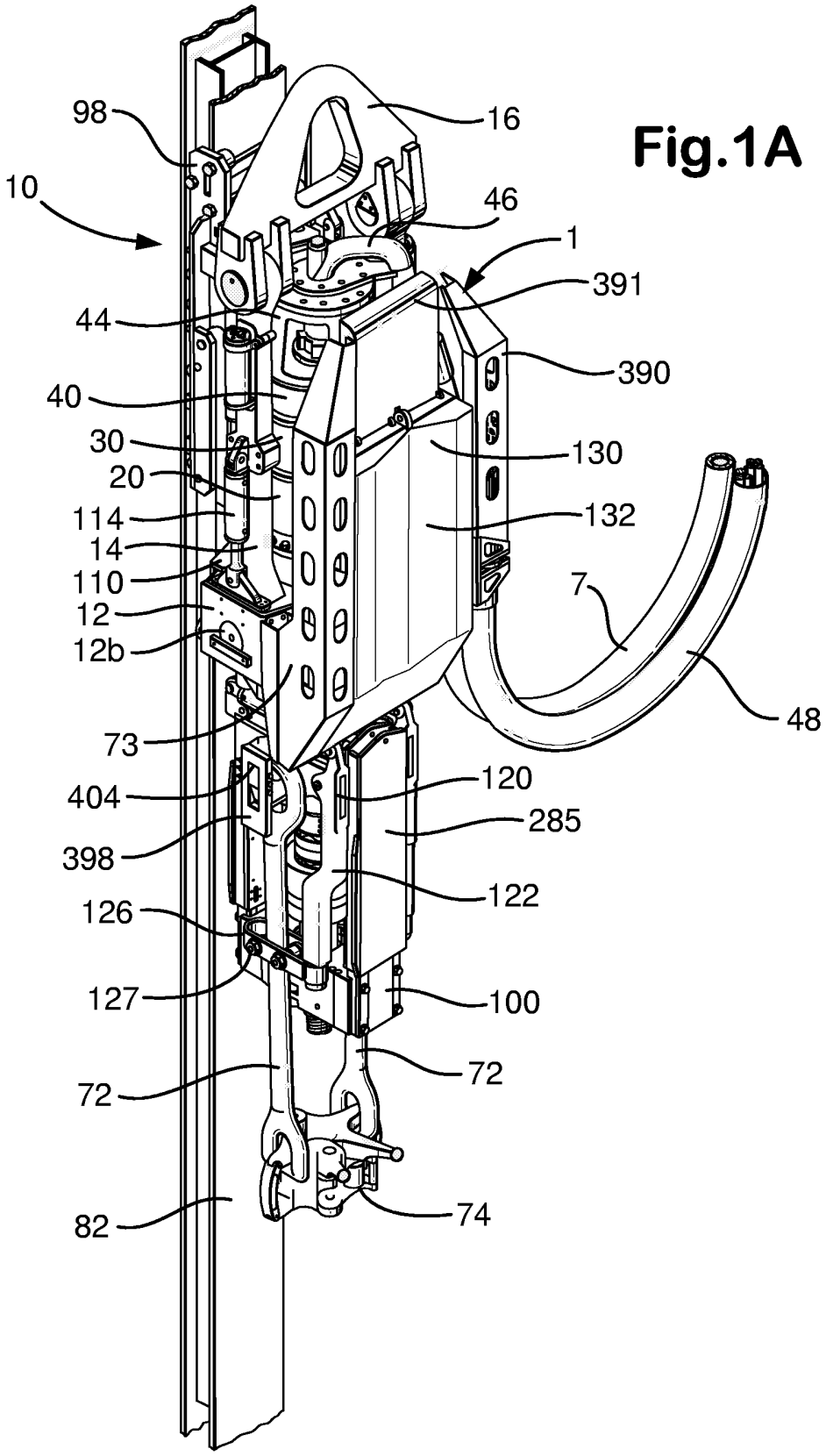
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Fig.1A

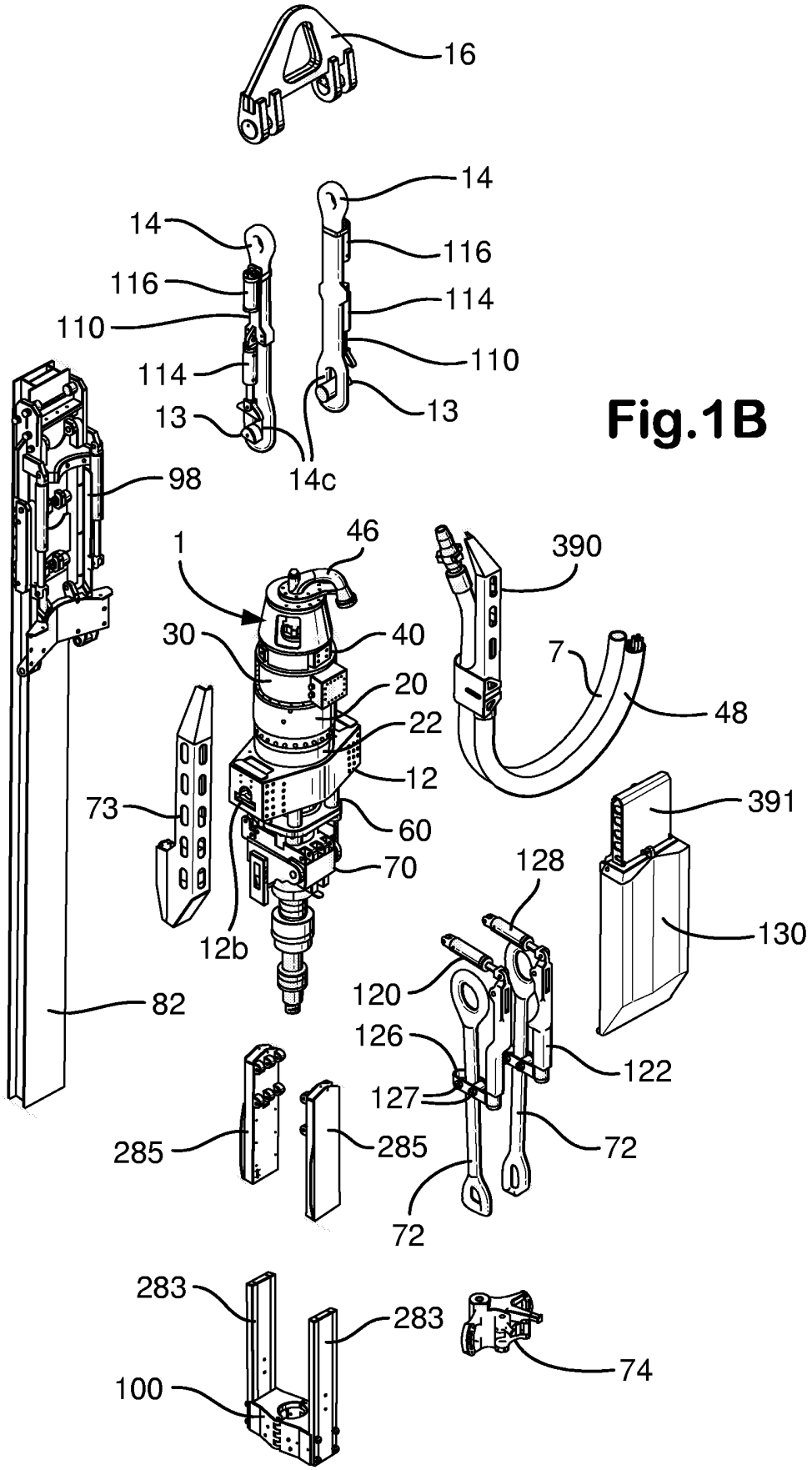
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Fig.1B

Fig.1C

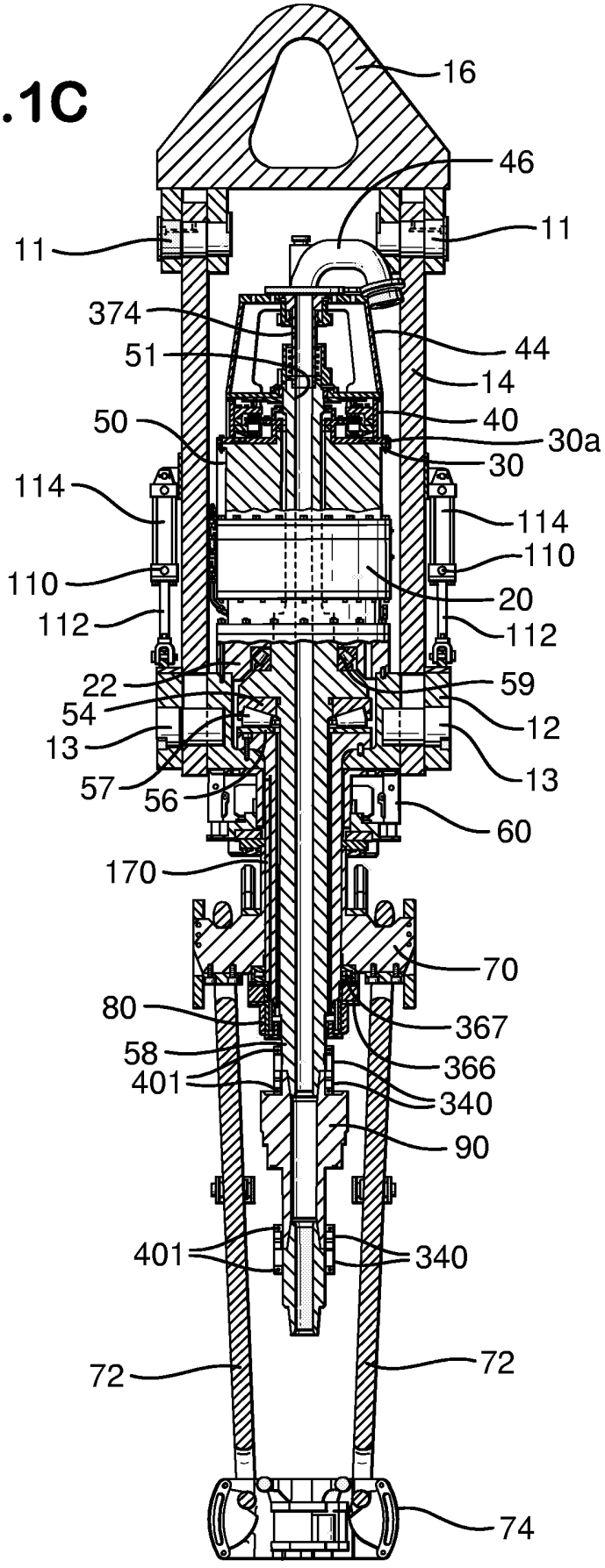
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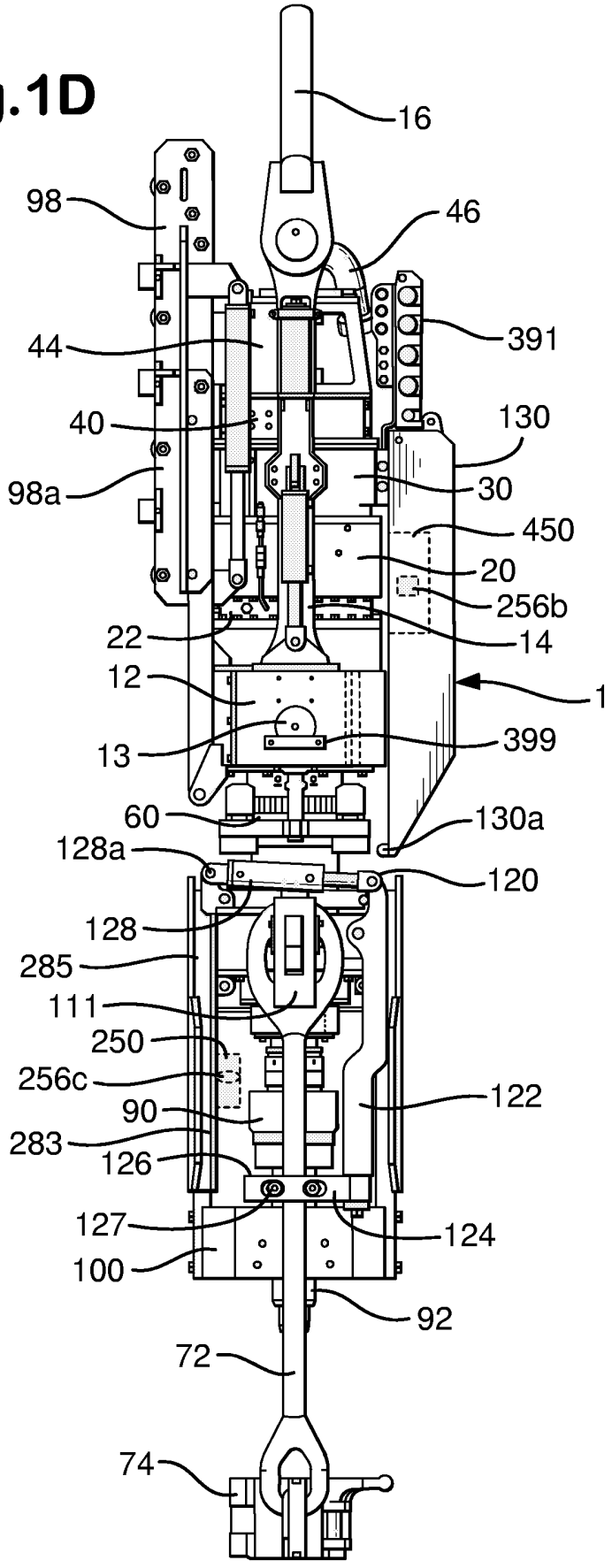
Fig.1D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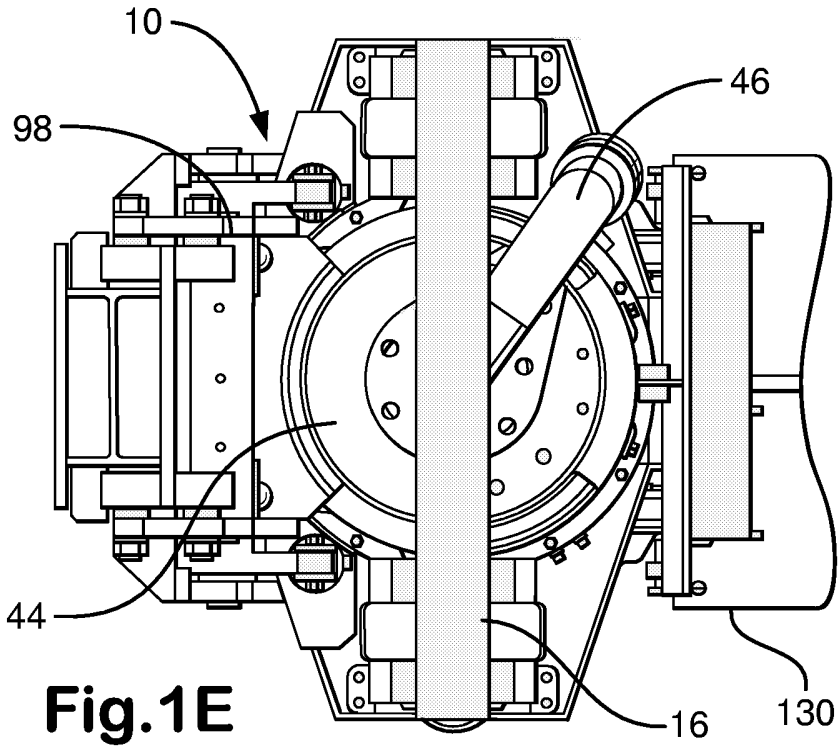


Fig.1E

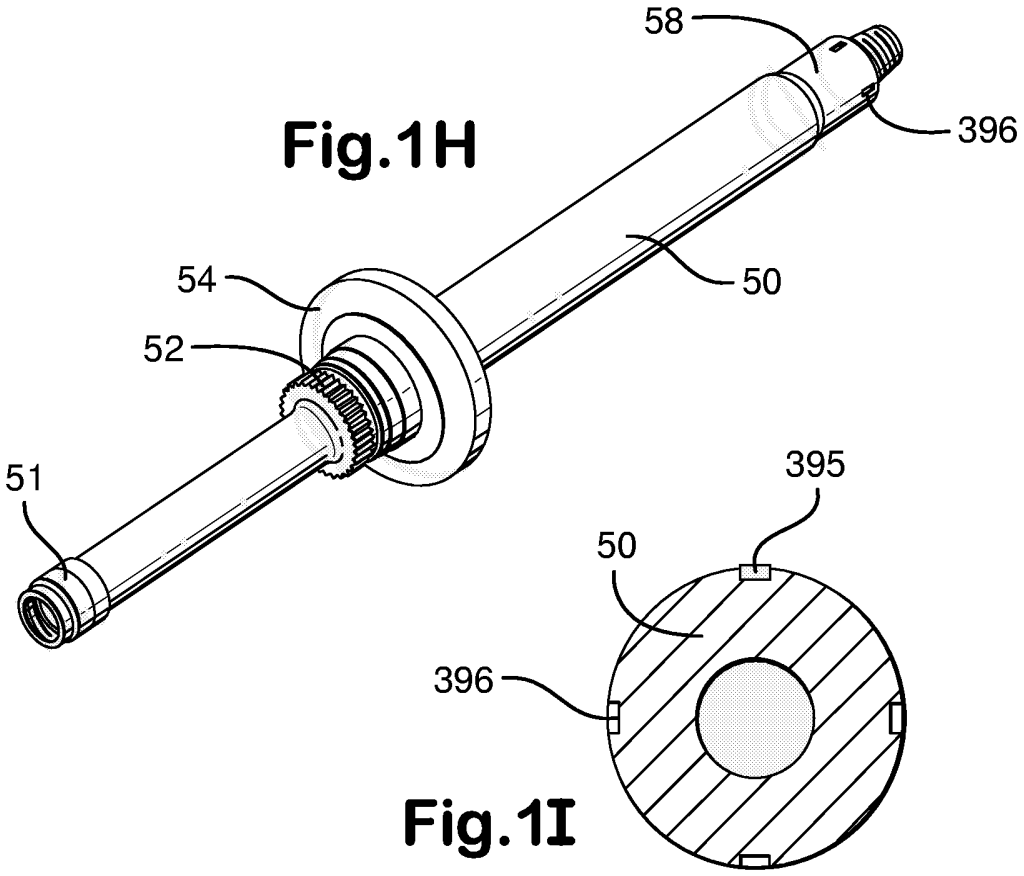
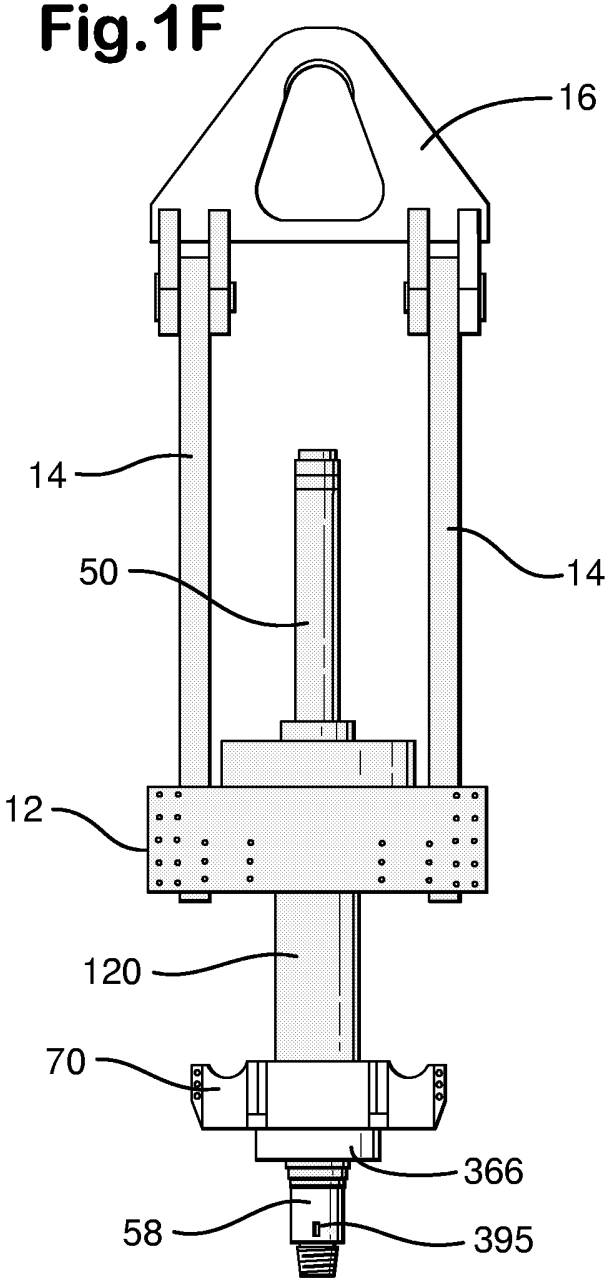


Fig.1H

Fig.1I

Fig.1F



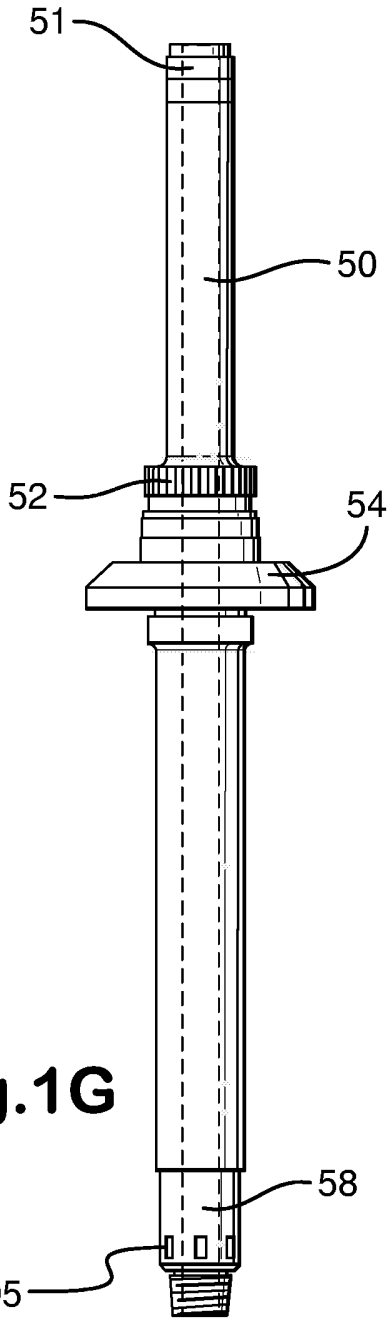


Fig.1G

Fig.1J

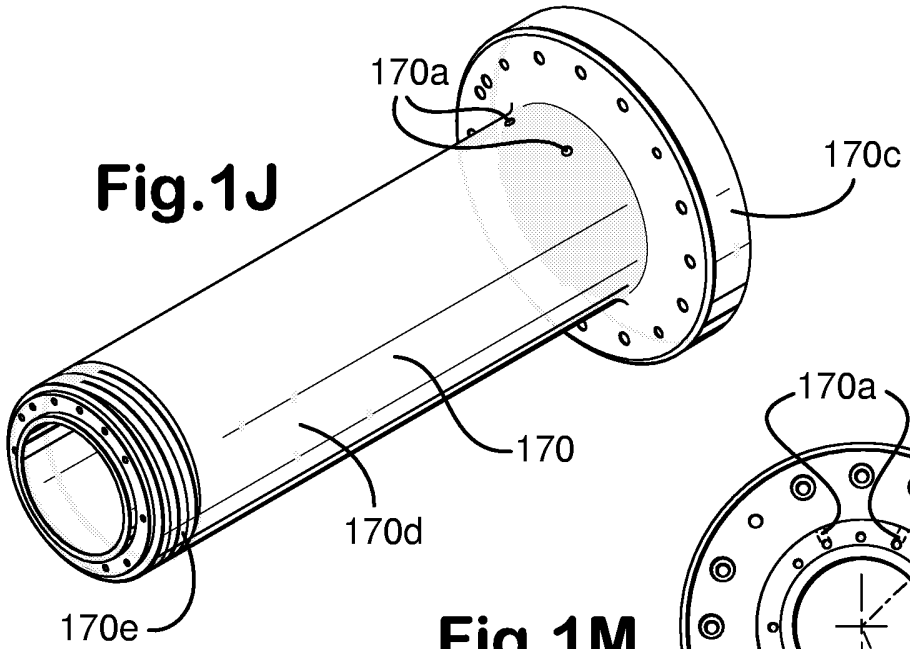


Fig.1M

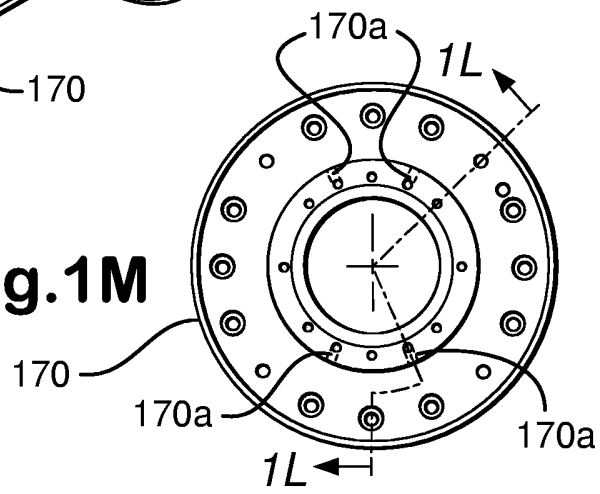


Fig.1K

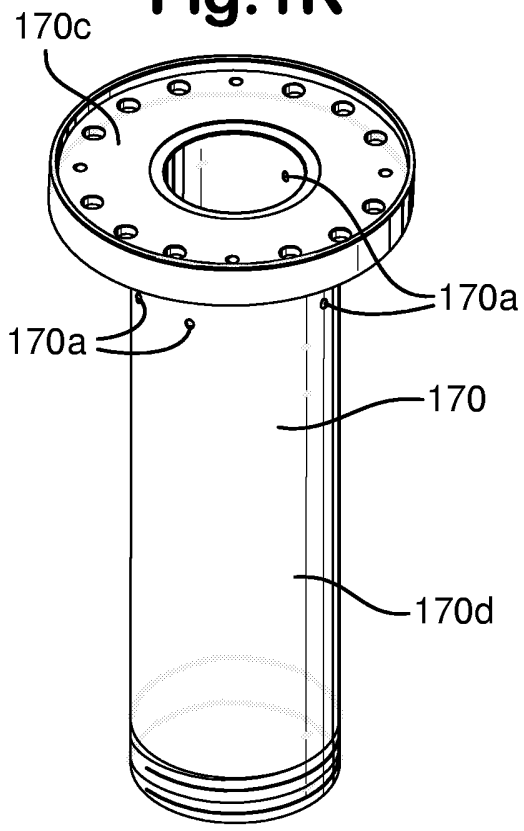
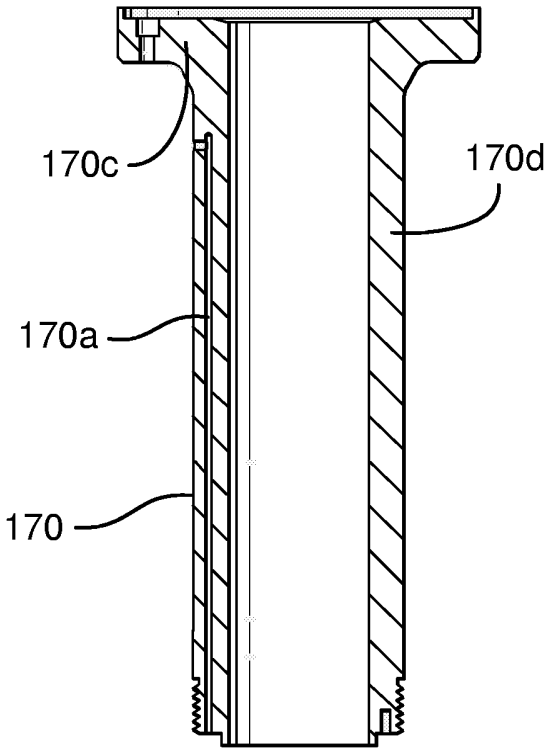


Fig.1L



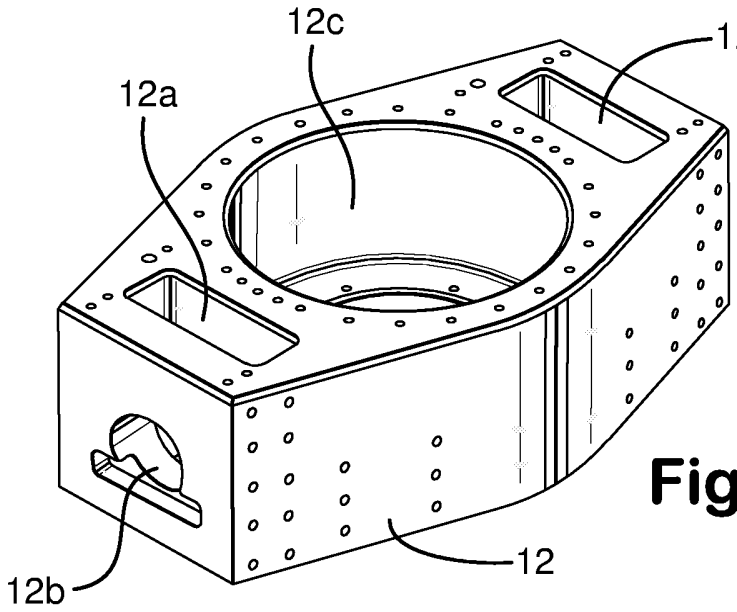


Fig.1N

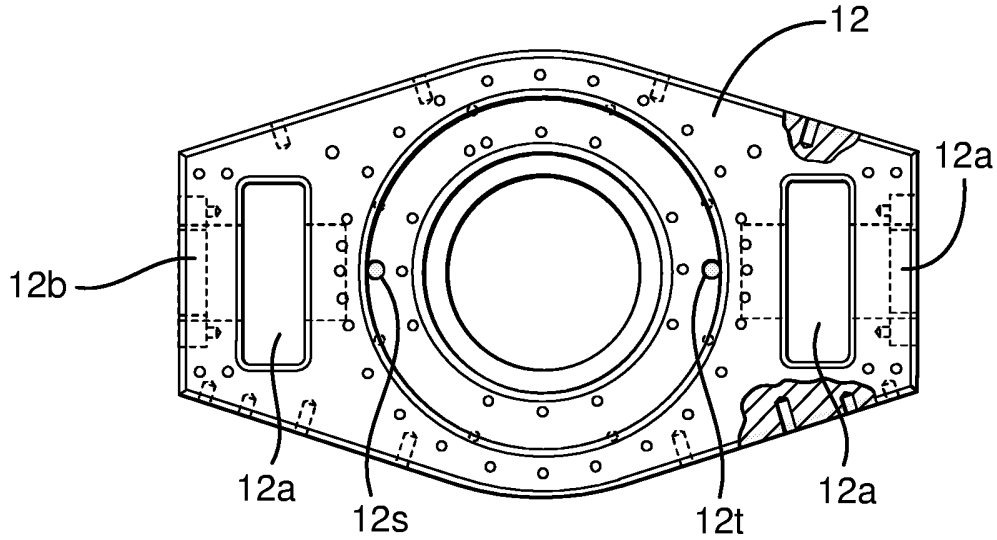


Fig.1O

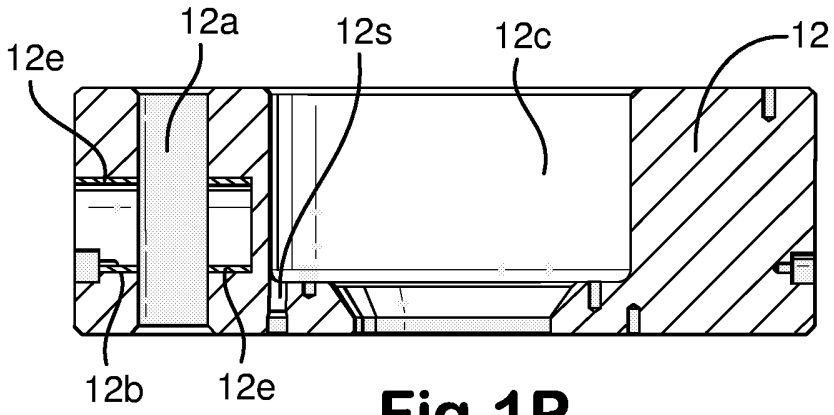


Fig.1P

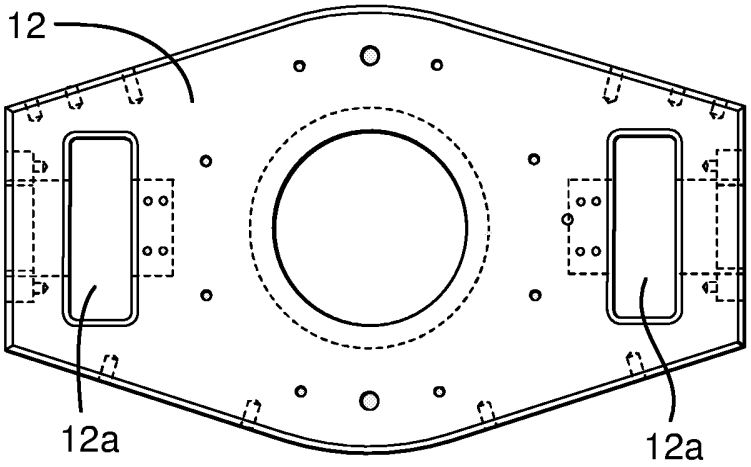


Fig.1Q

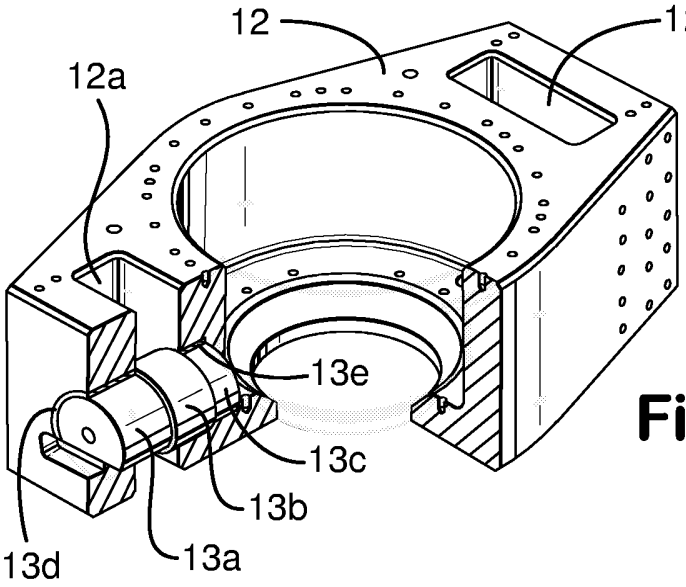


Fig.1R

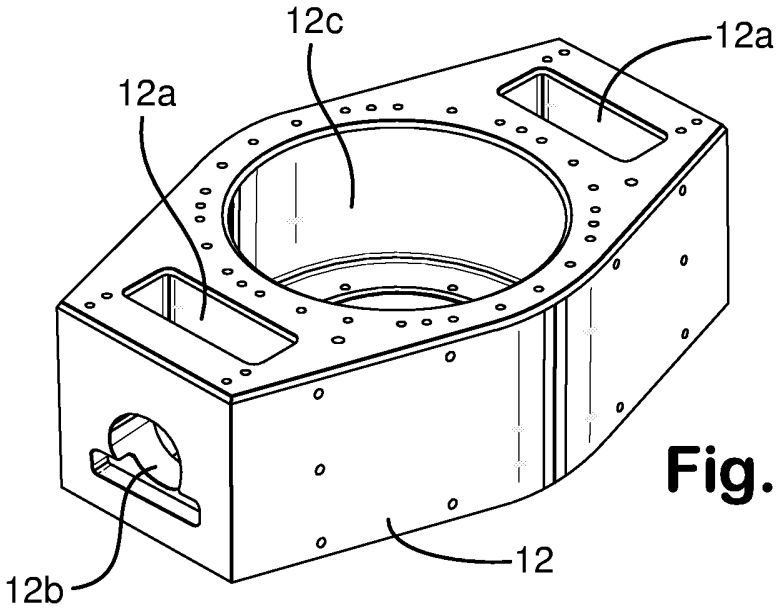


Fig.1S

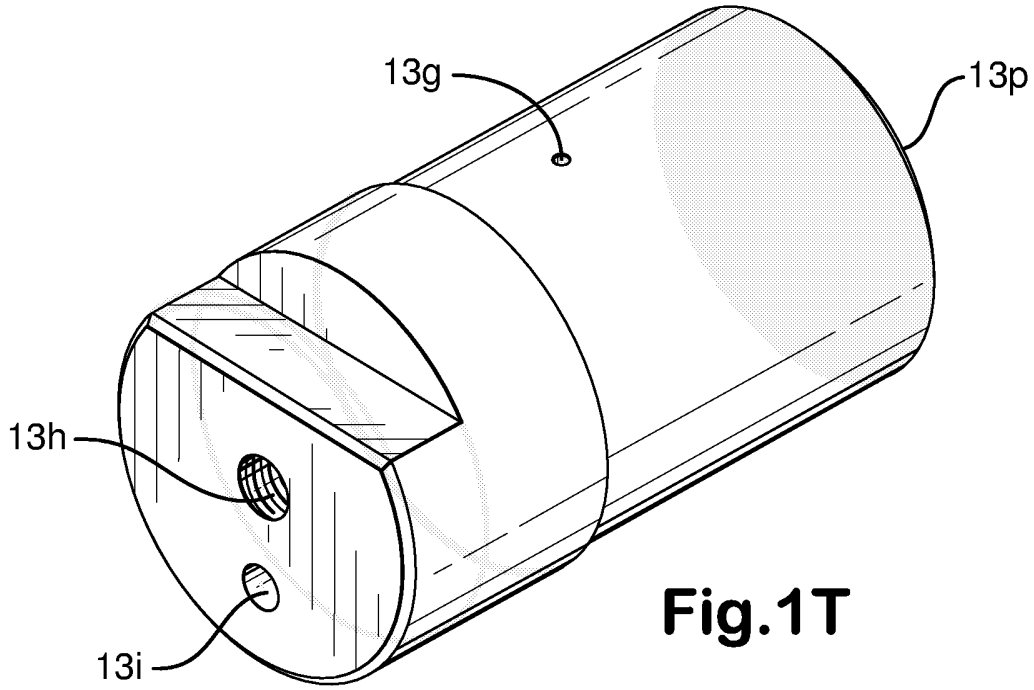


Fig.1T

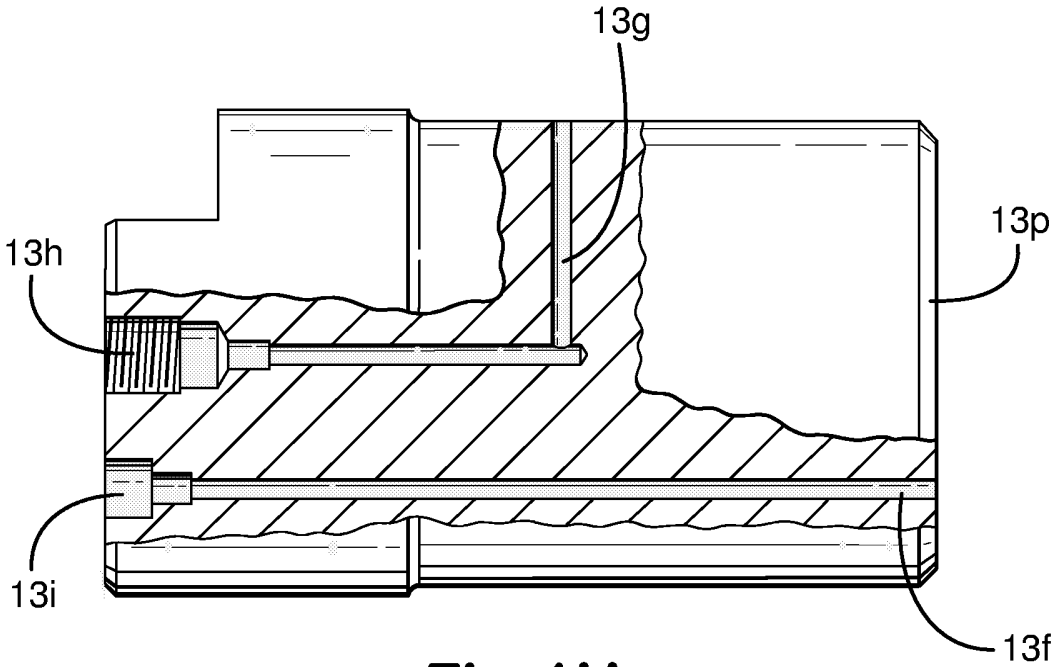


Fig.1U

Fig.2A

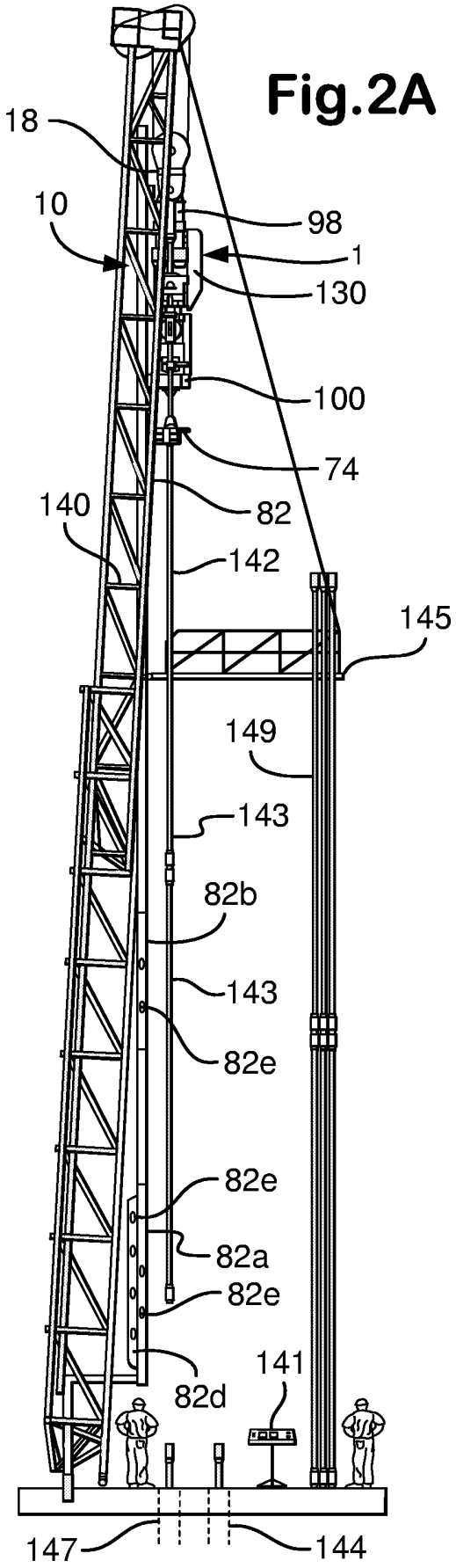


Fig.2B

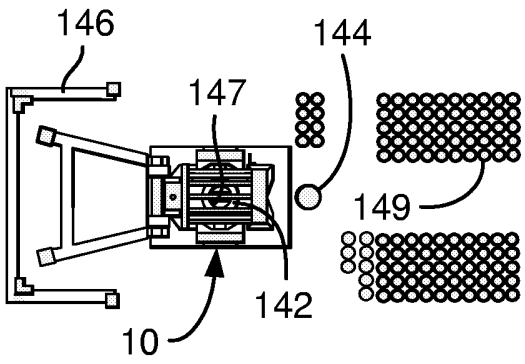


Fig.2F

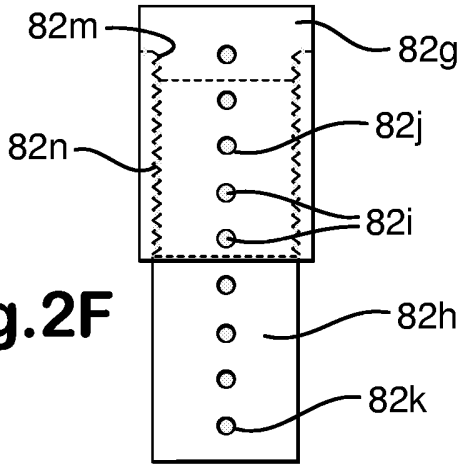


Fig.2G

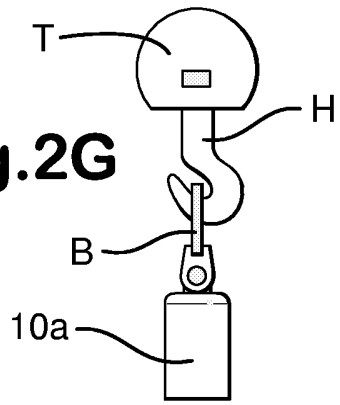


Fig.2C

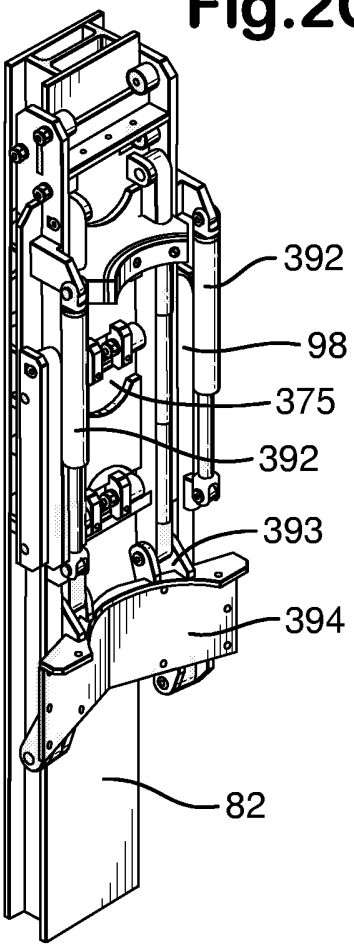


Fig.2D

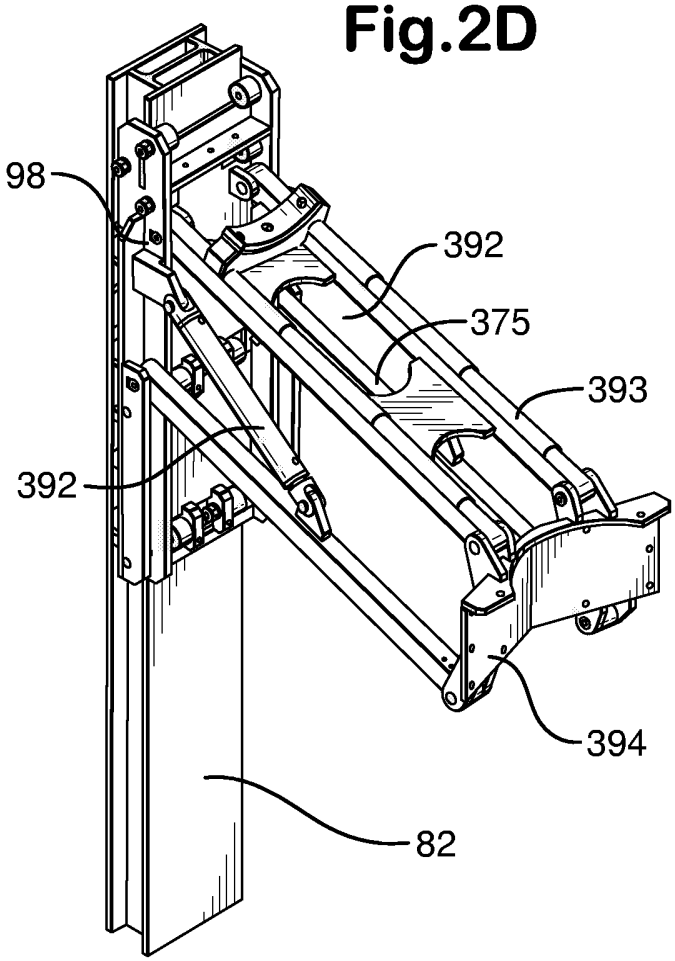


Fig.2E

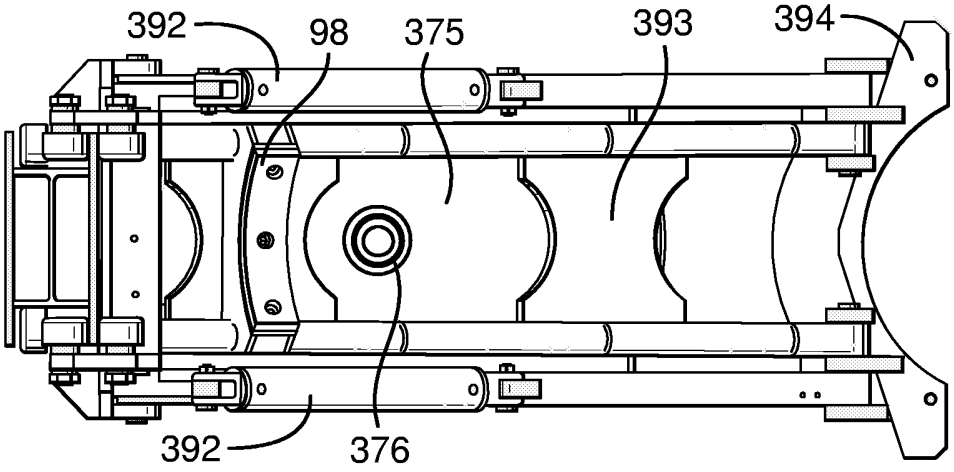
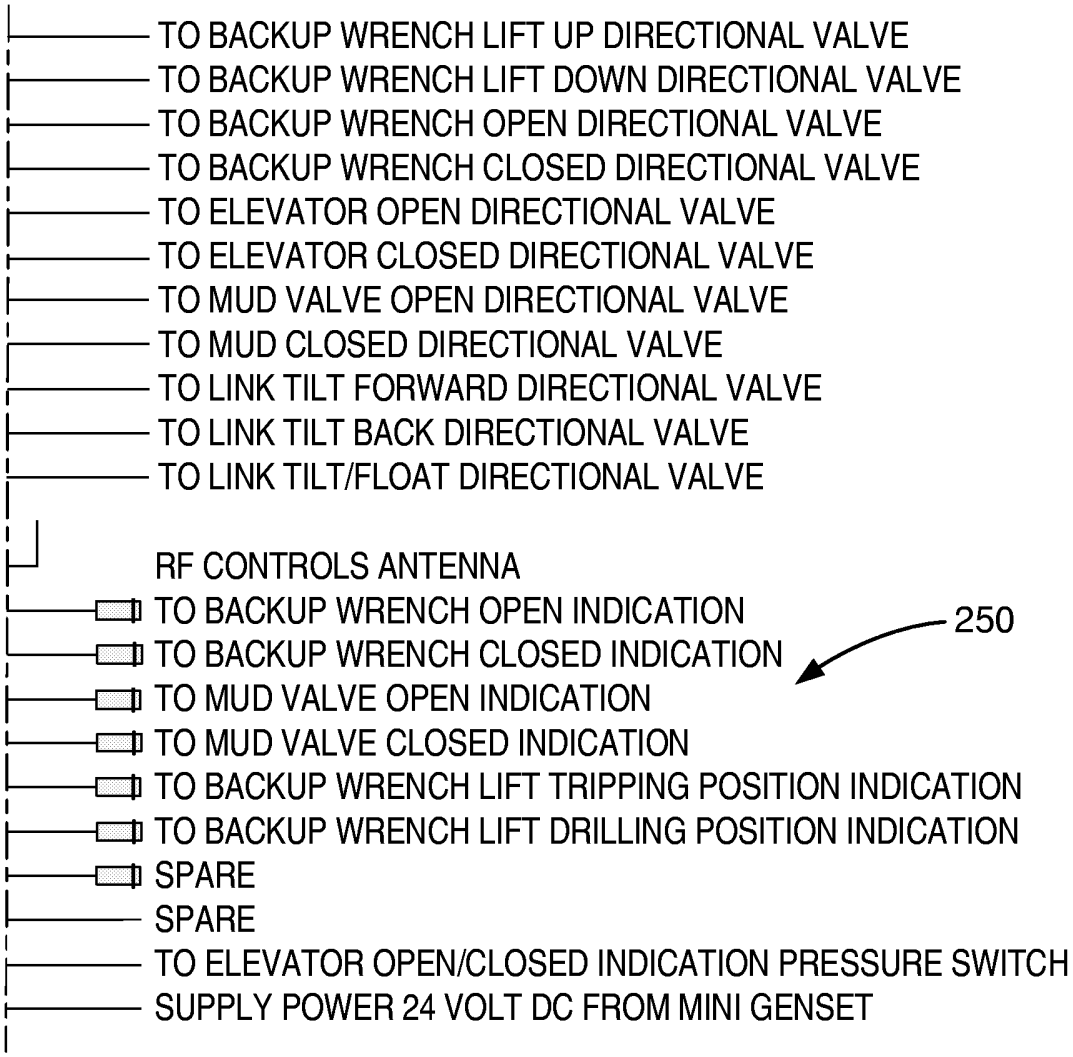


Fig.3E



EXPLODED VIEW OF LOWER JUNCTION BOX

Fig.3

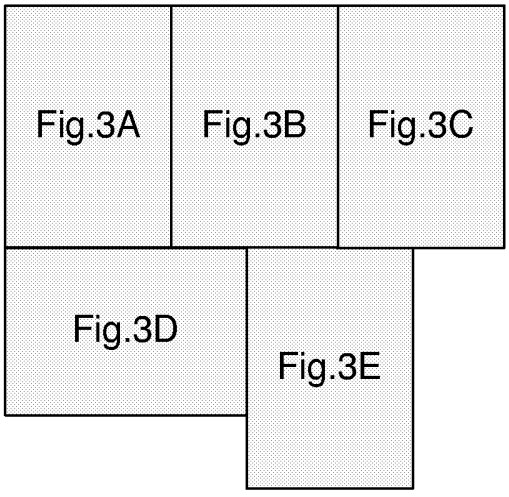


Fig.3A

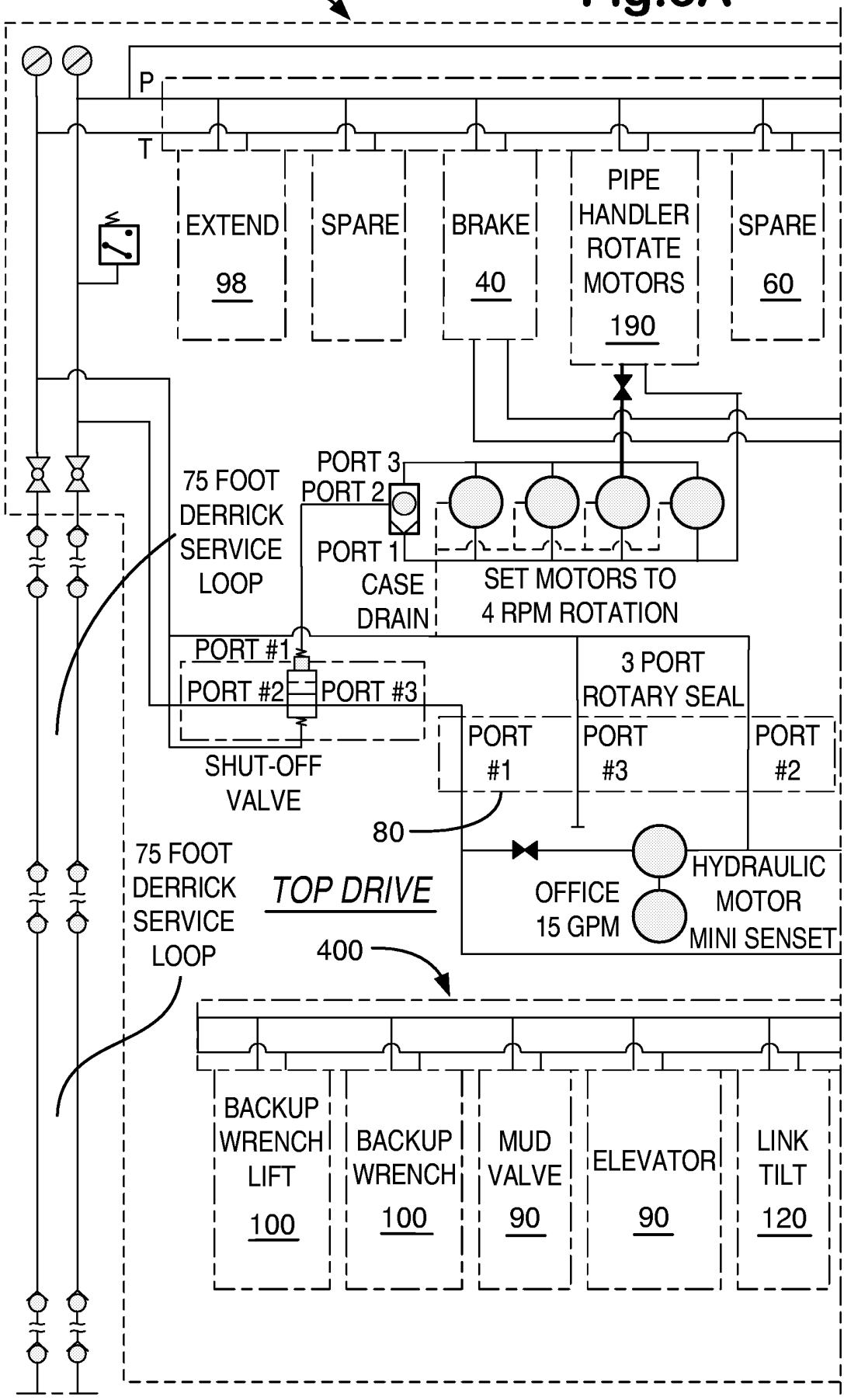
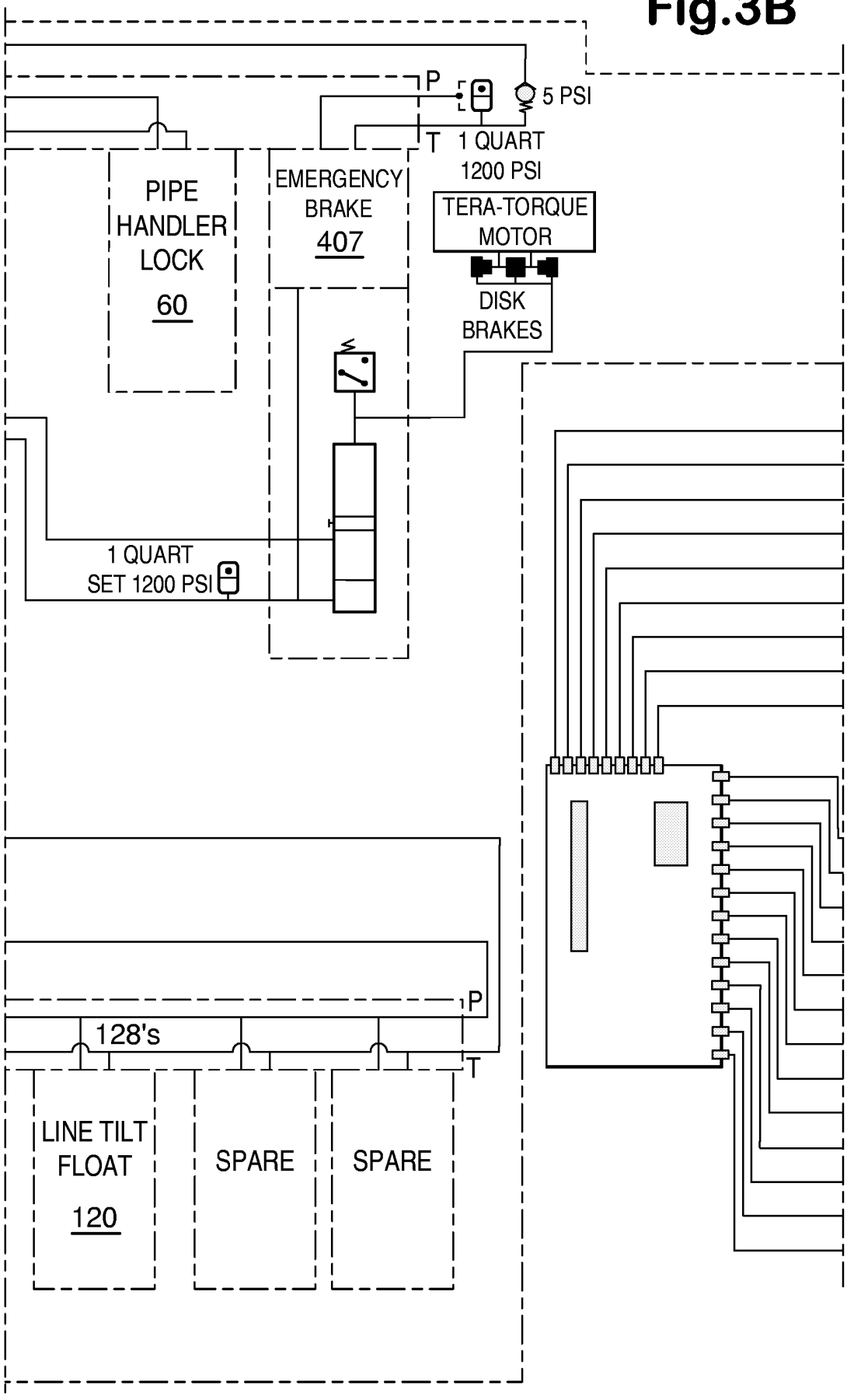

10
P
T
EXTEND
98
SPARE
BRAKE
40
PIPE HANDLER ROTATE MOTORS
190
SPARE
60
75 FOOT DERRICK SERVICE LOOP
PORT 3
PORT 2
PORT 1
CASE DRAIN
SET MOTORS TO 4 RPM ROTATION
PORT #1
PORT #2
PORT #3
SHUT-OFF VALVE
3 PORT ROTARY SEAL
PORT #1
PORT #3
PORT #2
80
75 FOOT DERRICK SERVICE LOOP
TOP DRIVE
OFFICE 15 GPM
HYDRAULIC MOTOR MINI SENSET
400
BACKUP WRENCH LIFT
100
BACKUP WRENCH
100
MUD VALVE
90
ELEVATOR
90
LINK TILT
120

Fig.3B


P
5 PSI
T
1 QUART
1200 PSI
PIPE
HANDLER
LOCK
60
EMERGENCY
BRAKE
407
TERA-TORQUE
MOTOR
DISK
BRAKES
1 QUART
SET 1200 PSI
P
128's
T
LINE TILT
FLOAT
120
SPARE
SPARE

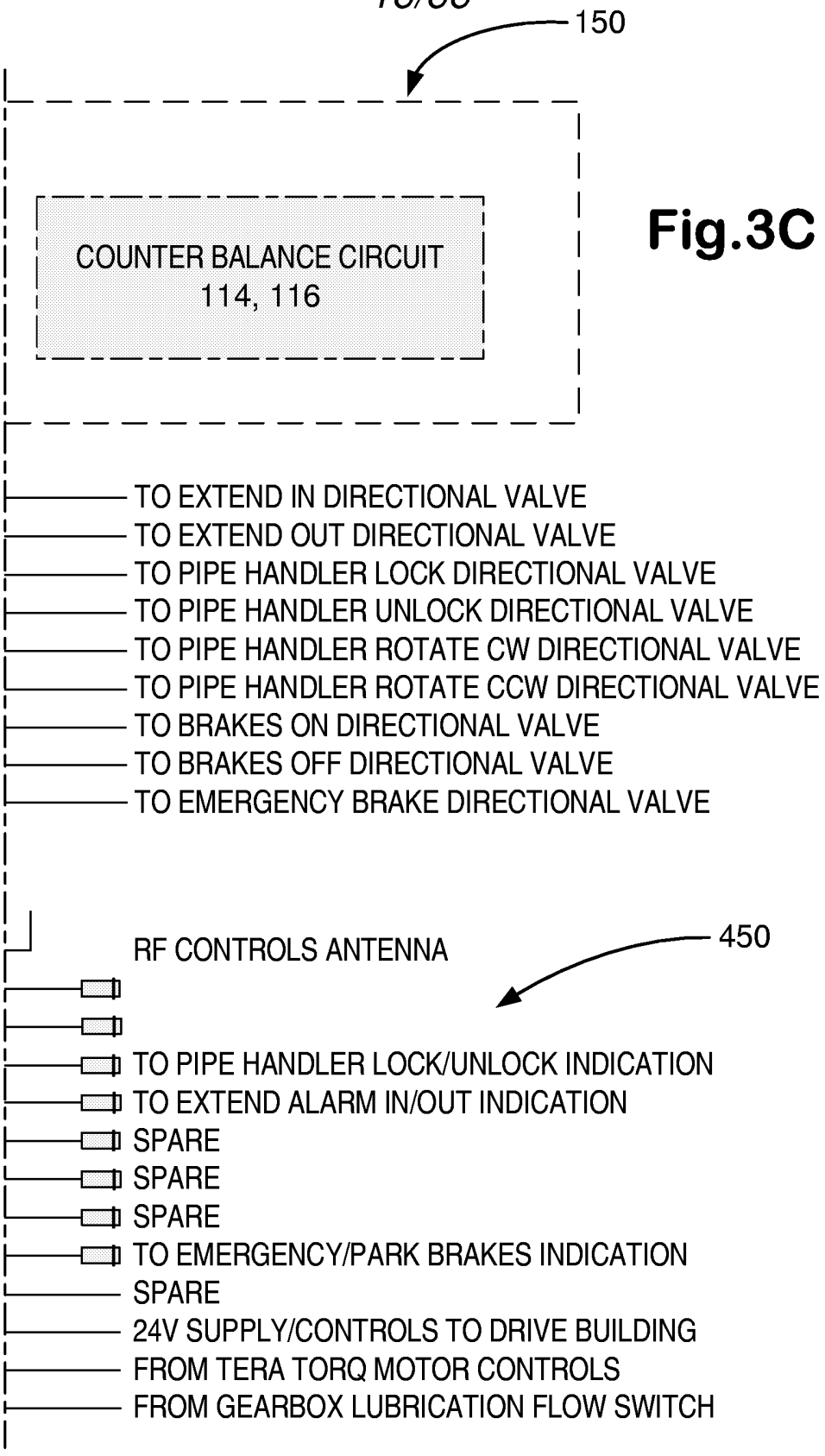


Fig.3C

EXPLODED VIEW OF UPPER JUNCTION BOX BEHIND ACCESS PLATFORM 130

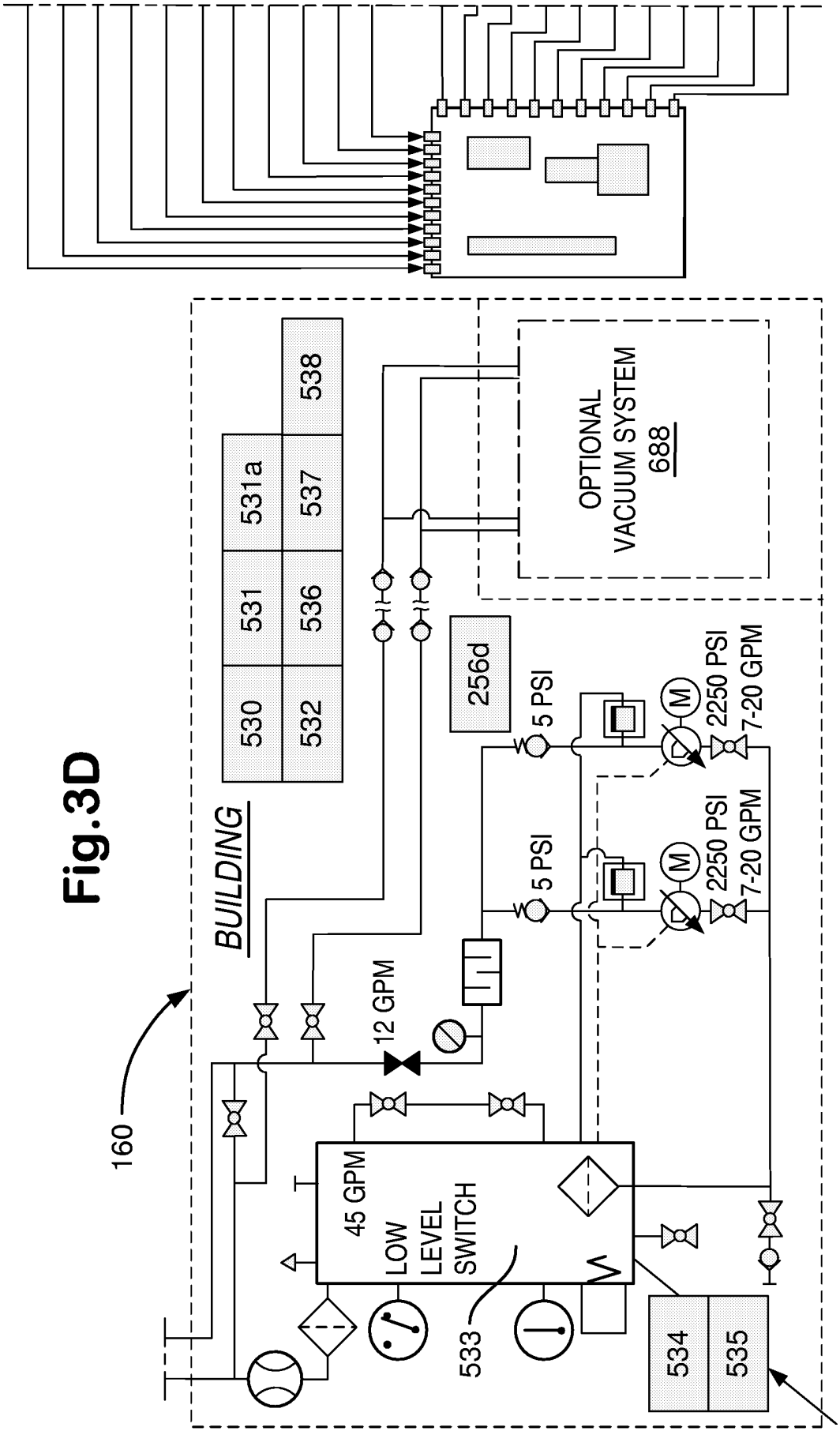

160
BUILDING
530
531
531a
532
536
537
538
OPTIONAL
VACUUM SYSTEM
688
256d
5 PSI
5 PSI
2250 PSI
7-20 GPM
2250 PSI
7-20 GPM
M
M
12 GPM
45 GPM
LOW
LEVEL
SWITCH
533
534
535

Fig.3D

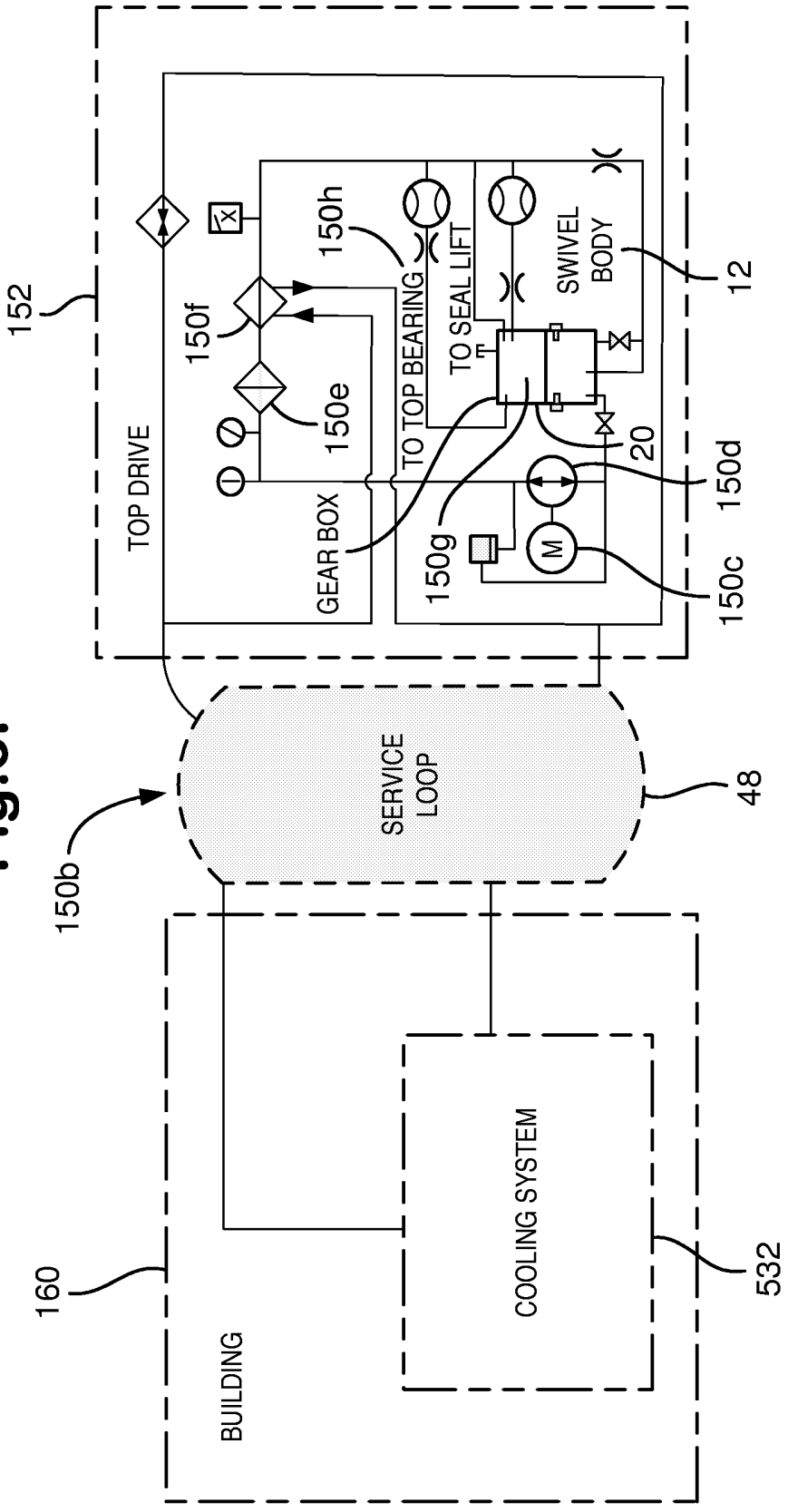

152
TOP DRIVE
150f
150e
150h
TO TOP BEARING
TO SEAL LIFT
SWIVEL BODY
12
GEAR BOX
150g
20
150d
150c
M
150b
SERVICE LOOP
48
160
BUILDING
COOLING SYSTEM
532

Fig.3F

Fig.4A

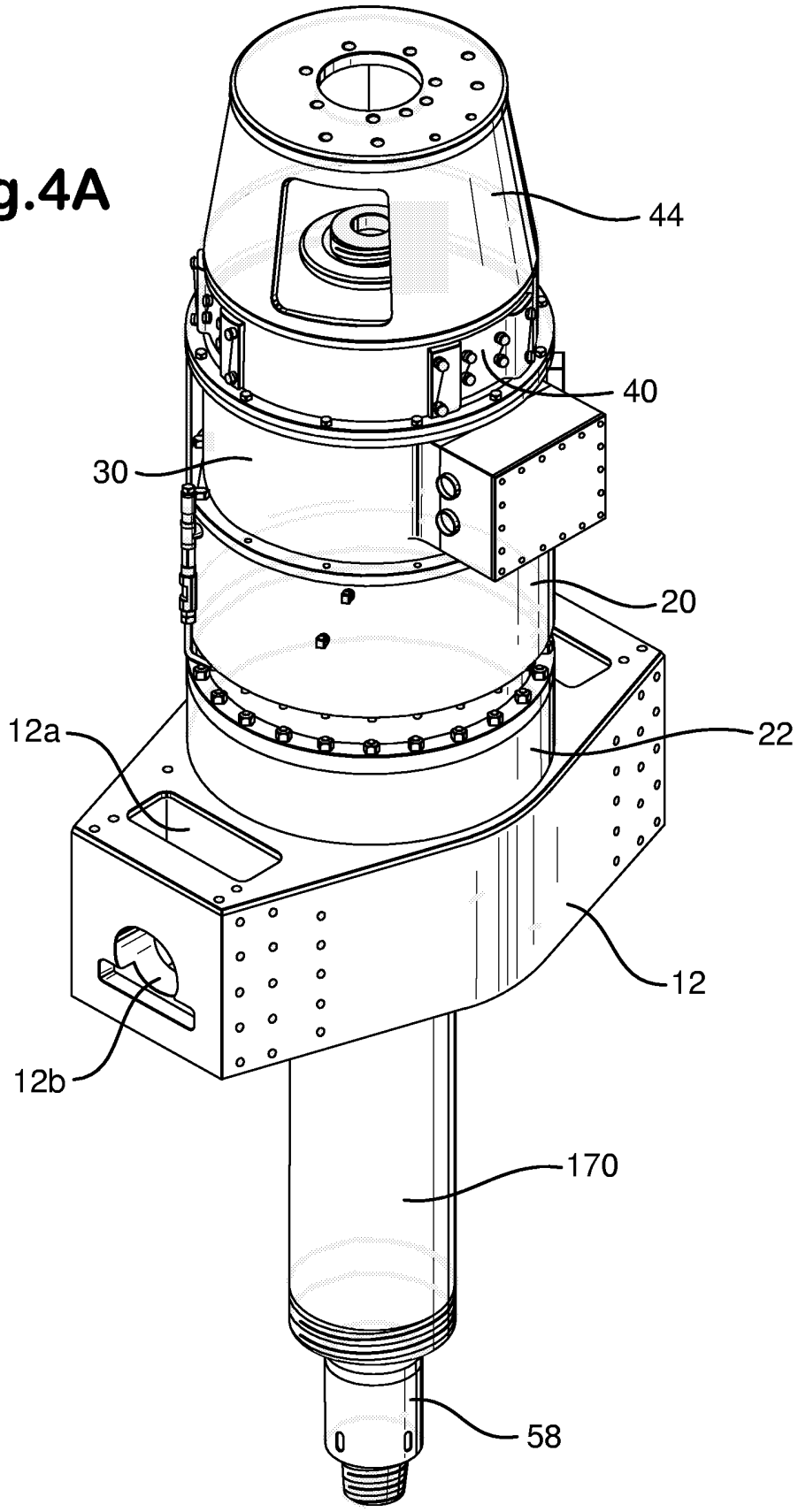
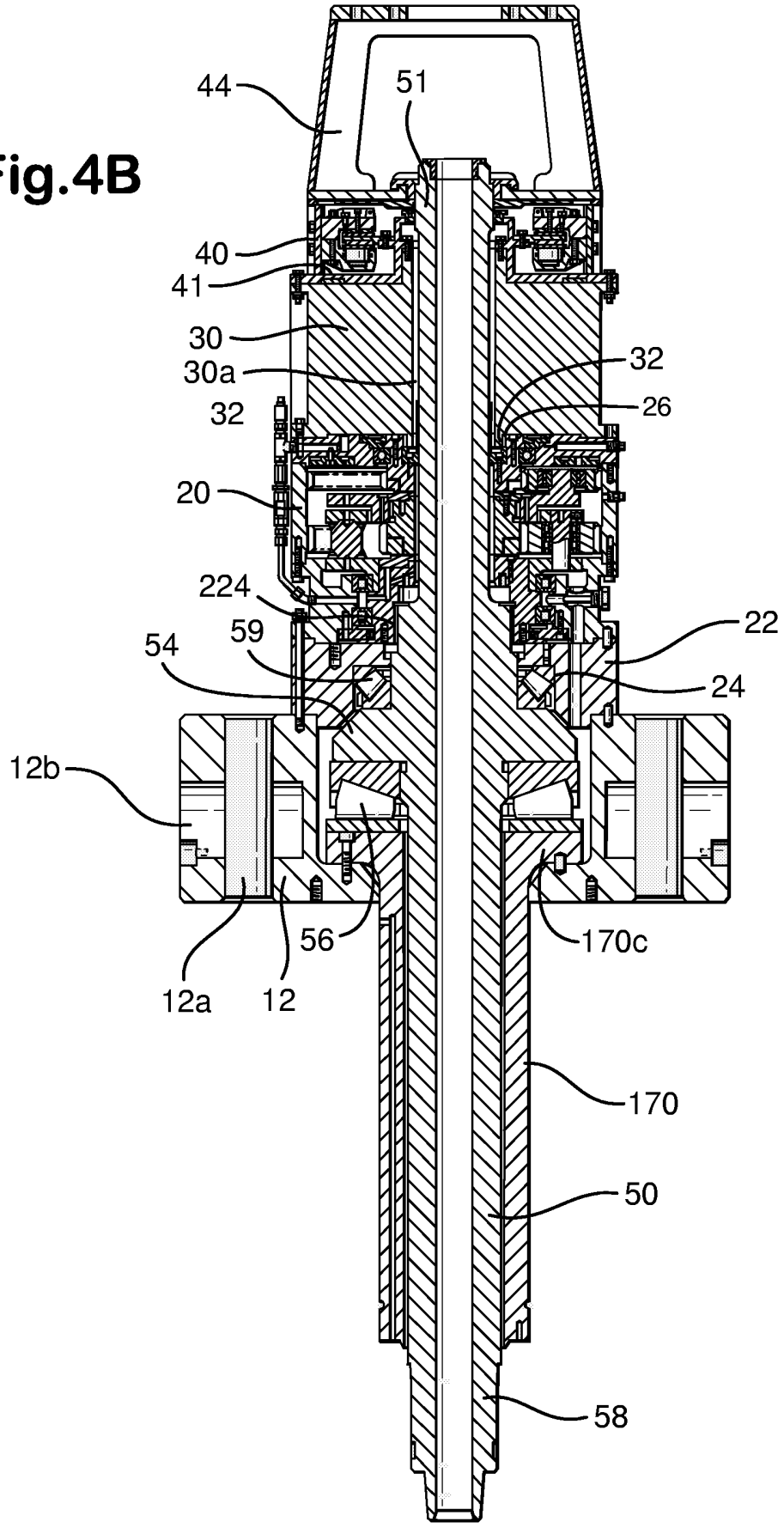


Fig.4B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170c
12a
12
170
50
58

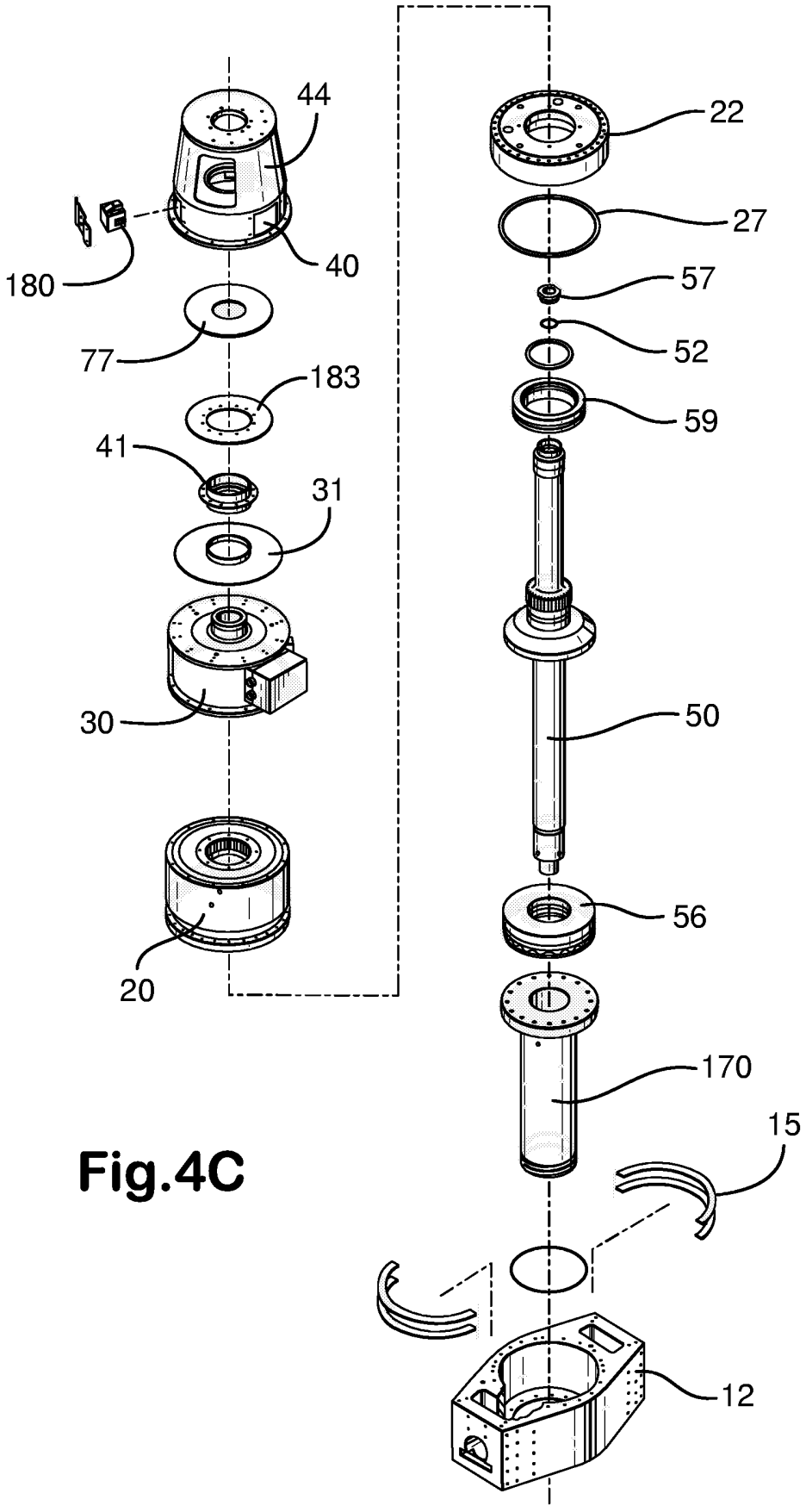

Fig.4C

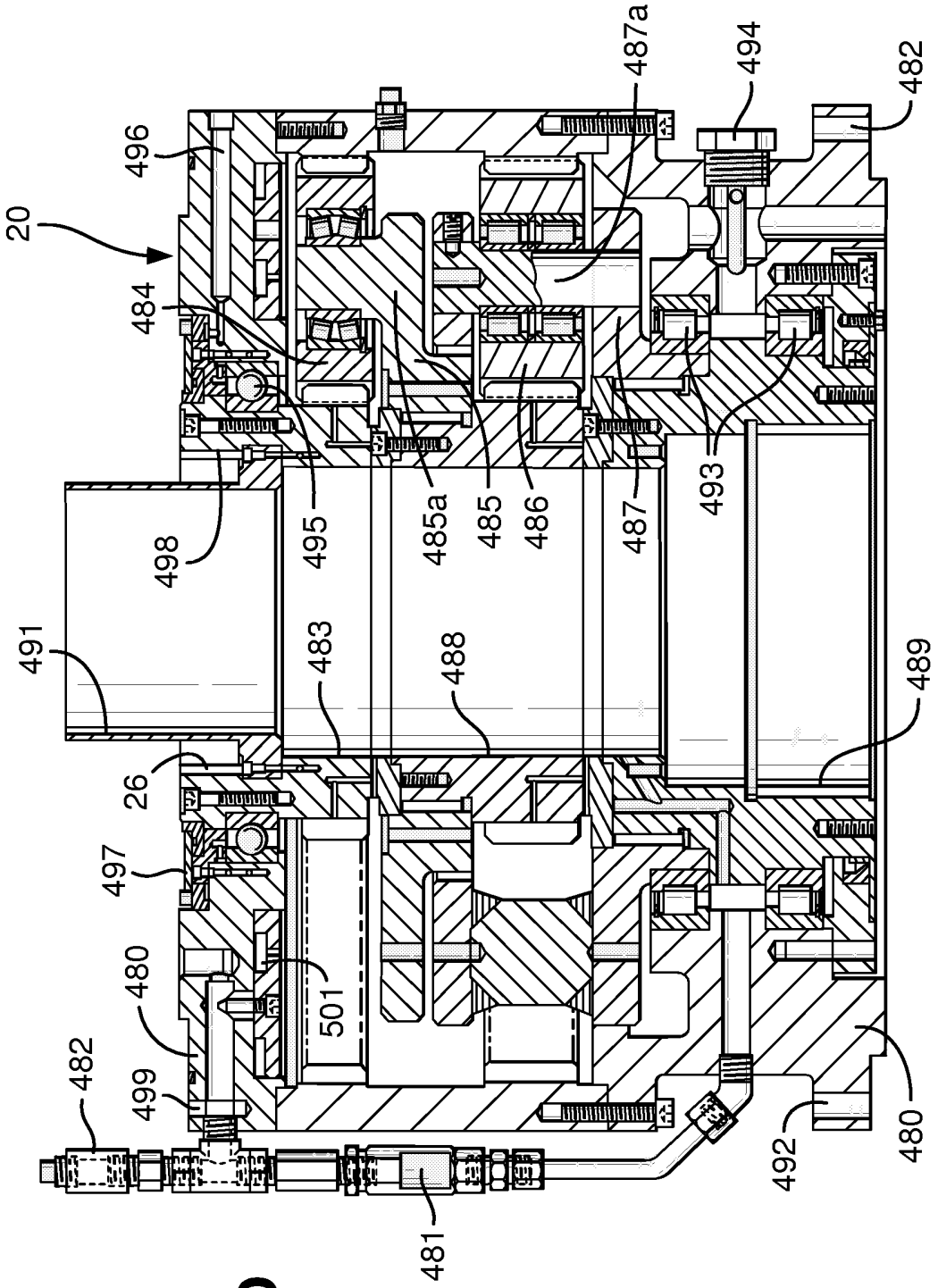
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Fig.4D

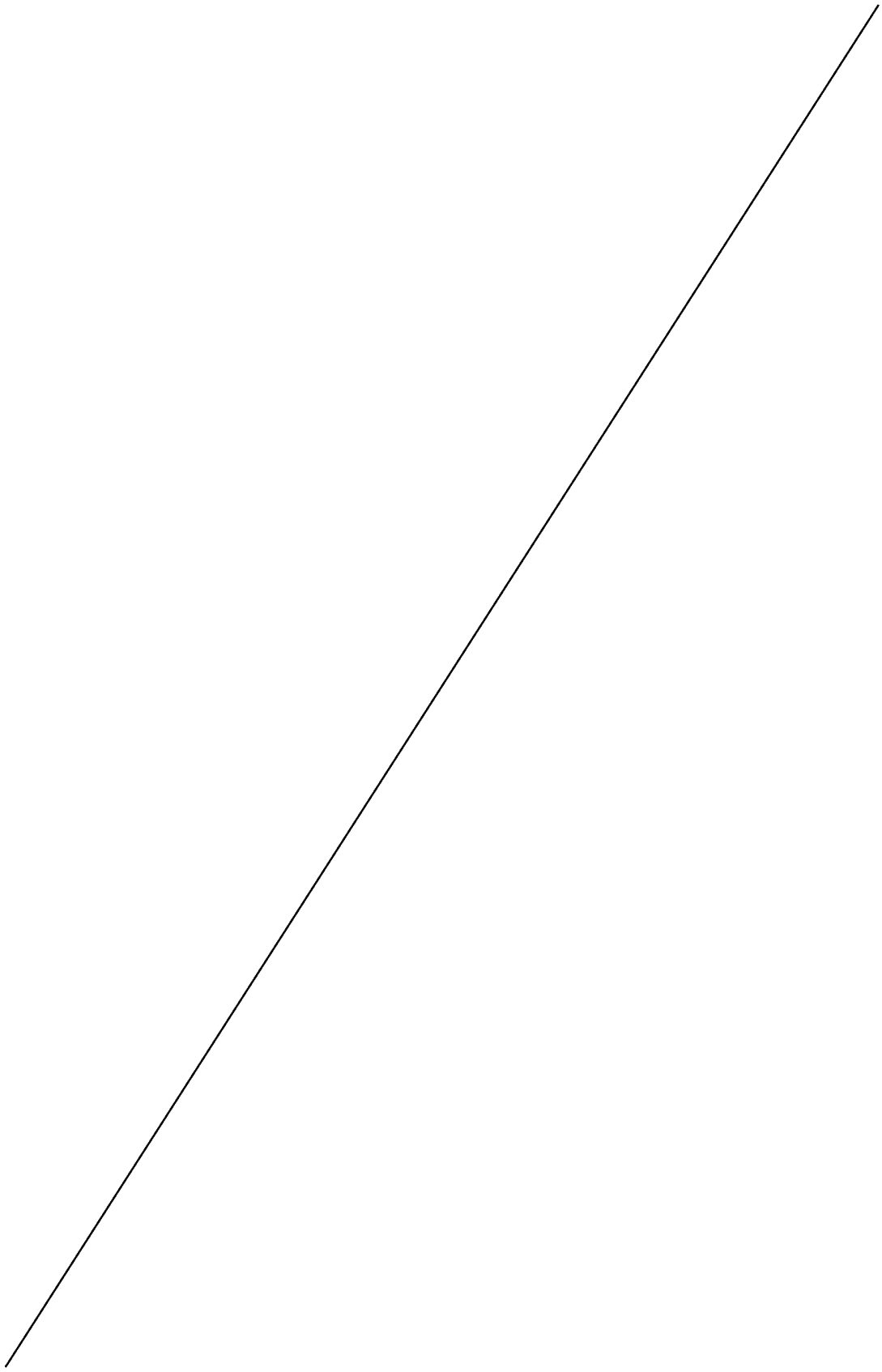


Fig.4F

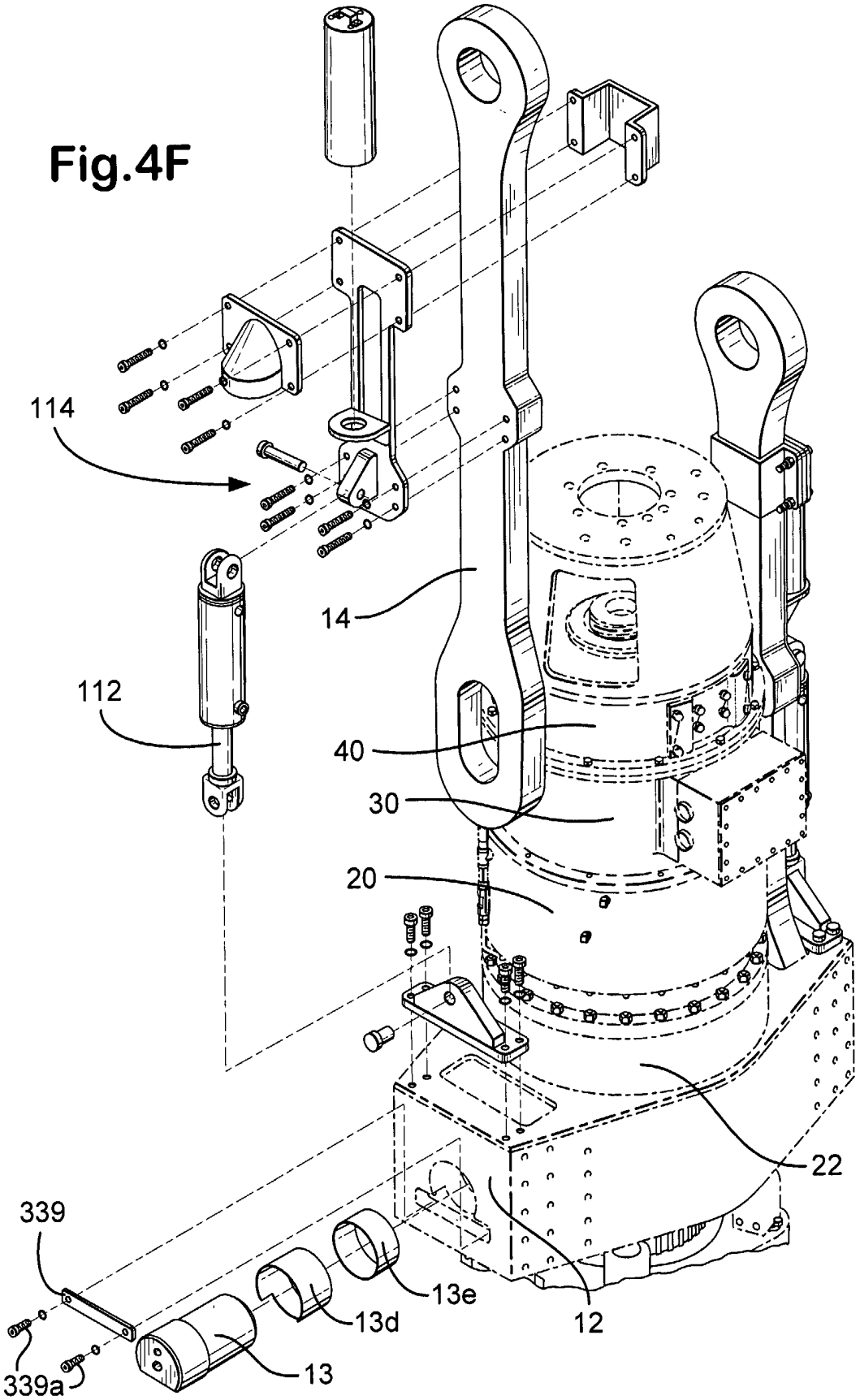


Fig.5A

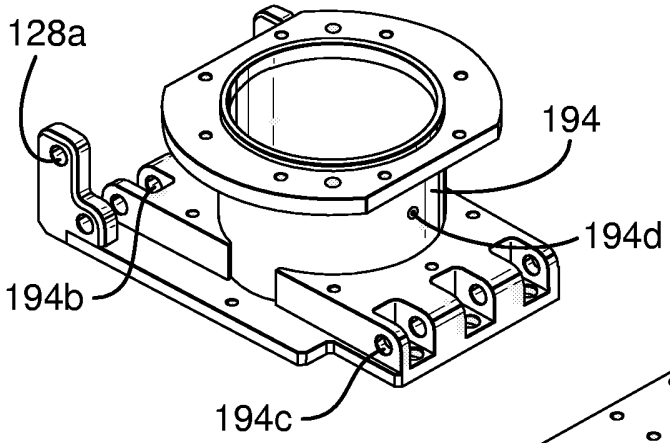
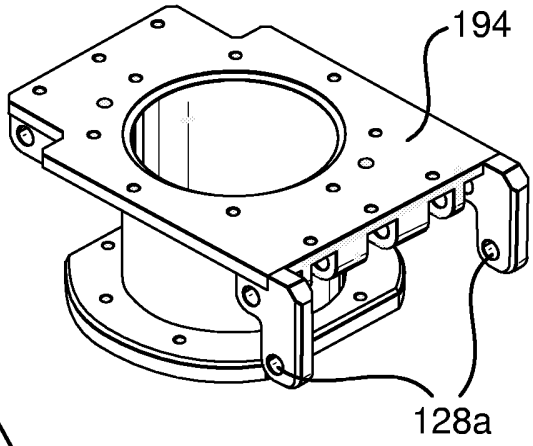


Fig.5B



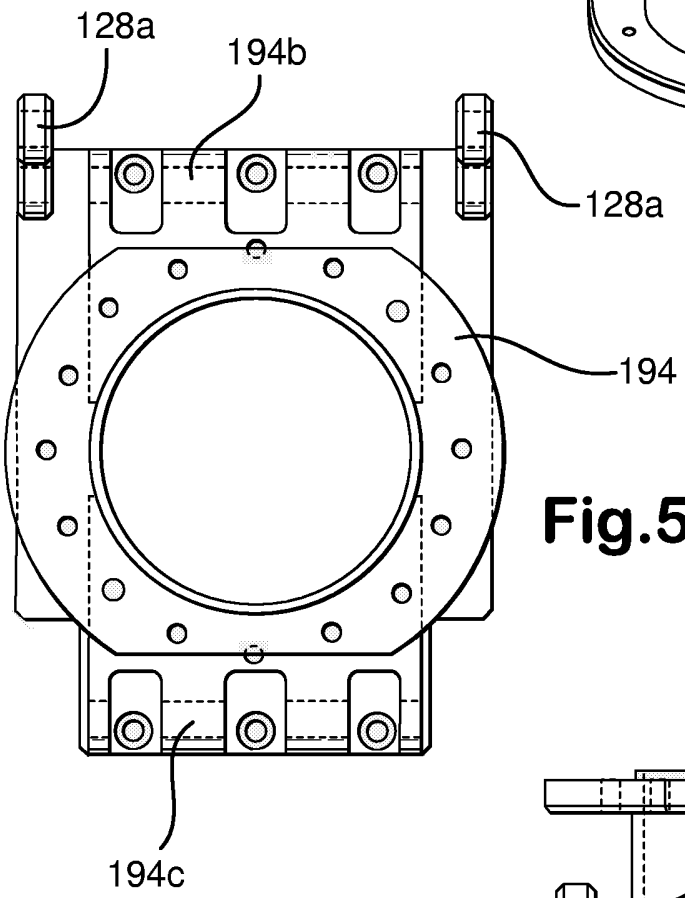


Fig.5C

Fig.5D

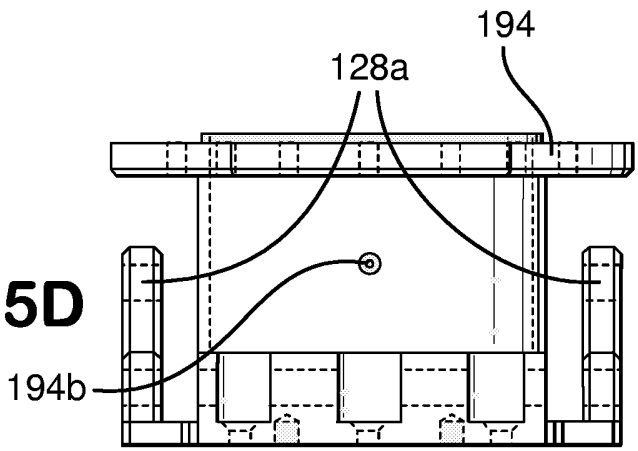


Fig.5E

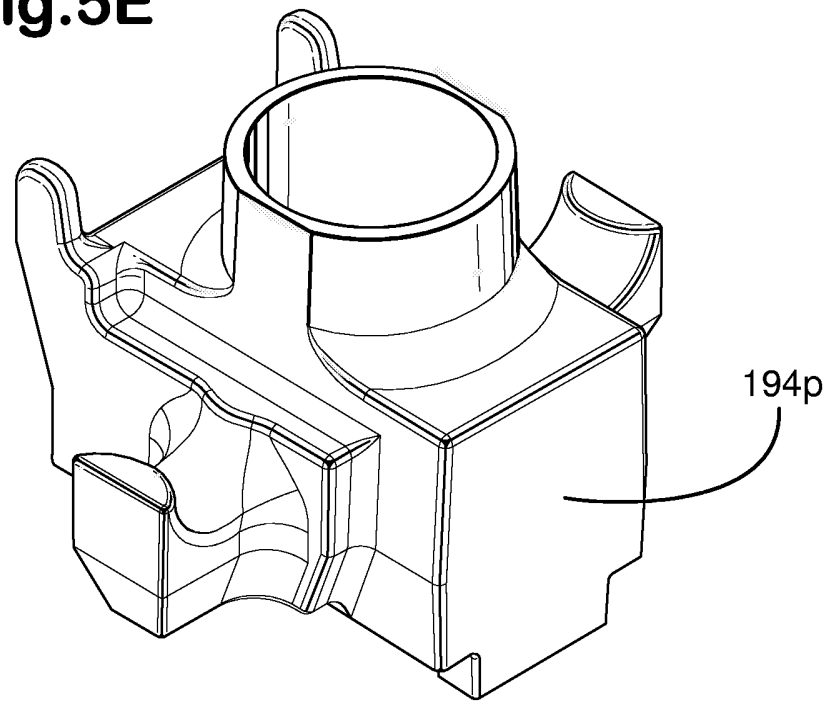
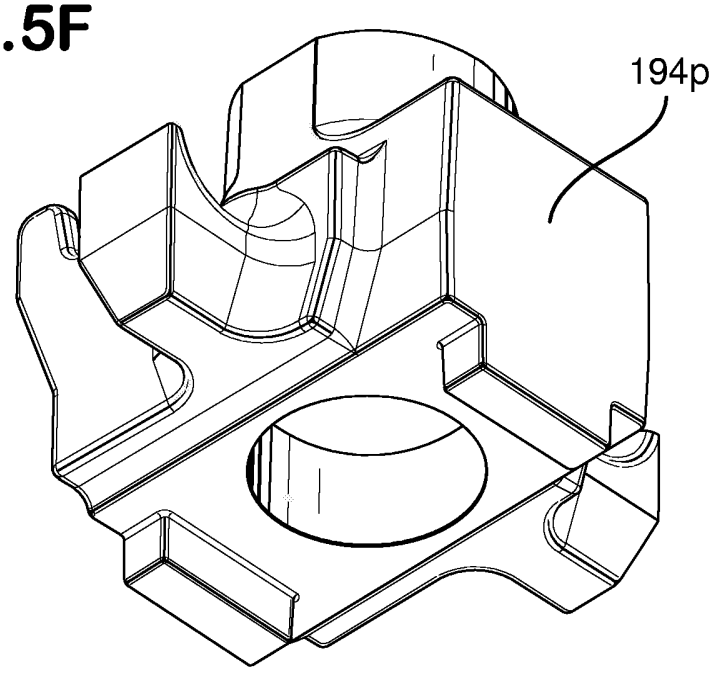


Fig.5F



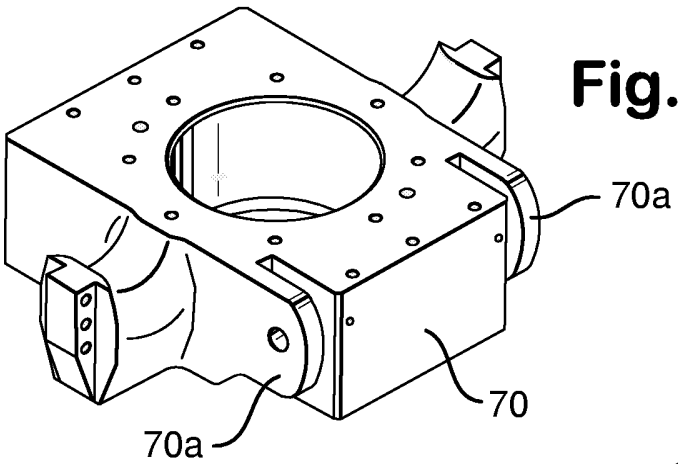


Fig.6A

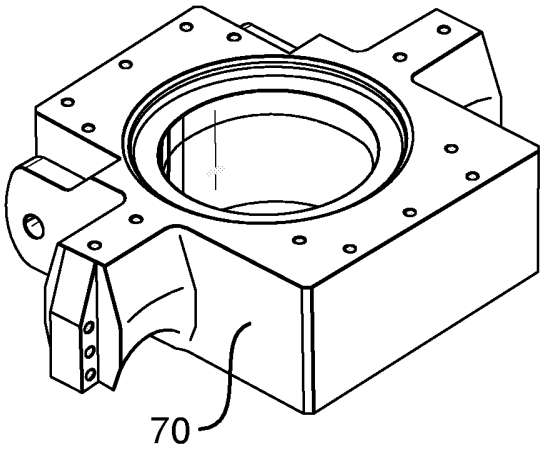


Fig.6B

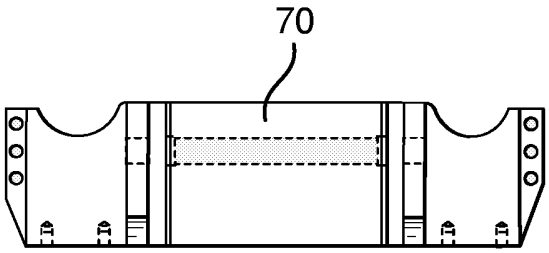


Fig.6C

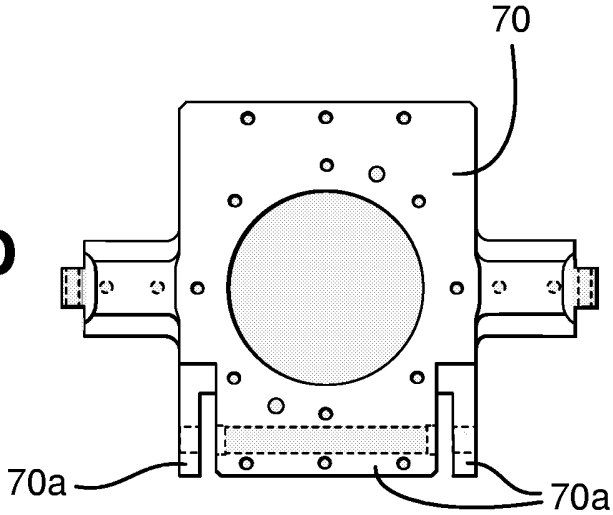


Fig.6D

Fig.7A

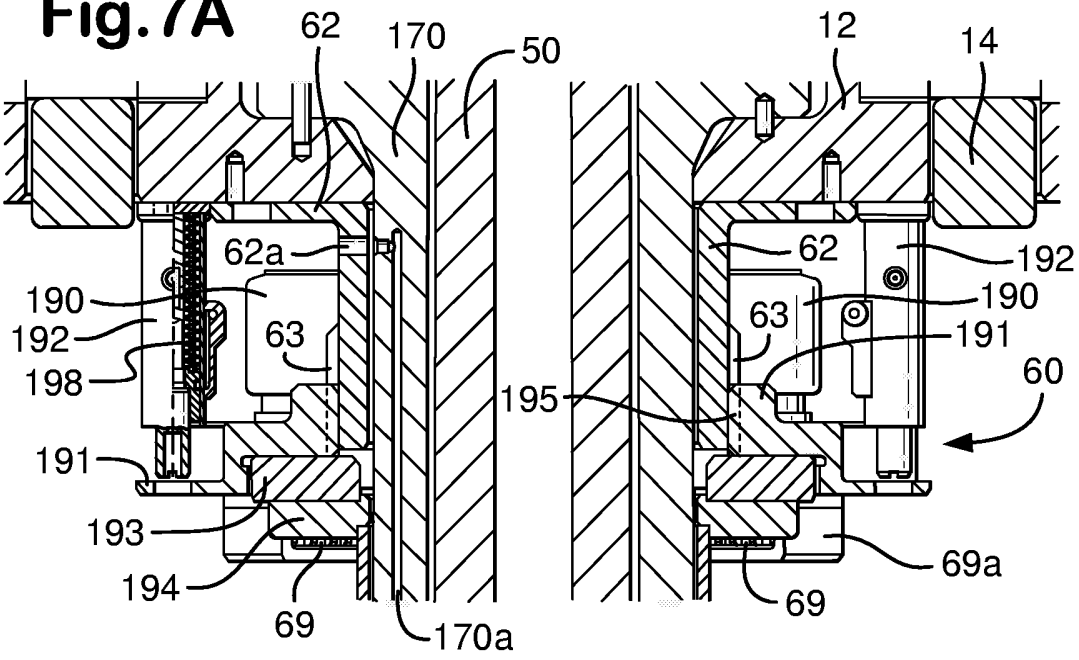


Fig.7B

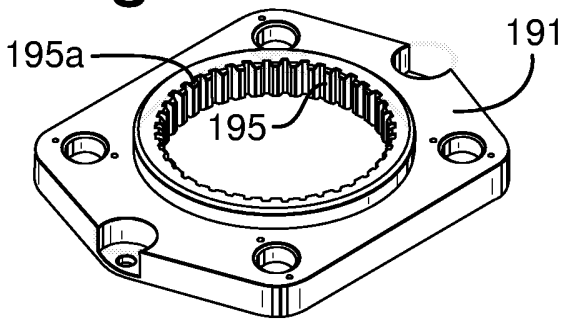


Fig.7C

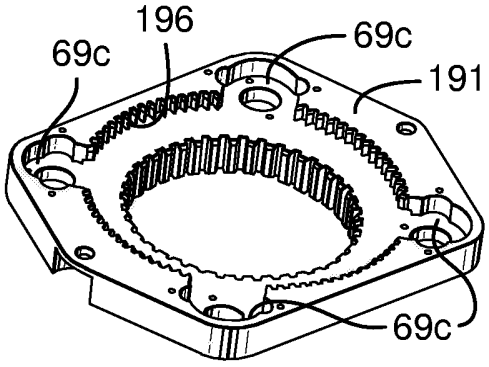


Fig.7F

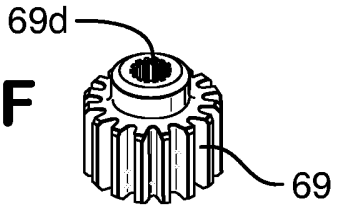


Fig.7D

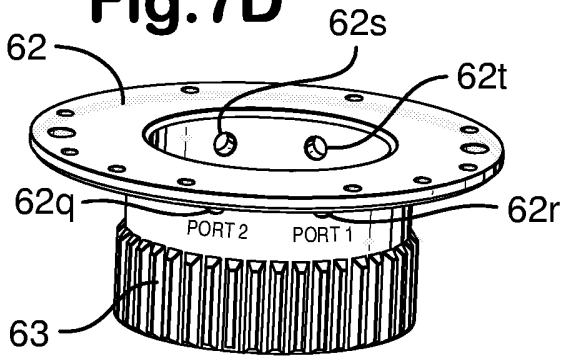
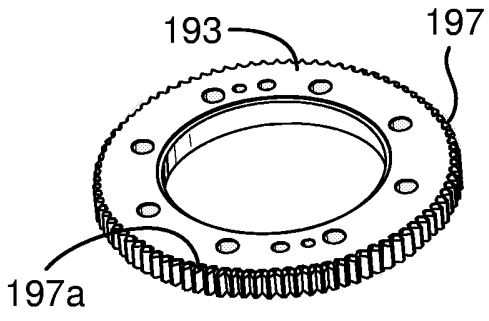


Fig.7E



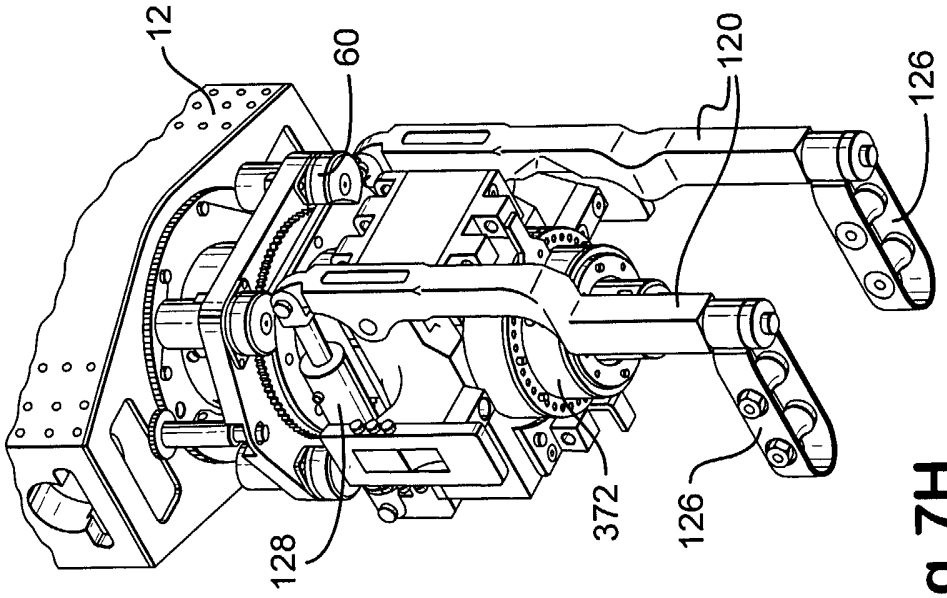


Fig.7H

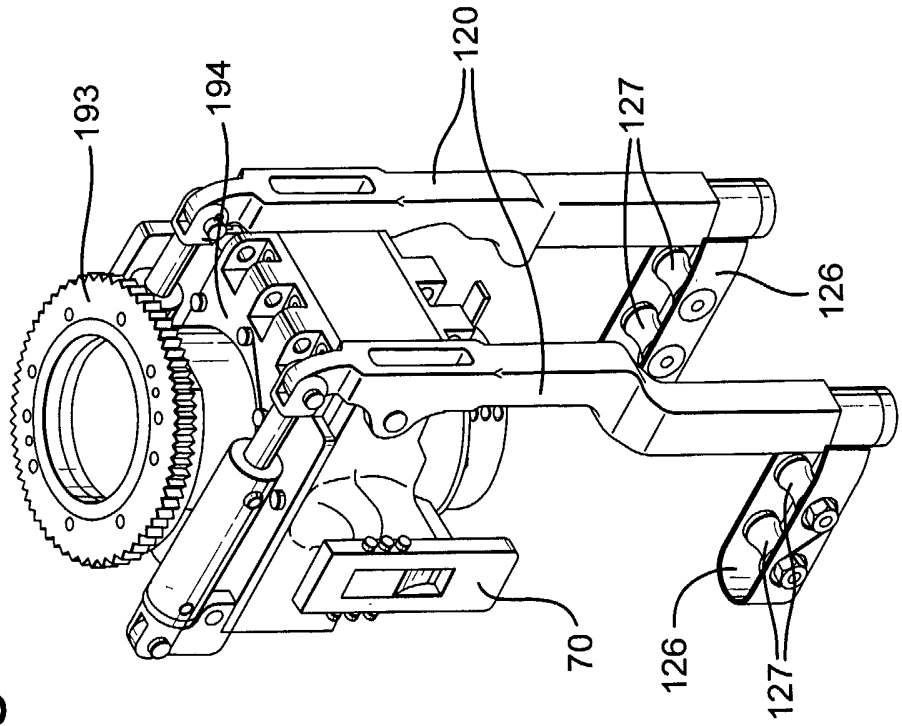
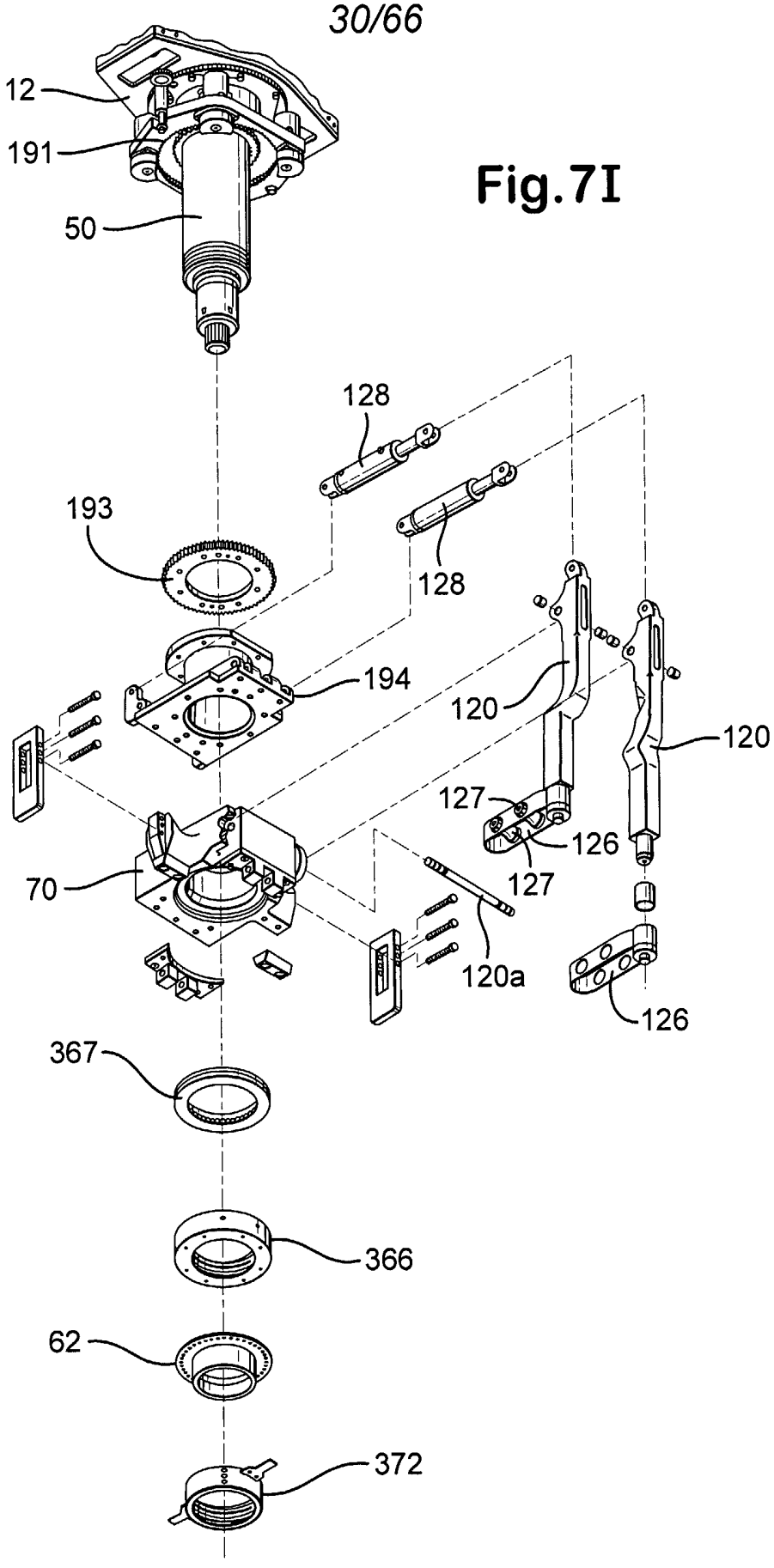


Fig.7G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191
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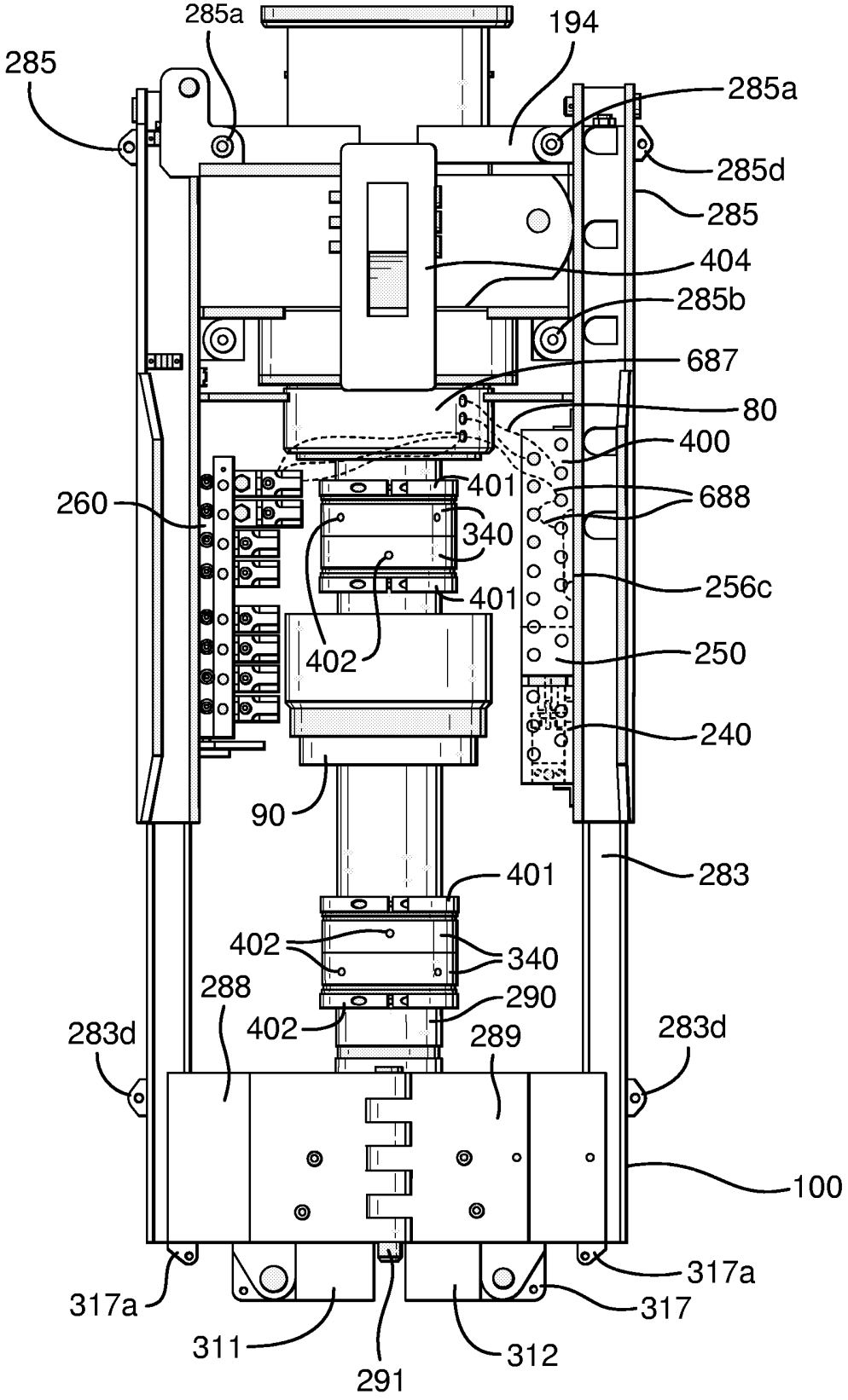
367
366
62
372

Fig.7I

Fig.8A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283d
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317a
317
317a
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312
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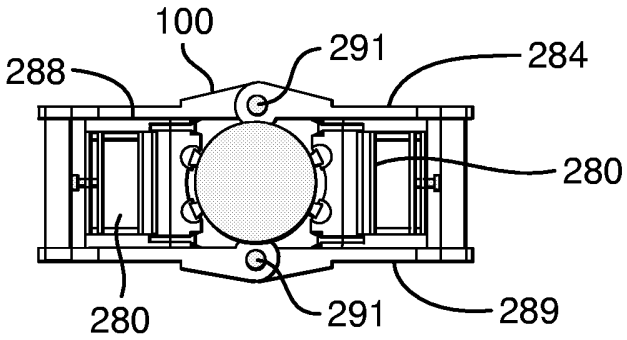
Fig.8B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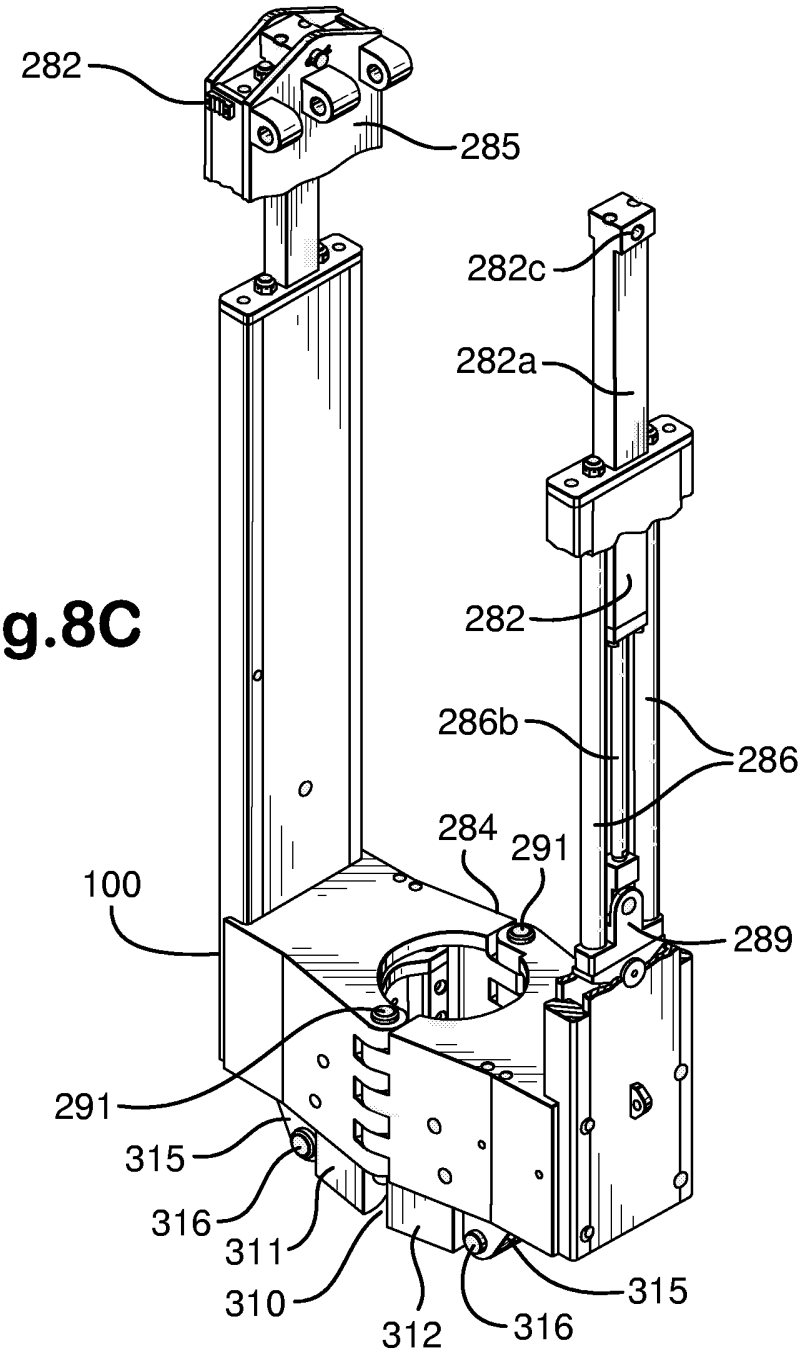
291
284
288
280
280
291
289

Fig.8C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315

Fig.8D

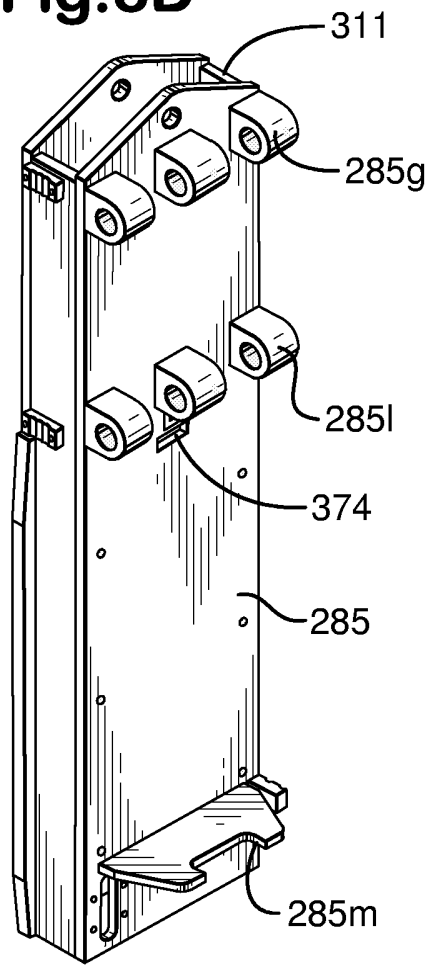


Fig.8E

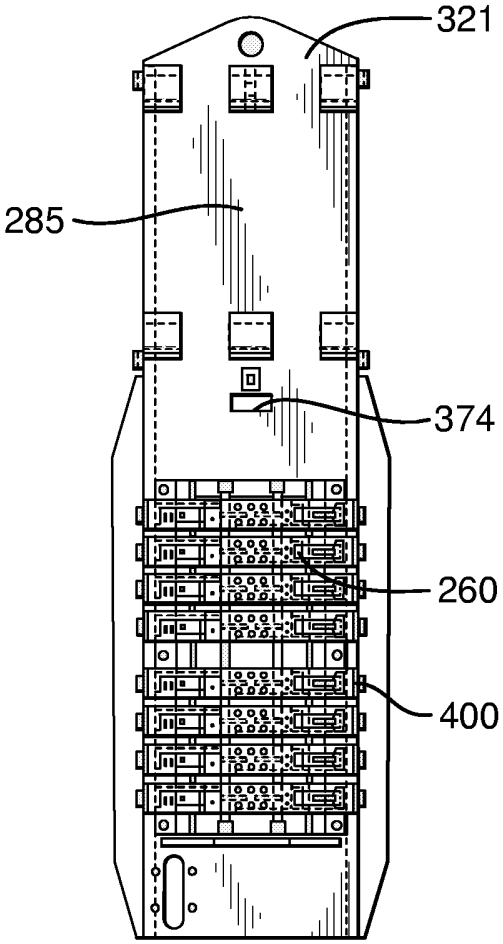


Fig.8F

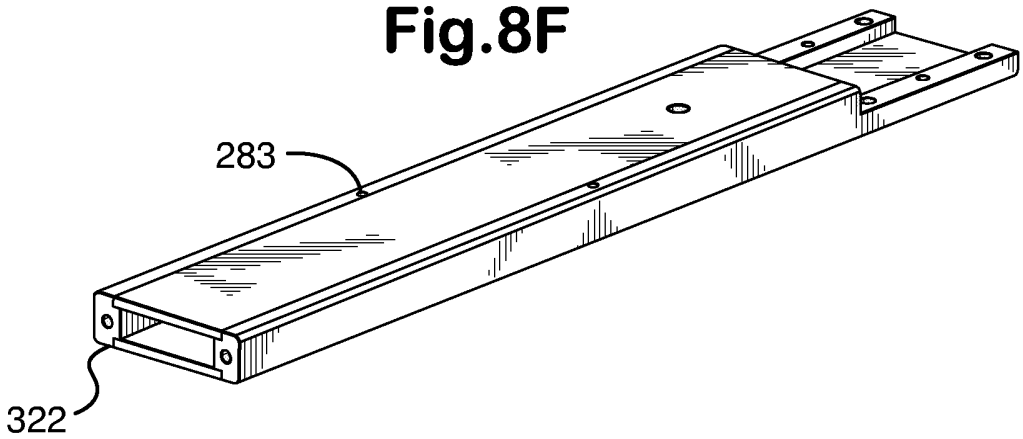


Fig.8G

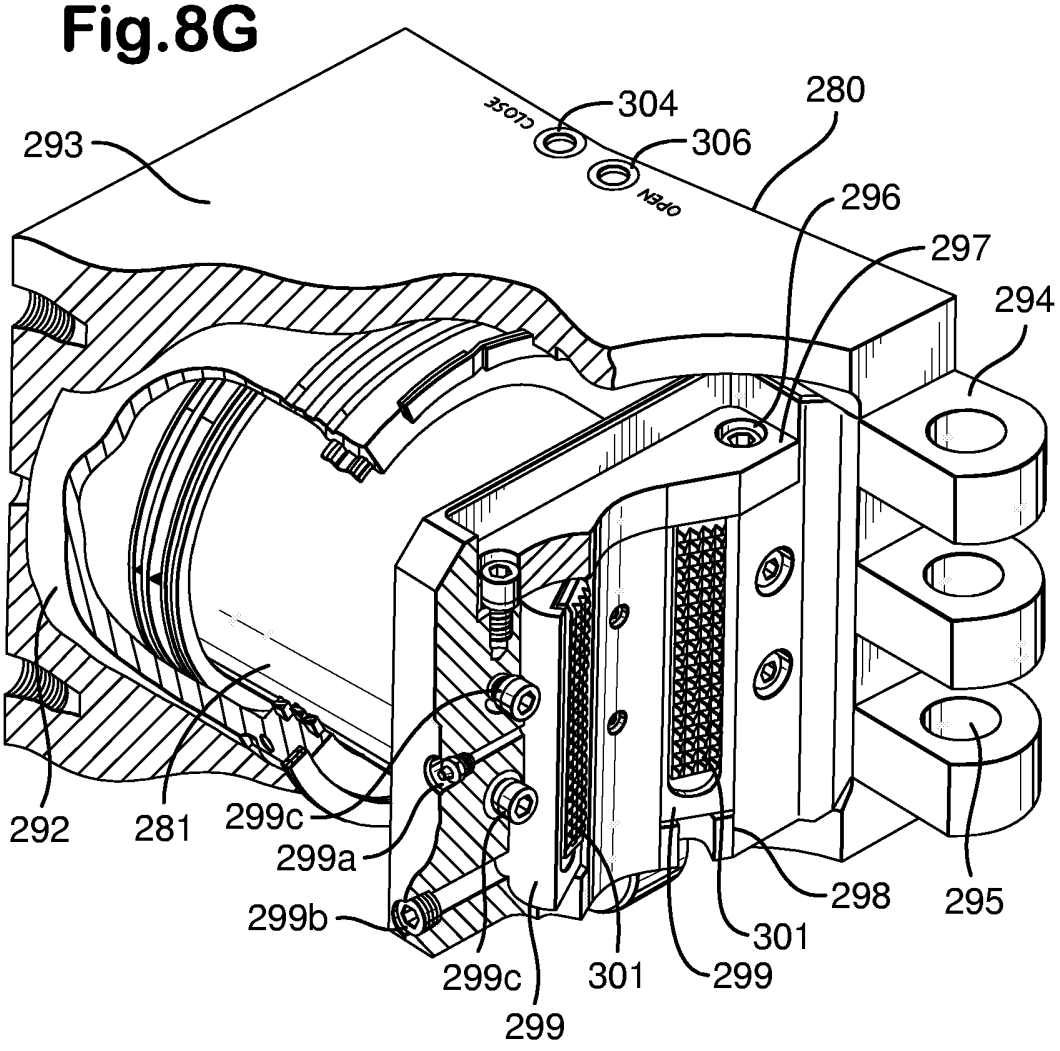


Fig.8H

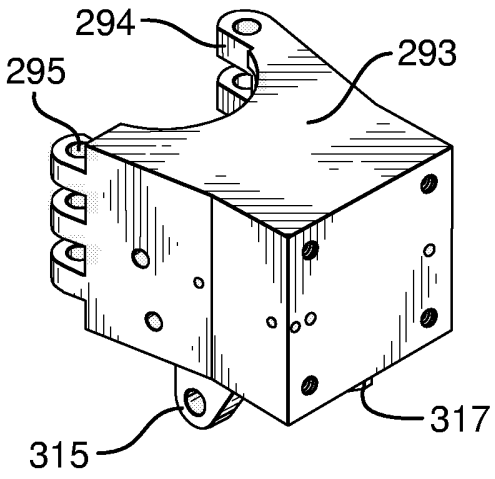


Fig.8I

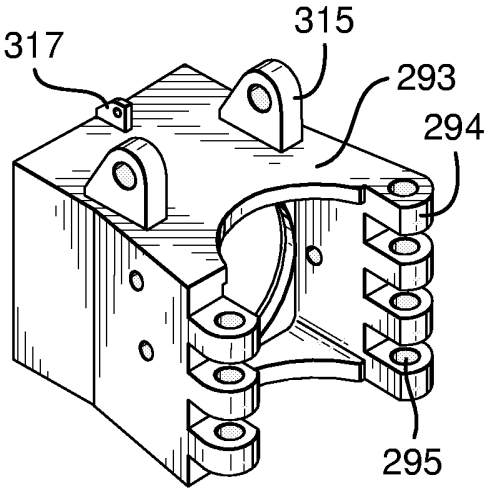


Fig.8J

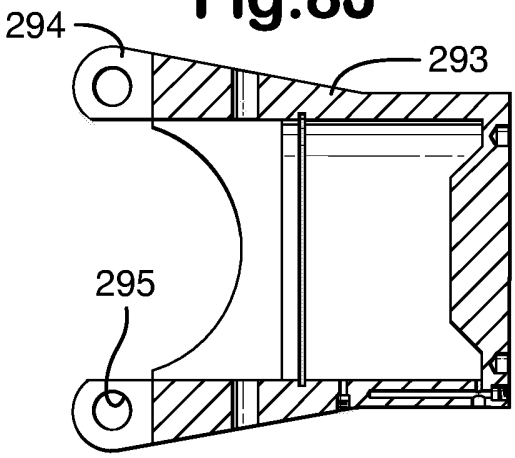


Fig.8K

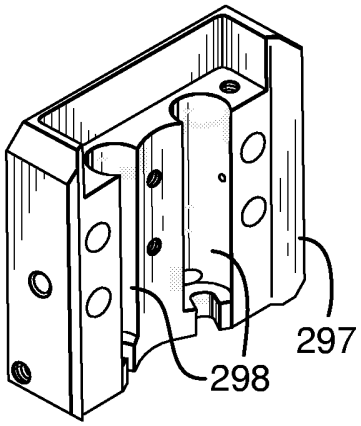


Fig.8L

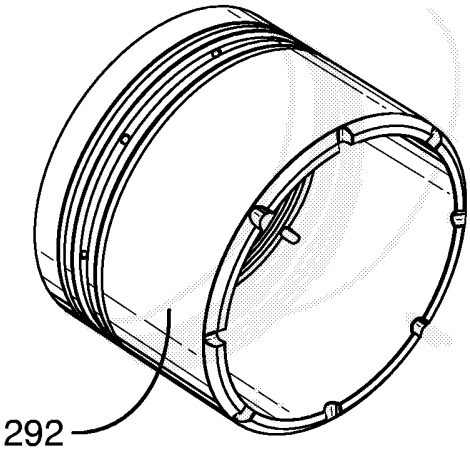


Fig.8M

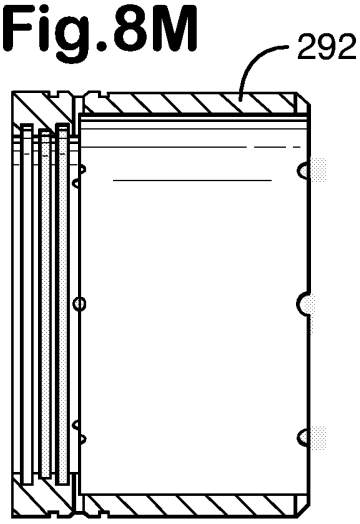


Fig.8N

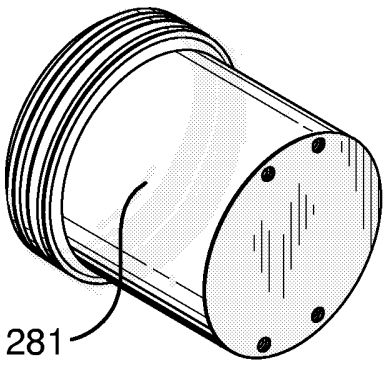


Fig.8O

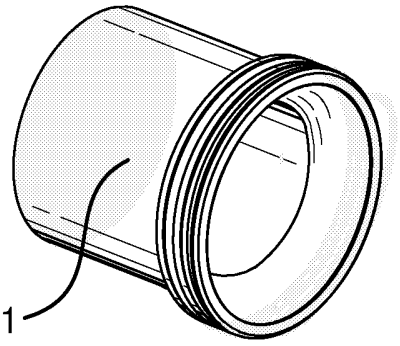


Fig.8P

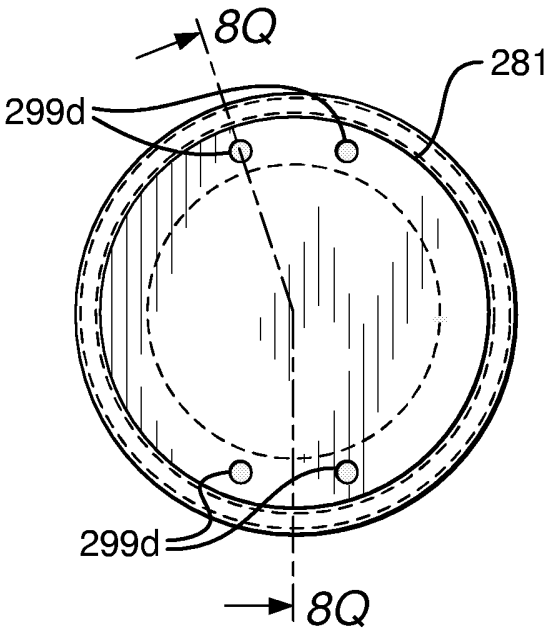


Fig.8Q

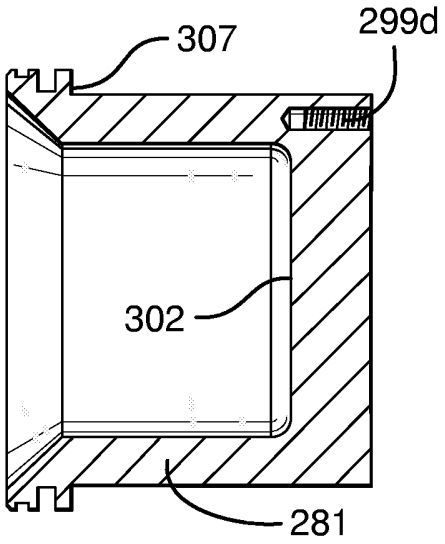
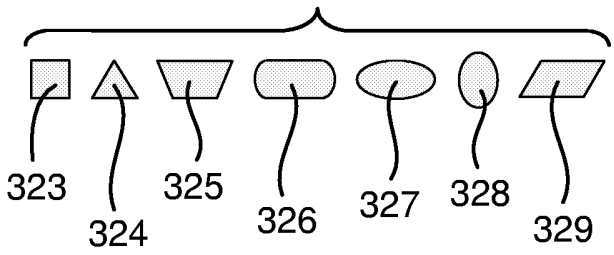


Fig.8T



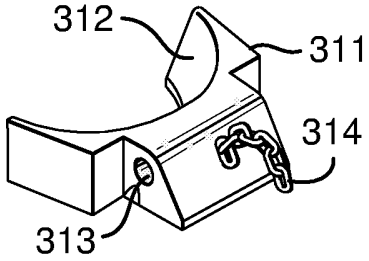
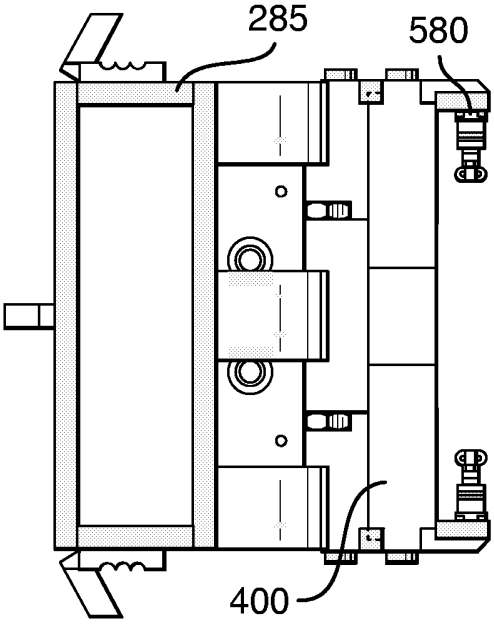


Fig.8R

Fig.8V



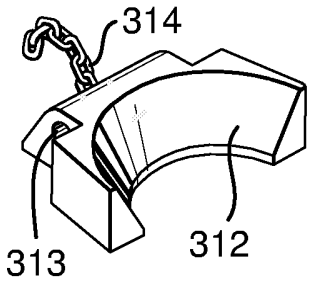
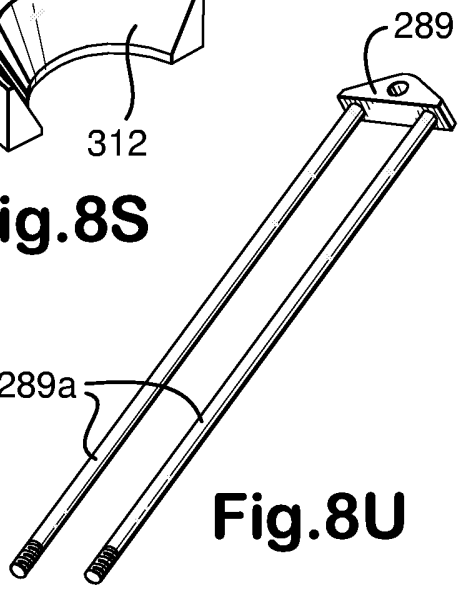


Fig.8S



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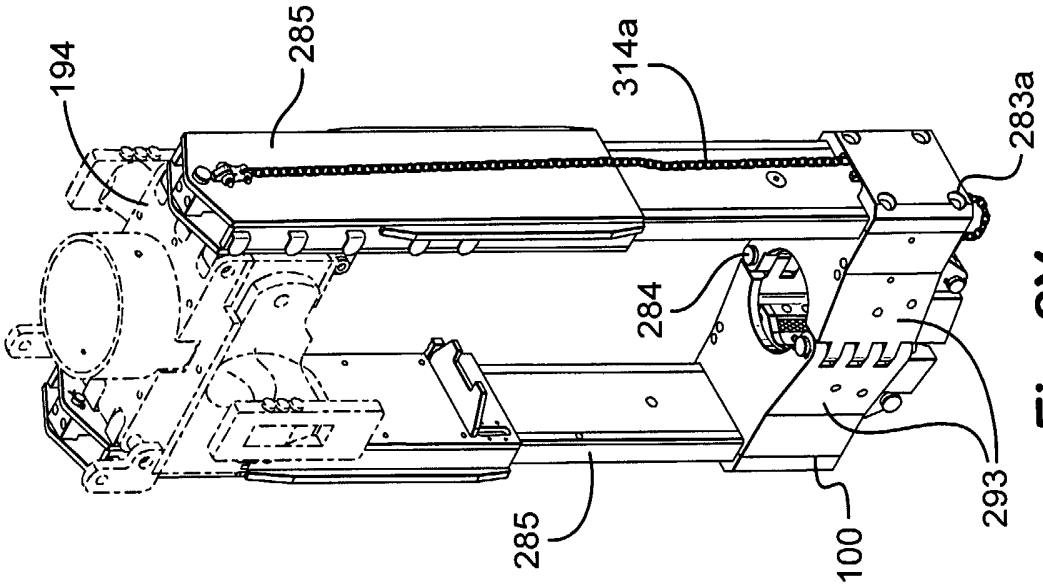

Fig.8Y

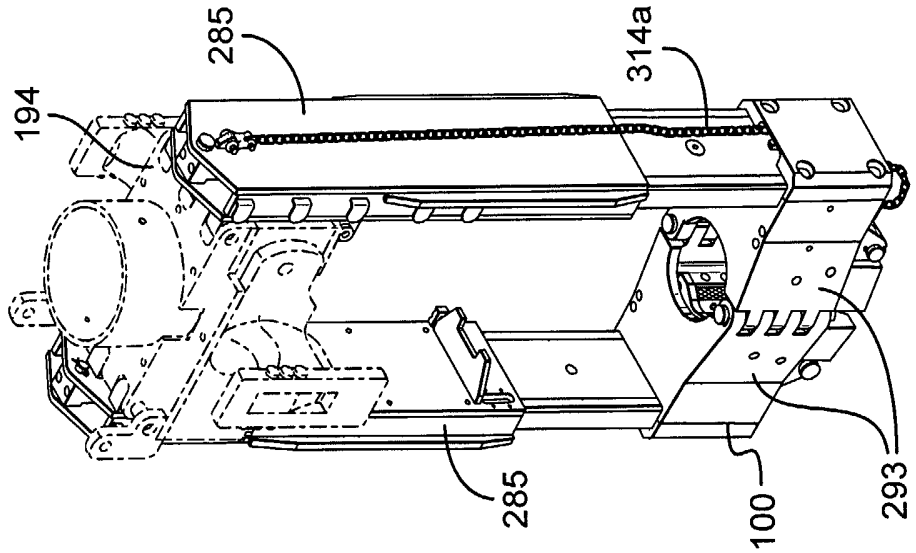

Fig.8X

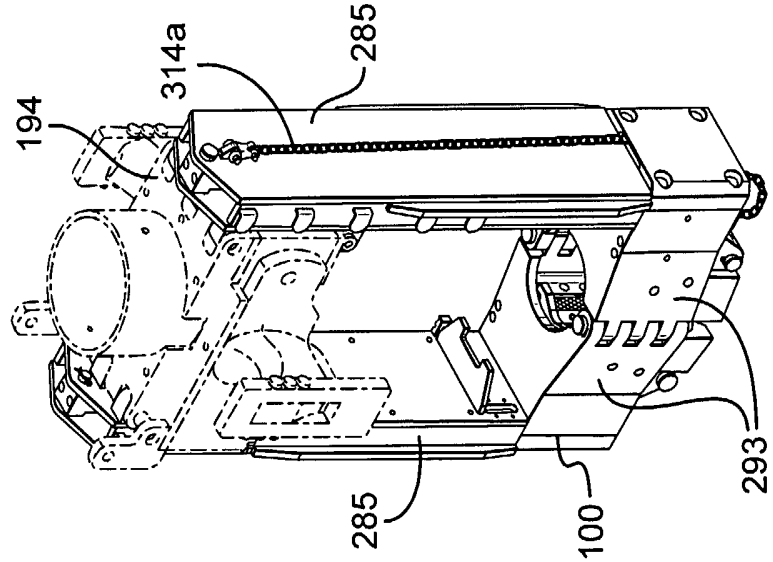

Fig.8W

Fig.8Z

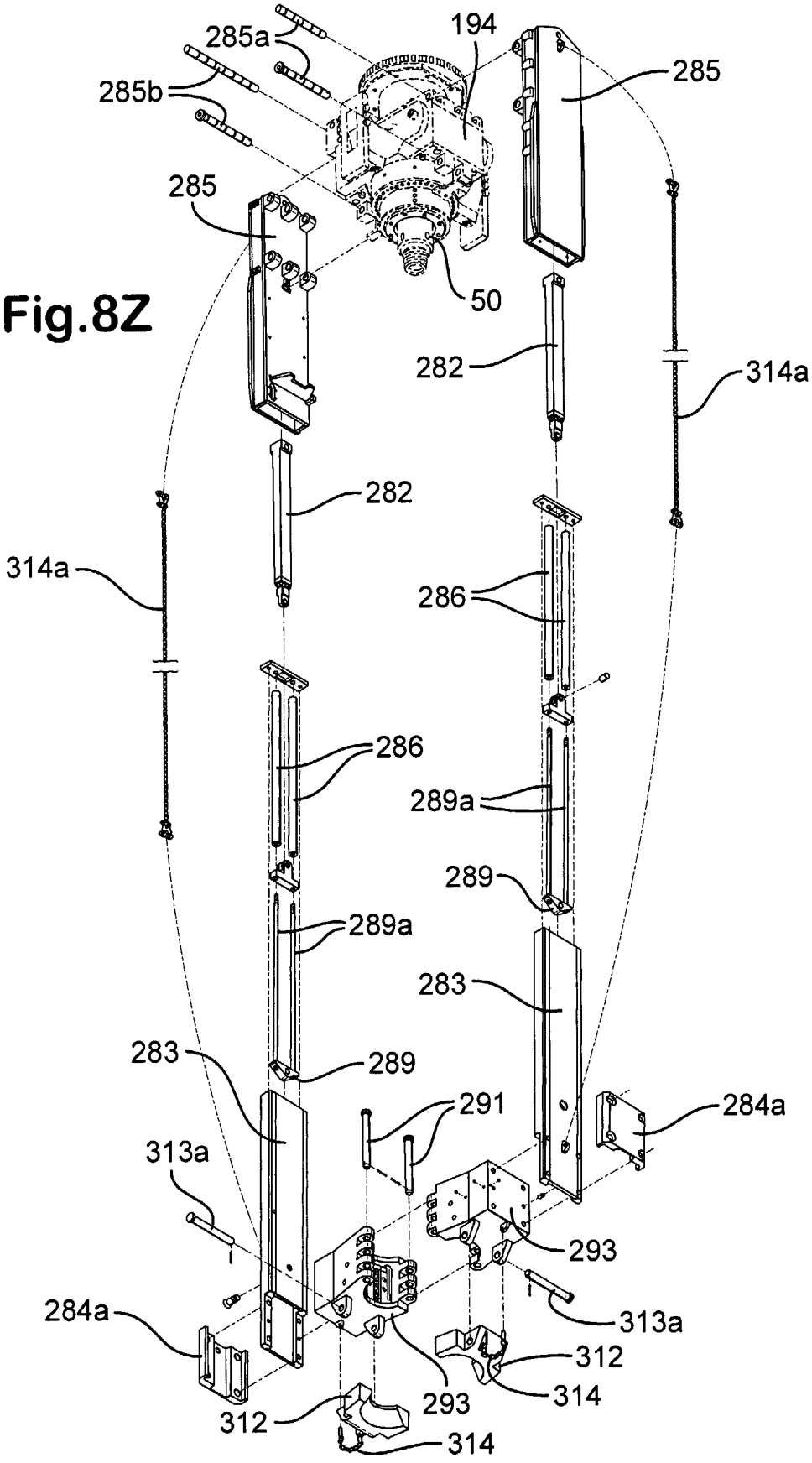
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Fig.9C

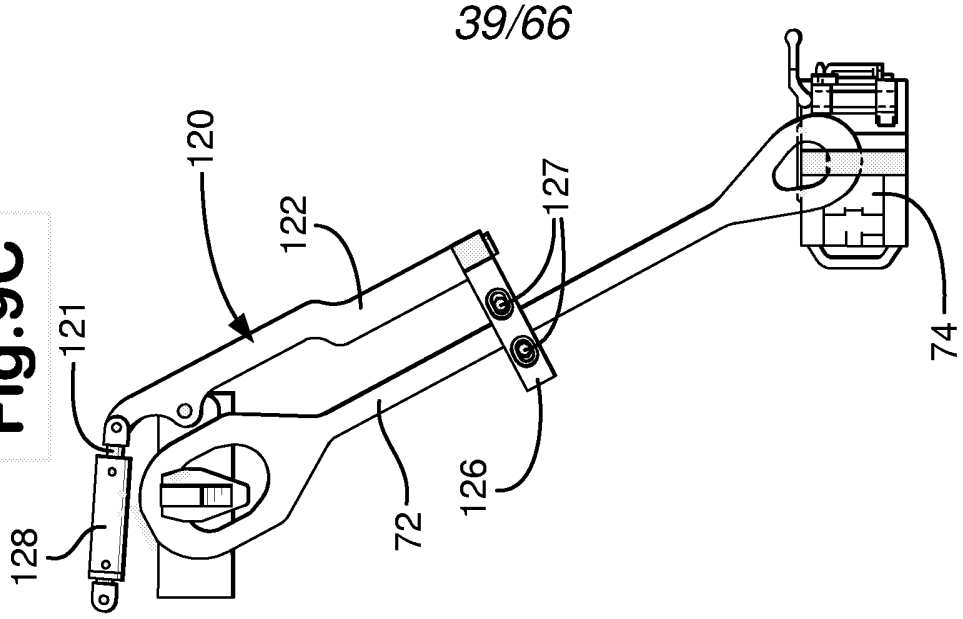


Fig.9B

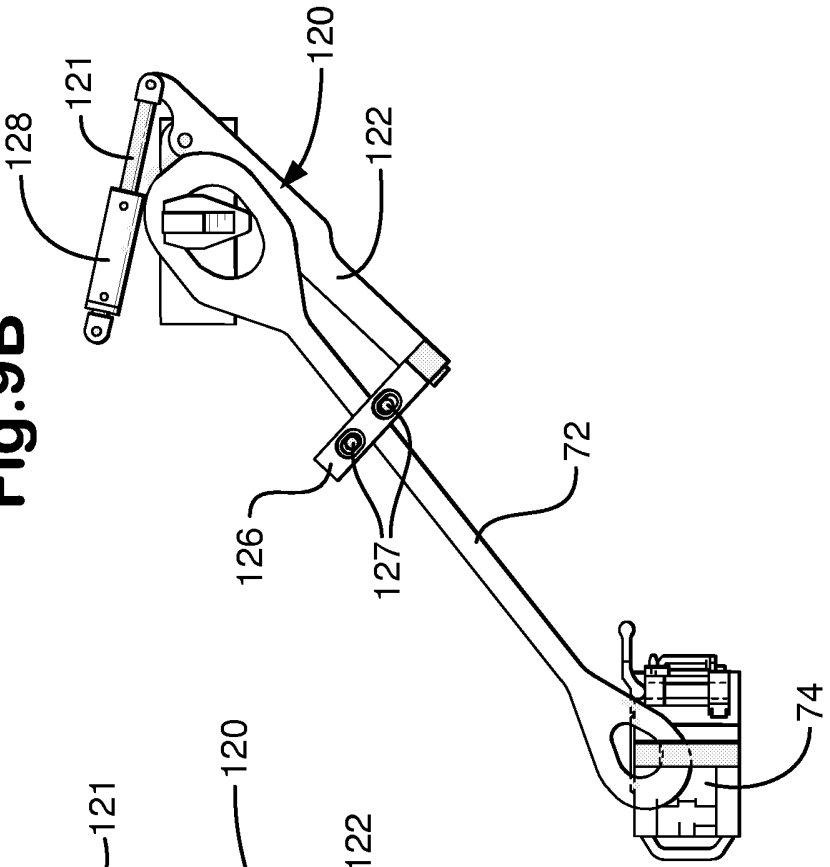


Fig.9A

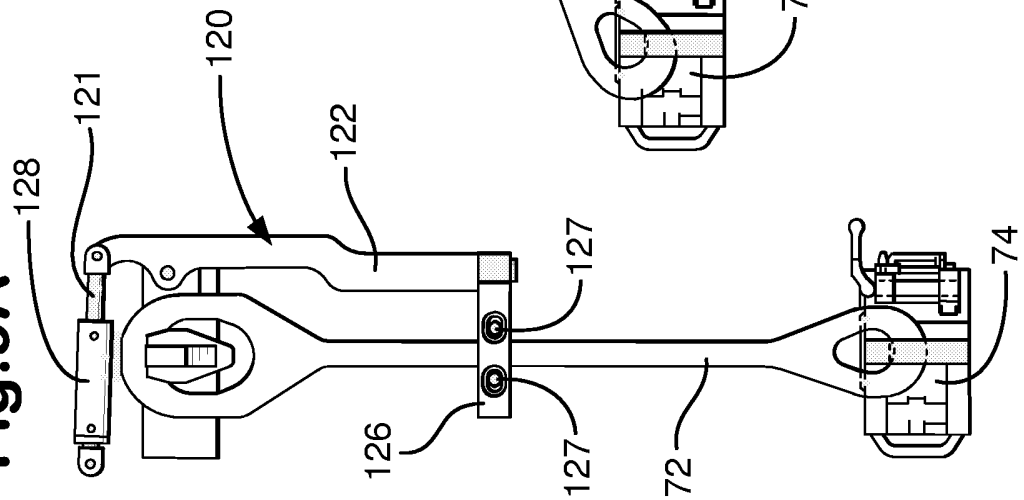


Fig.10A

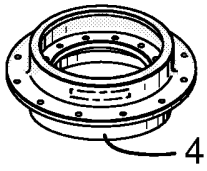


Fig.10B

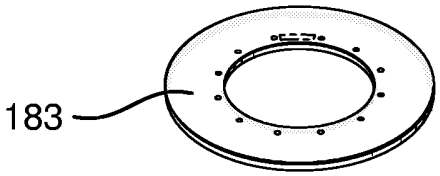


Fig.11A

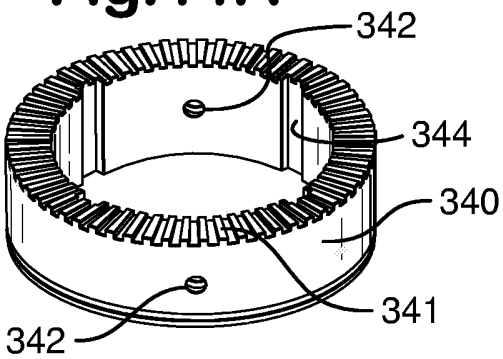


Fig.11B

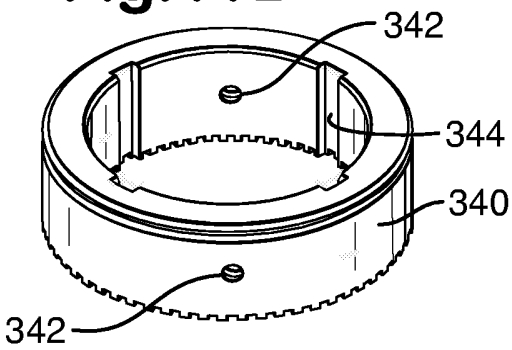


Fig.11C

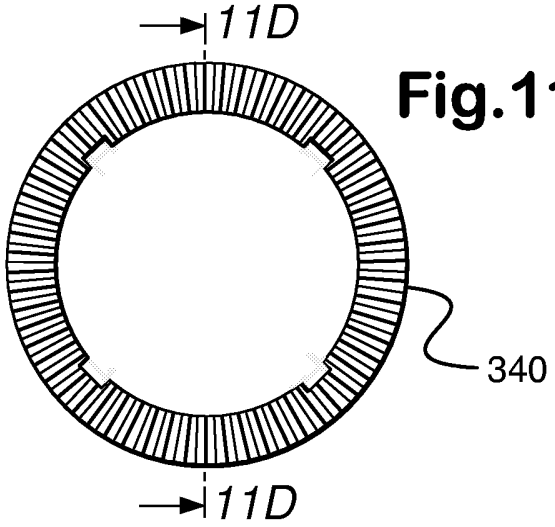


Fig.11D

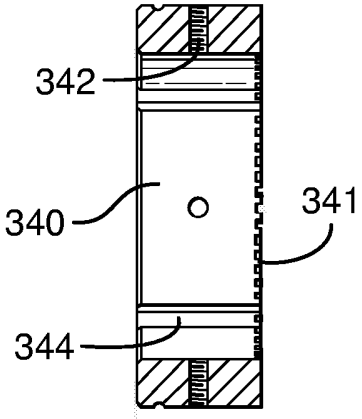


Fig.12A

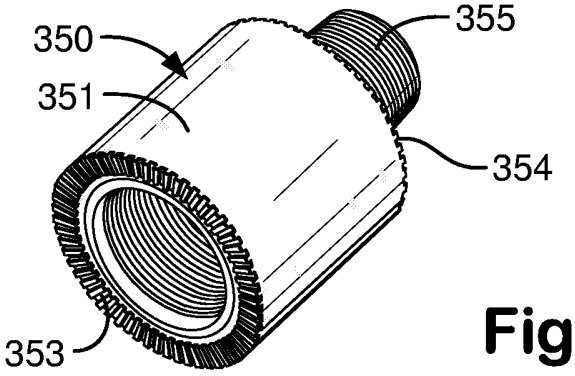
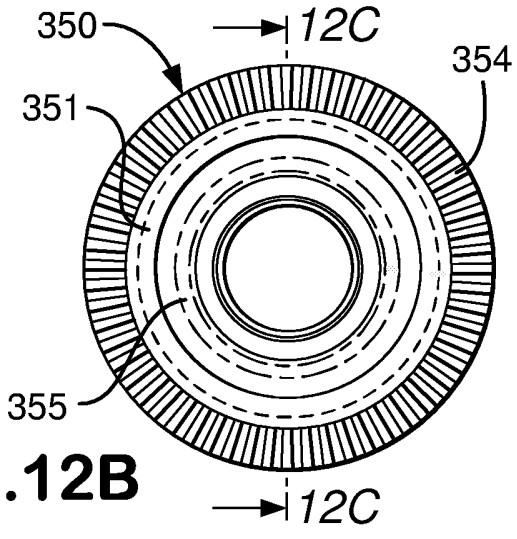


Fig.12B



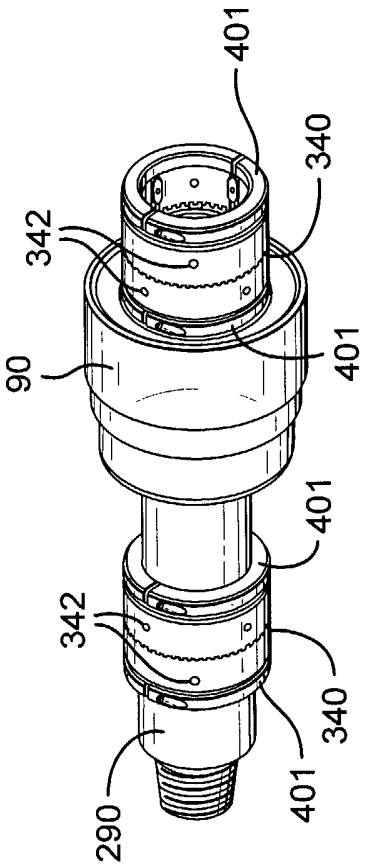


Fig.11E

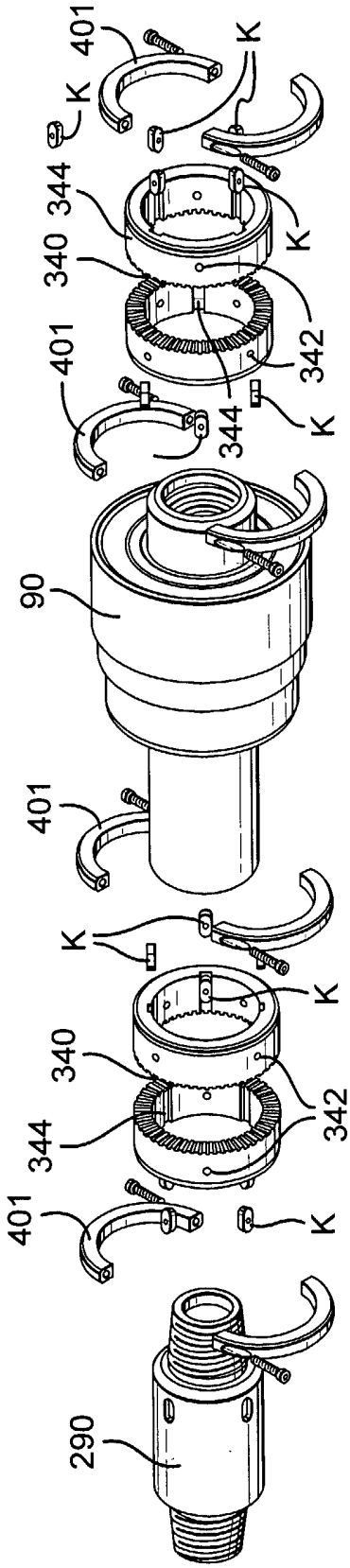


Fig.11F

Fig.12C

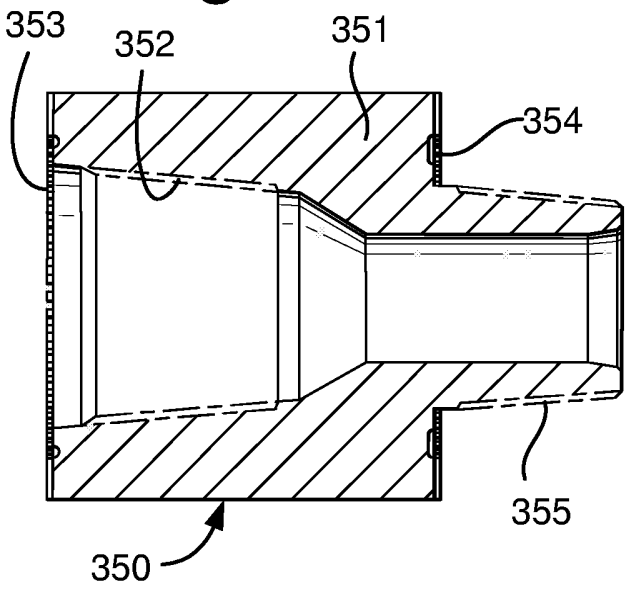
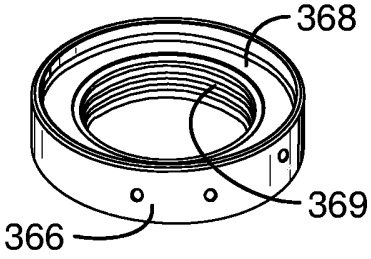


Fig.14A



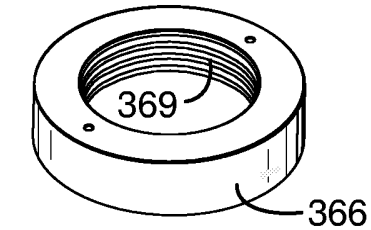


Fig.14B

Fig.13

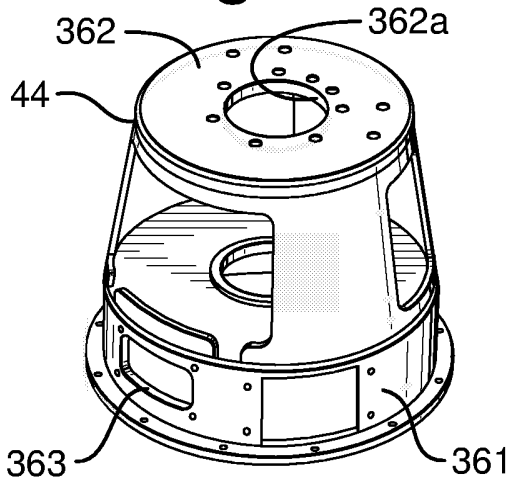
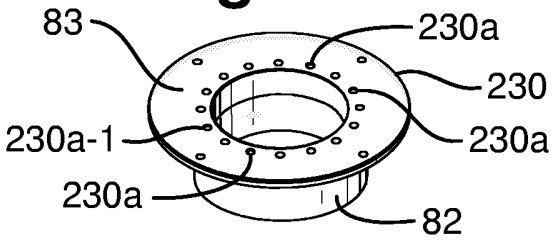


Fig.15A



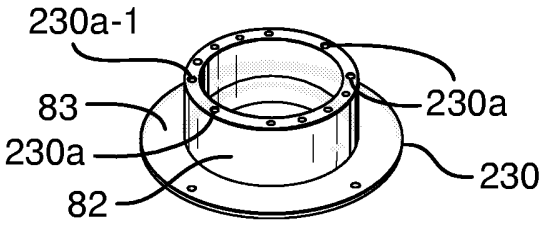


Fig.15B

Fig.15C

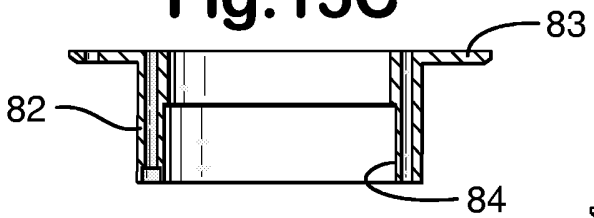


Fig.15F

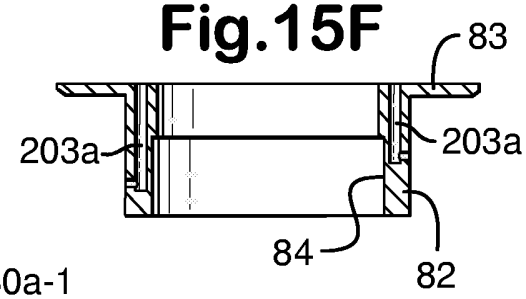


Fig.15D

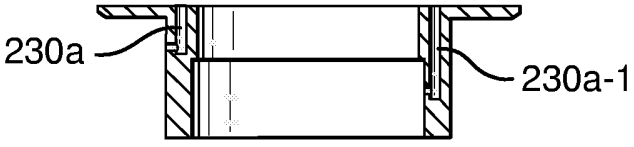


Fig.15E

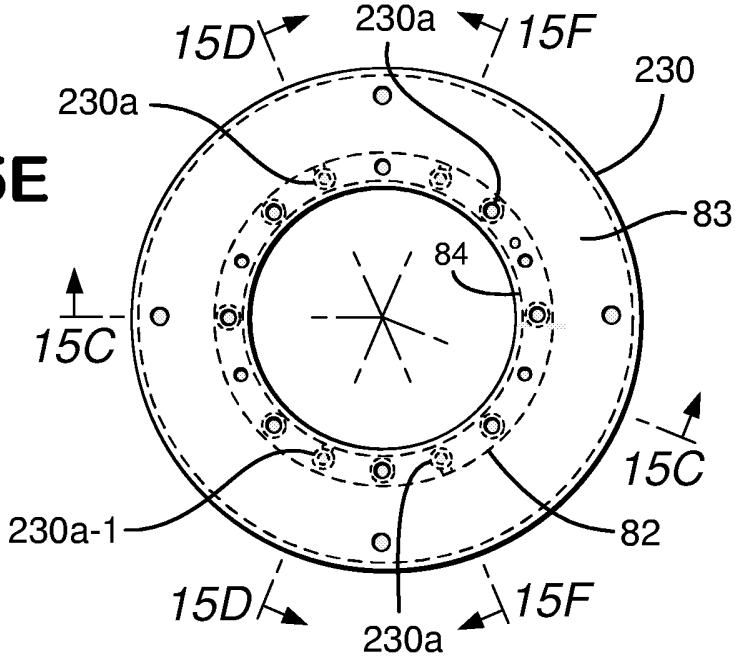


Fig.15G

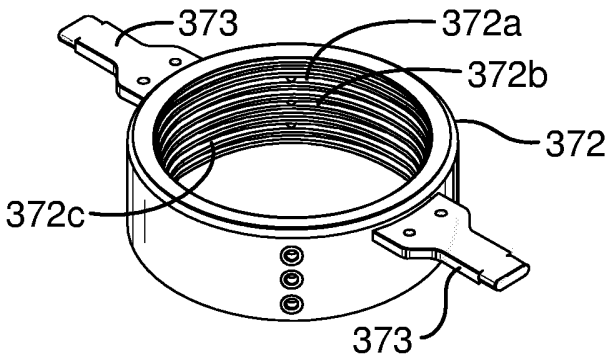


Fig.16A

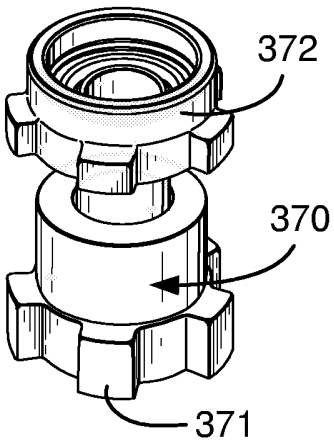


Fig.16B

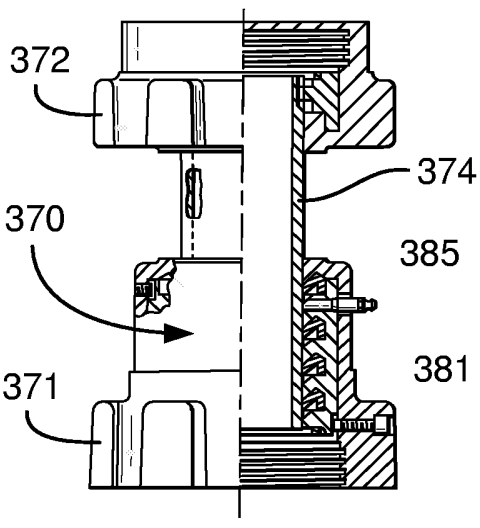


Fig.15H

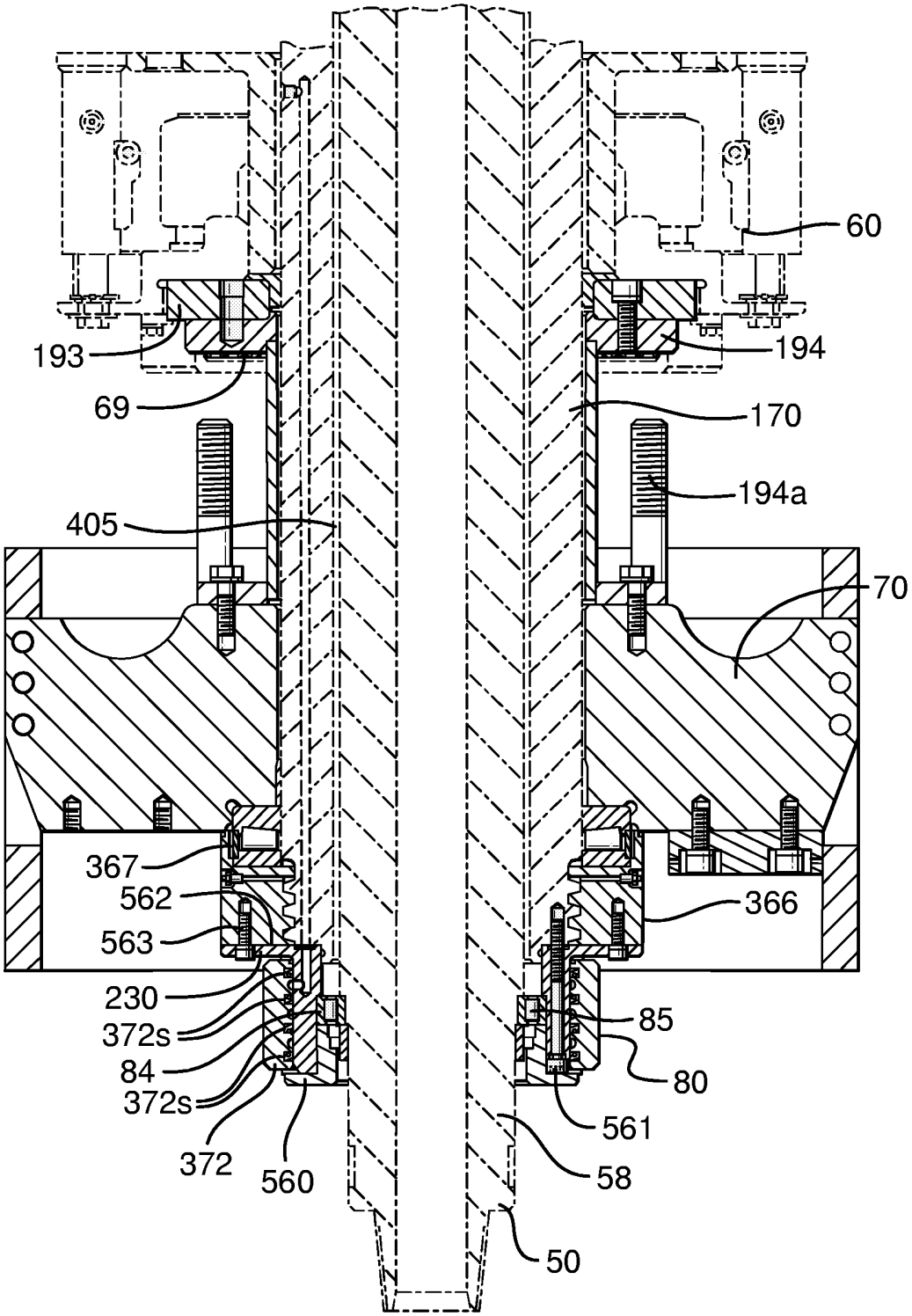

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Fig.17A

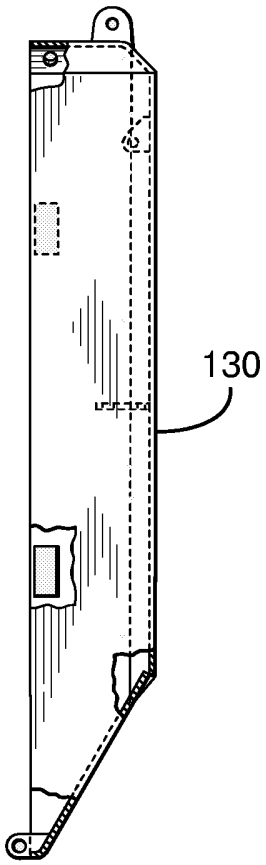


Fig.17B

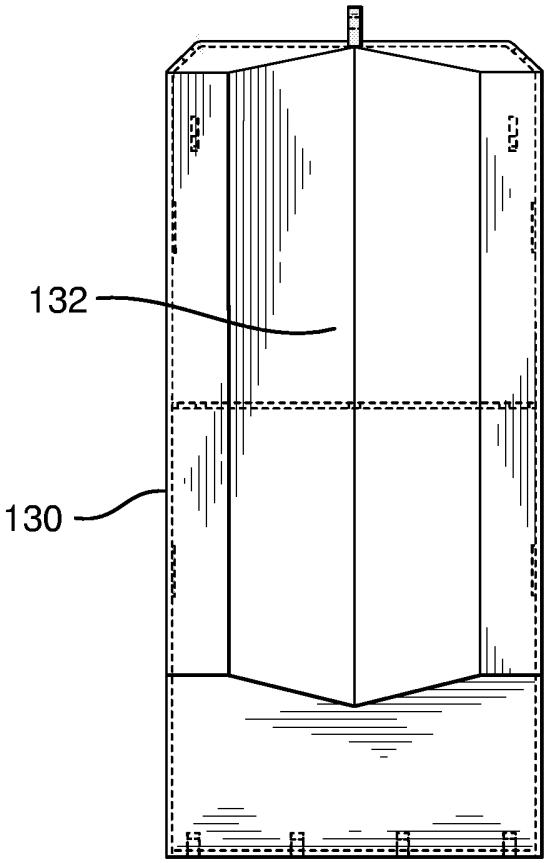


Fig.17C

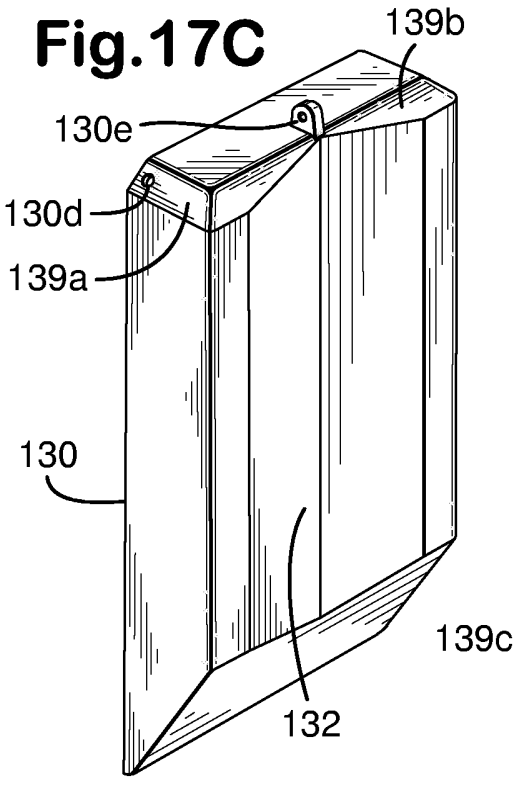


Fig.17D

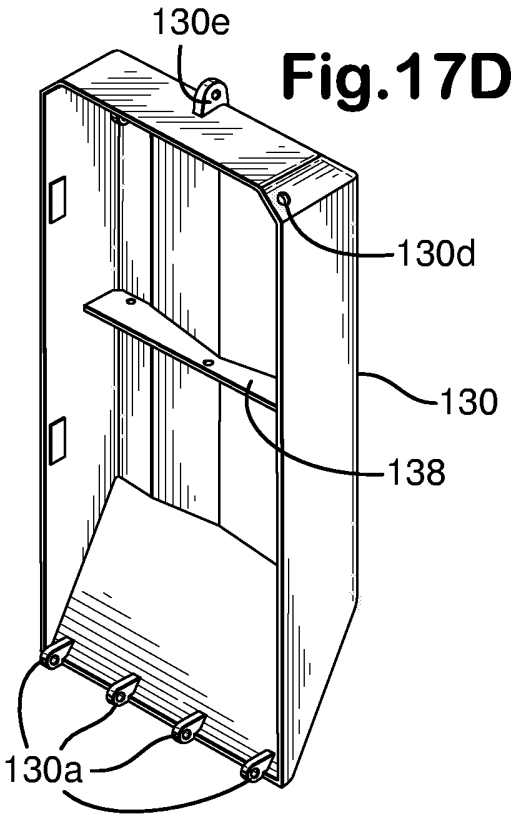


Fig.17E

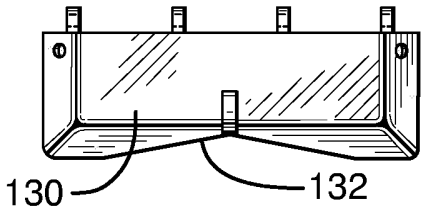


Fig.17F

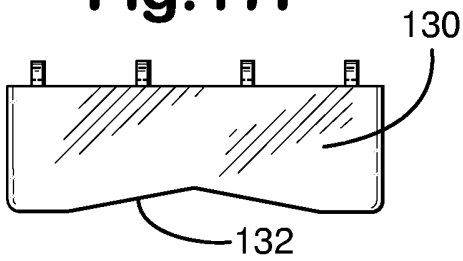


Fig.18A

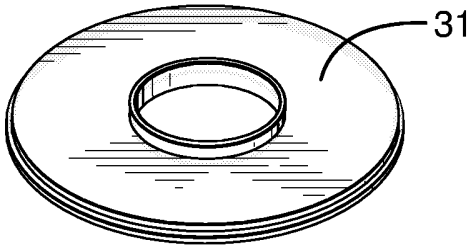


Fig.18B

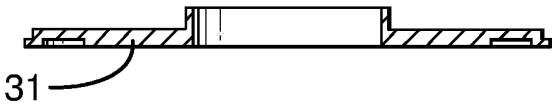


Fig.19B

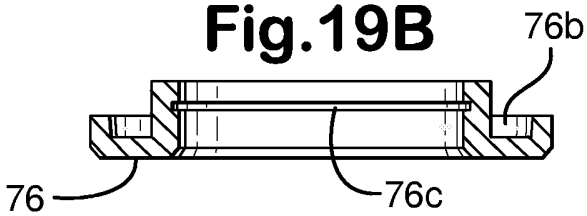


Fig.19A

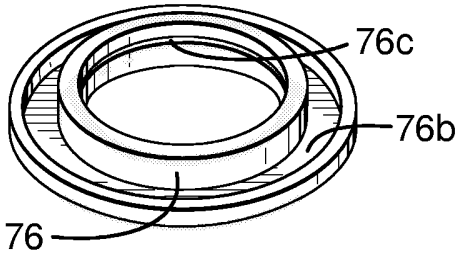


Fig.20B

Fig.20A

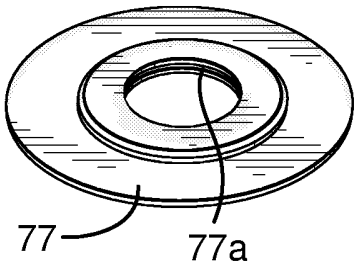


Fig.21

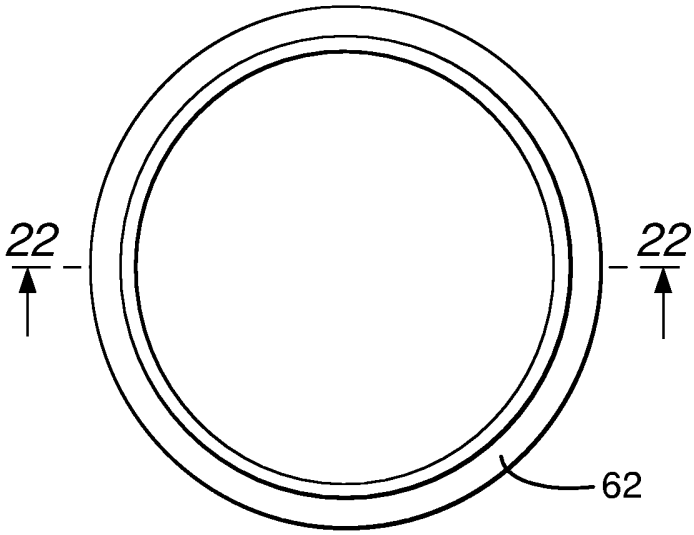


Fig.22

Fig.17H

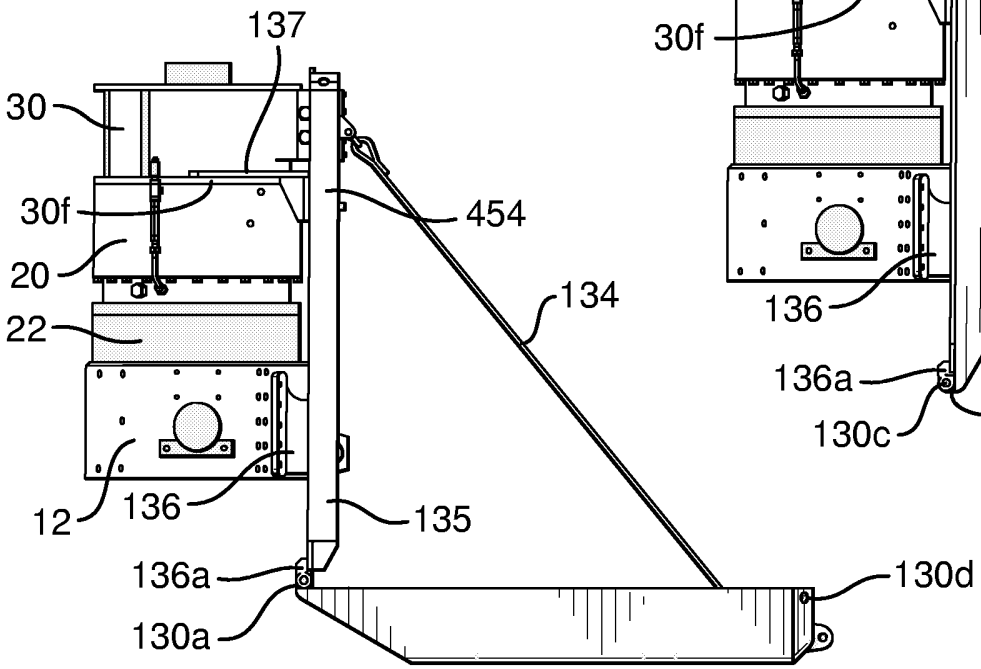


Fig.17G

Fig.17I

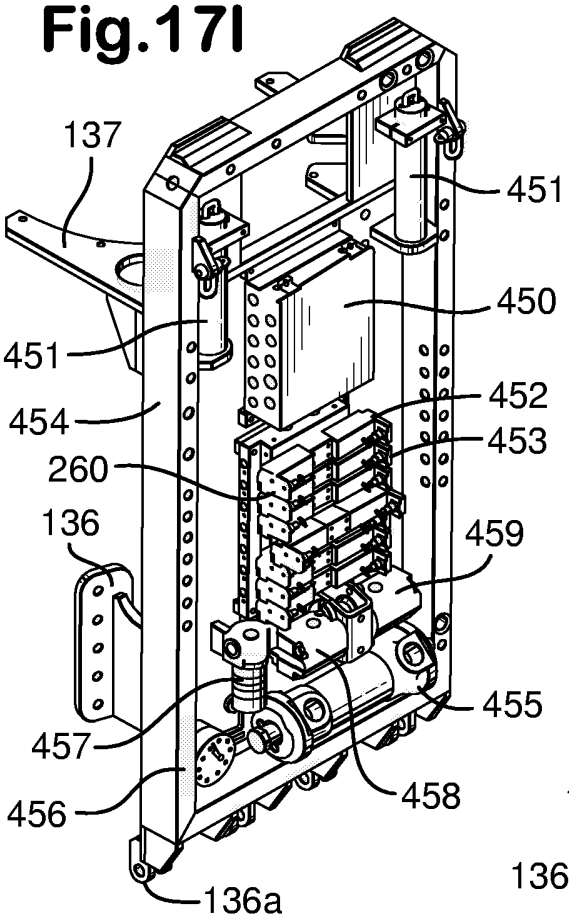


Fig.17J

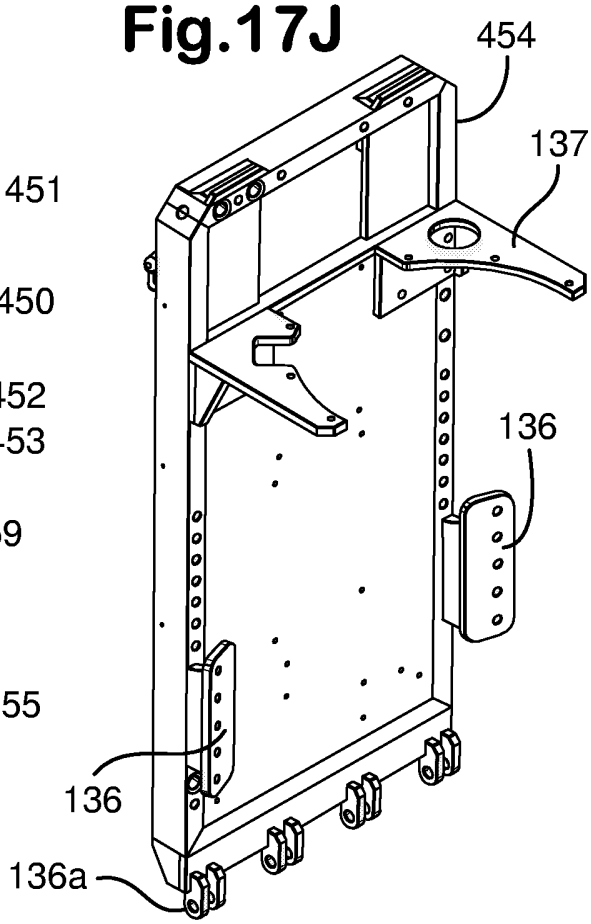


Fig.23A

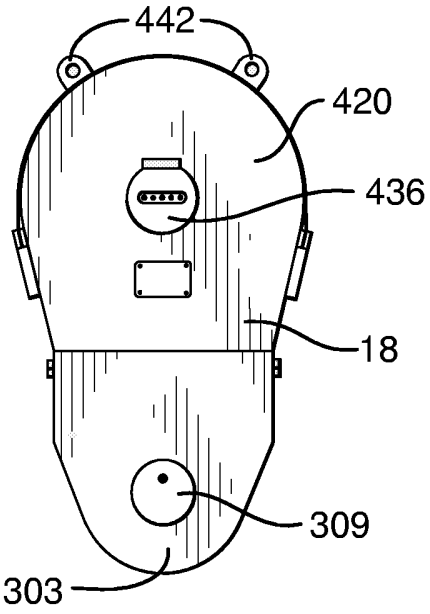


Fig.23B

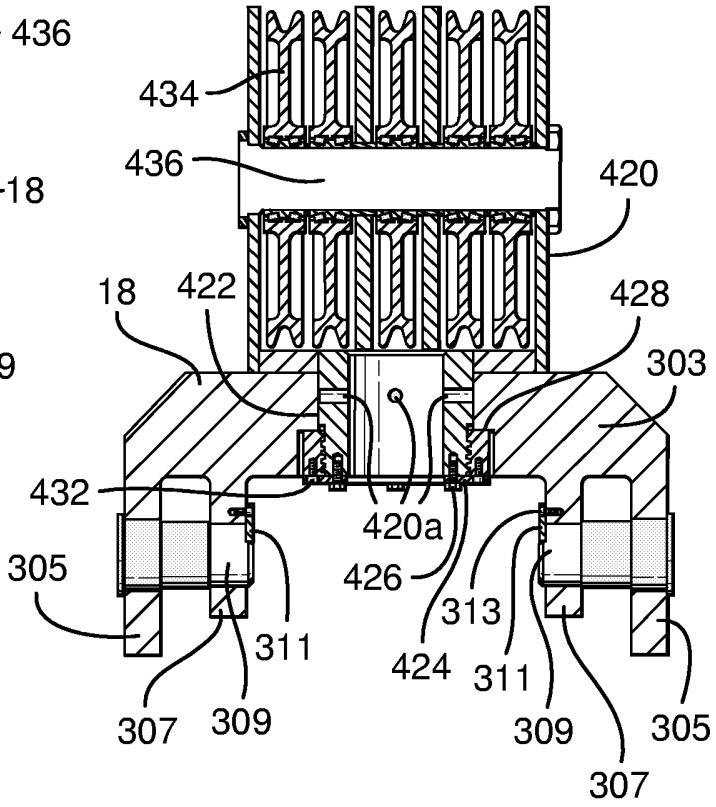


Fig.23C

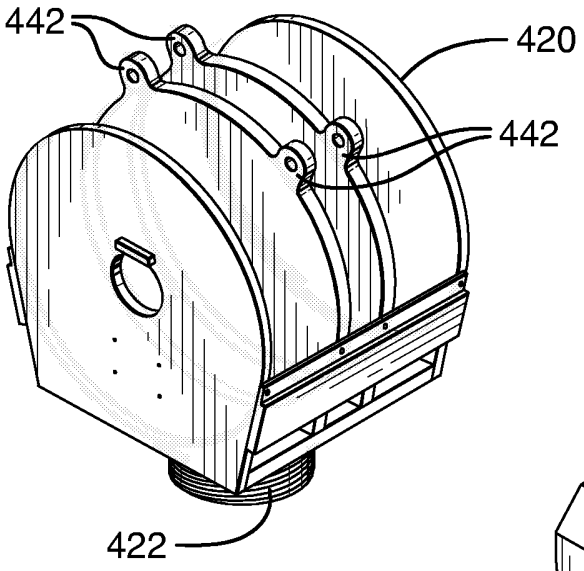


Fig.23D

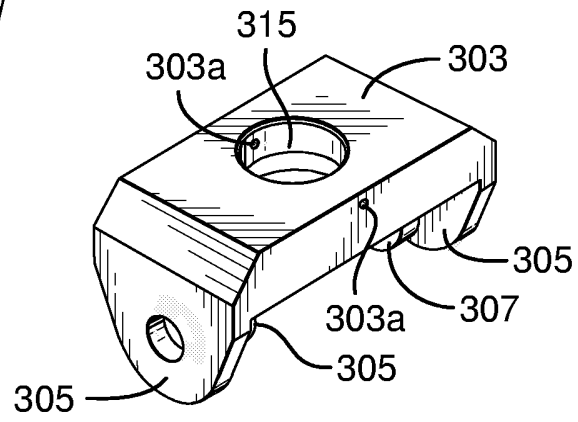


Fig.23E

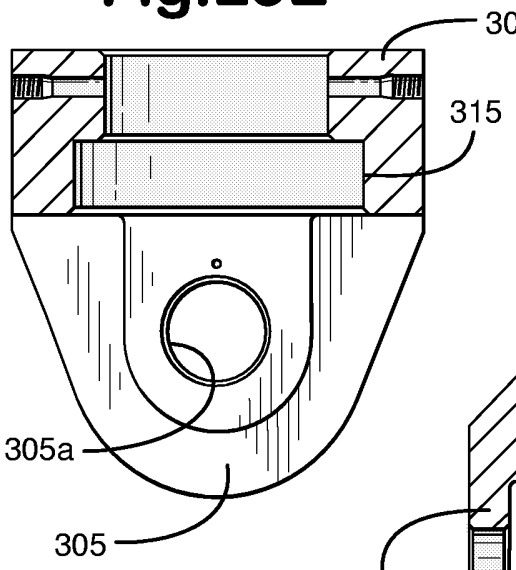


Fig.23F

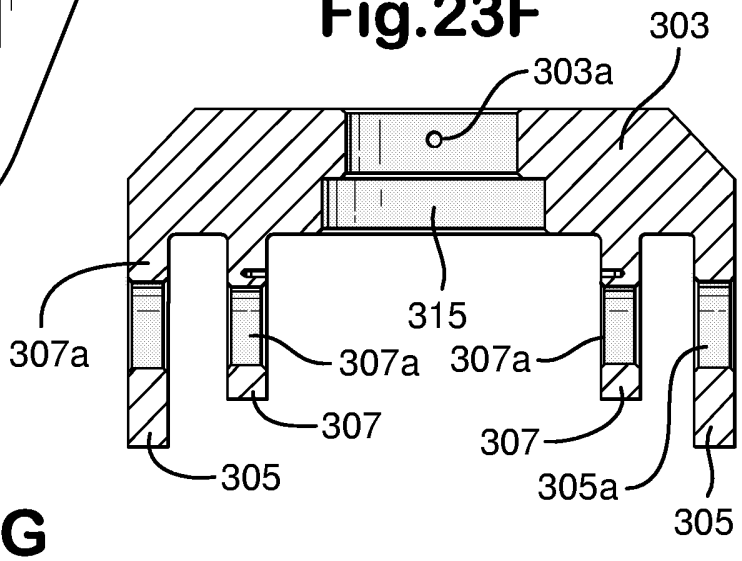


Fig.23G

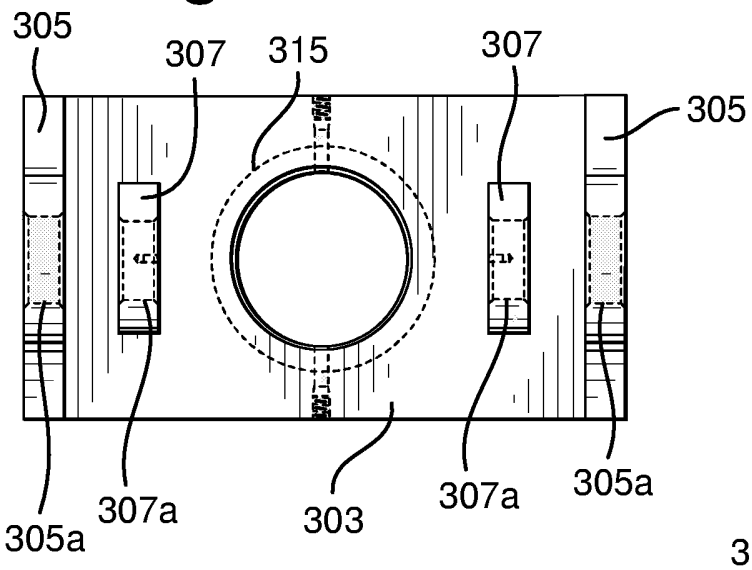


Fig.23H

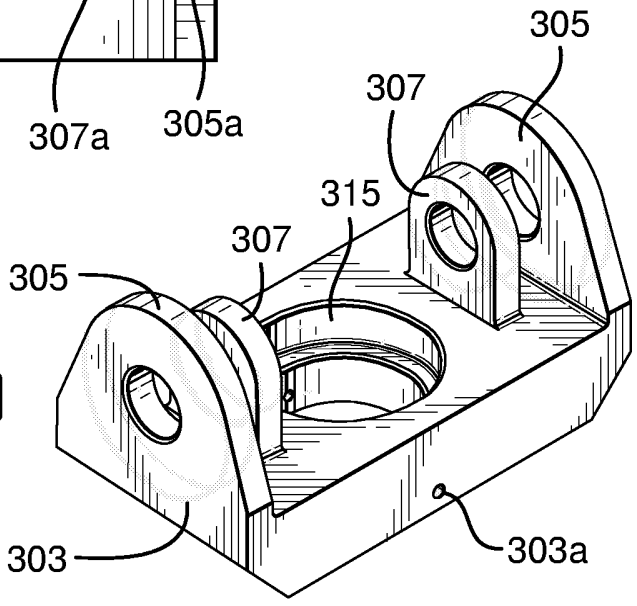


Fig.24A

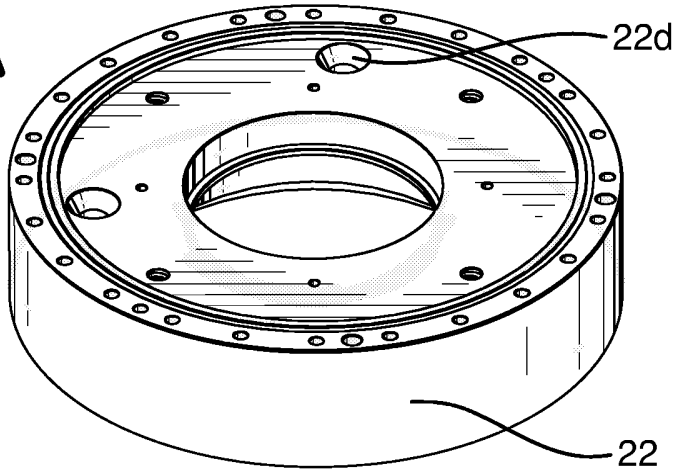


Fig.24B

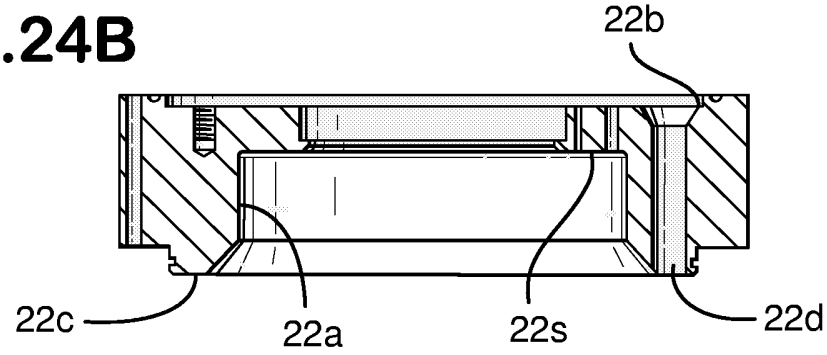
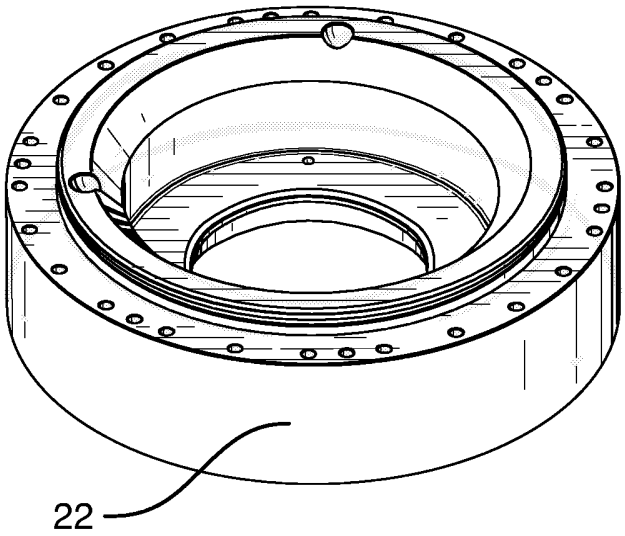


Fig.25



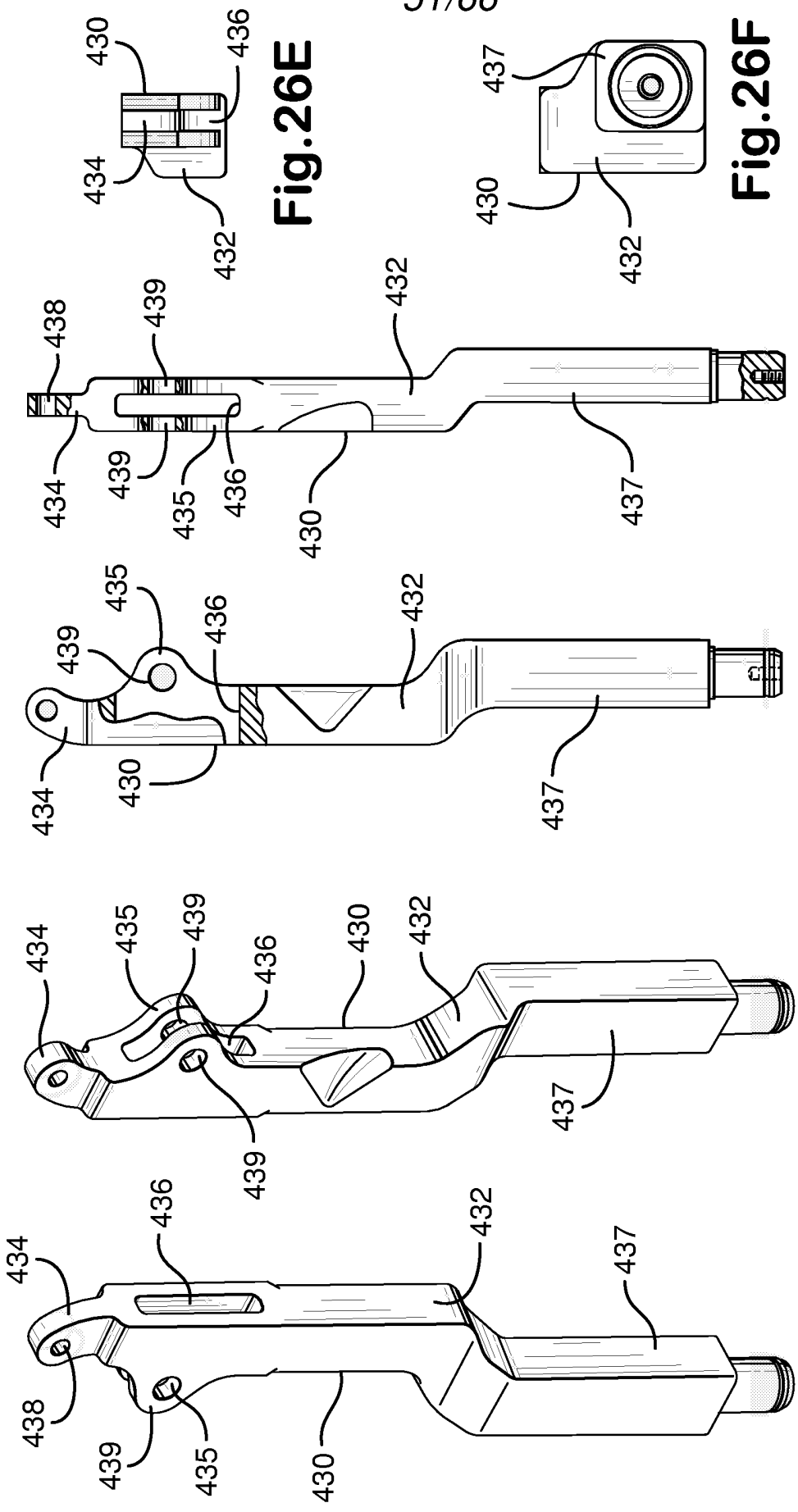


Fig.26A

Fig.26B

Fig.26C

Fig.26D

Fig.26E

Fig.26F

Fig.27A

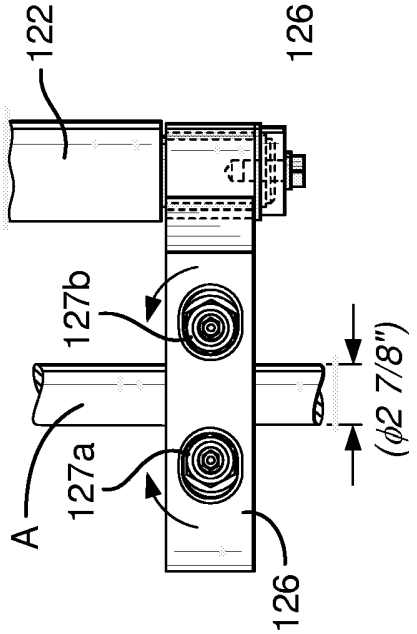


Fig.27B

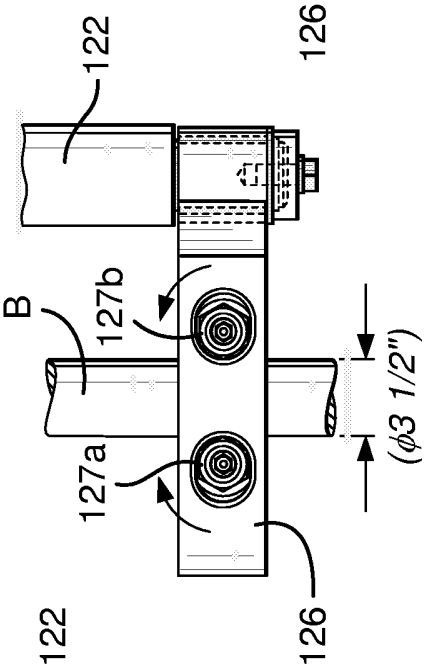


Fig.27C

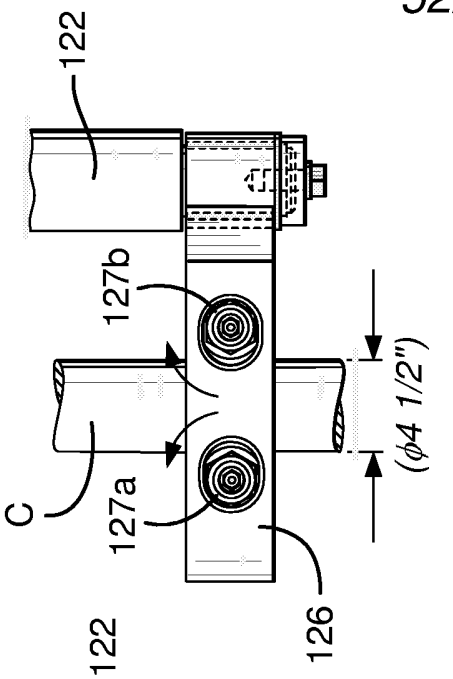


Fig.27D

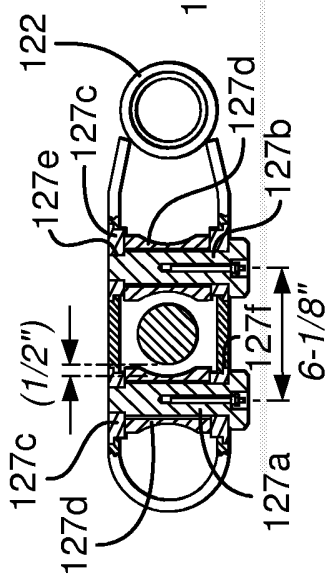


Fig.27E

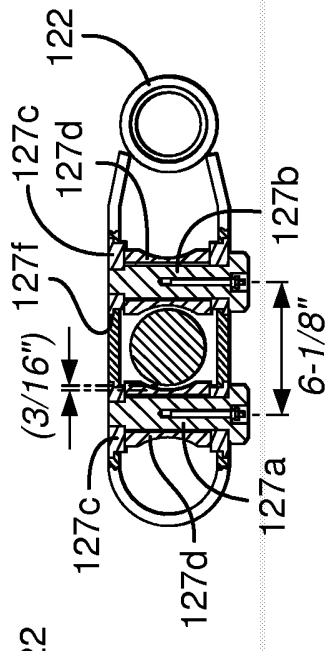
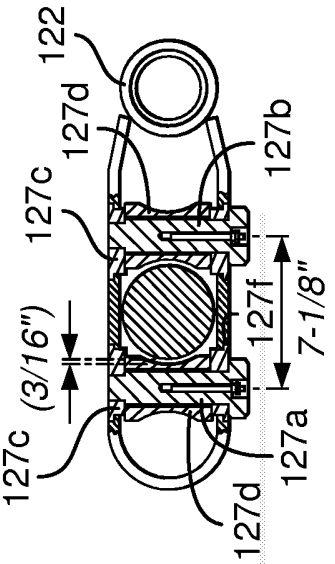


Fig.27F



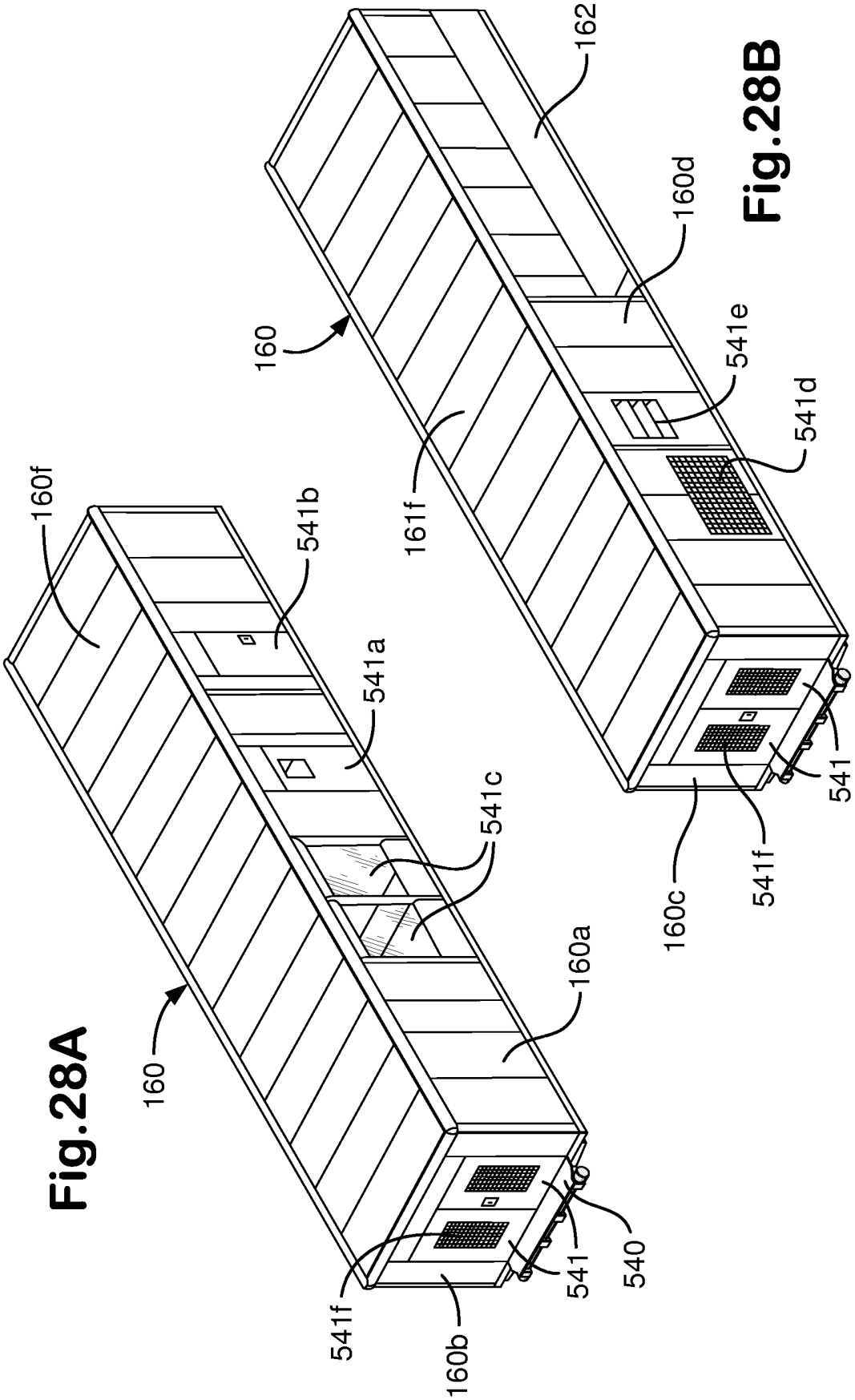


Fig.28A

Fig.28B

Fig.28C

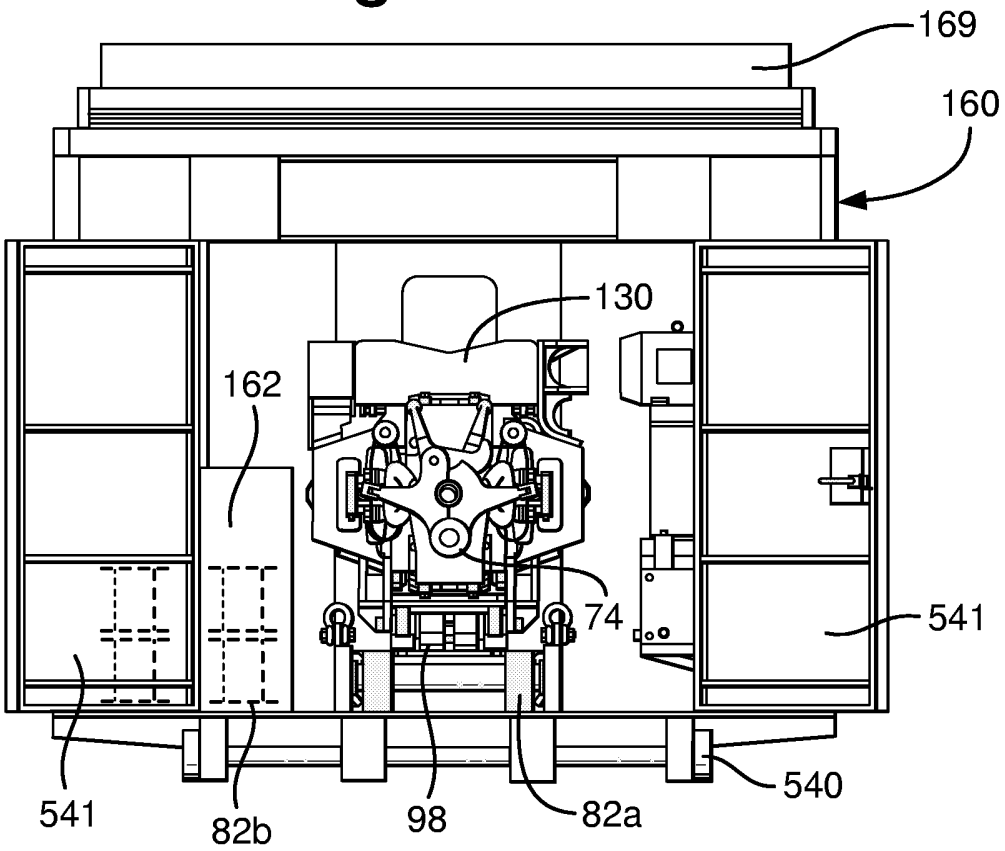


Fig.28E

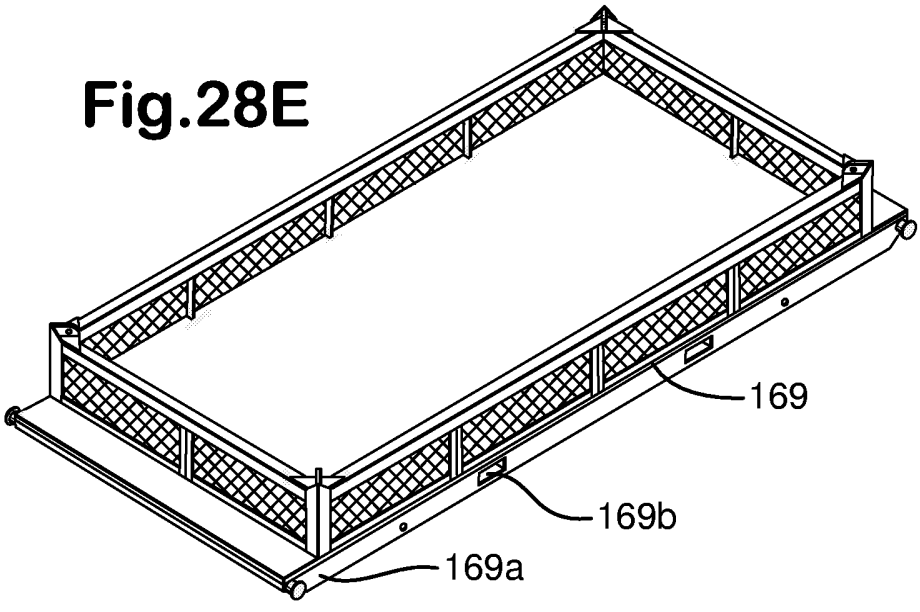
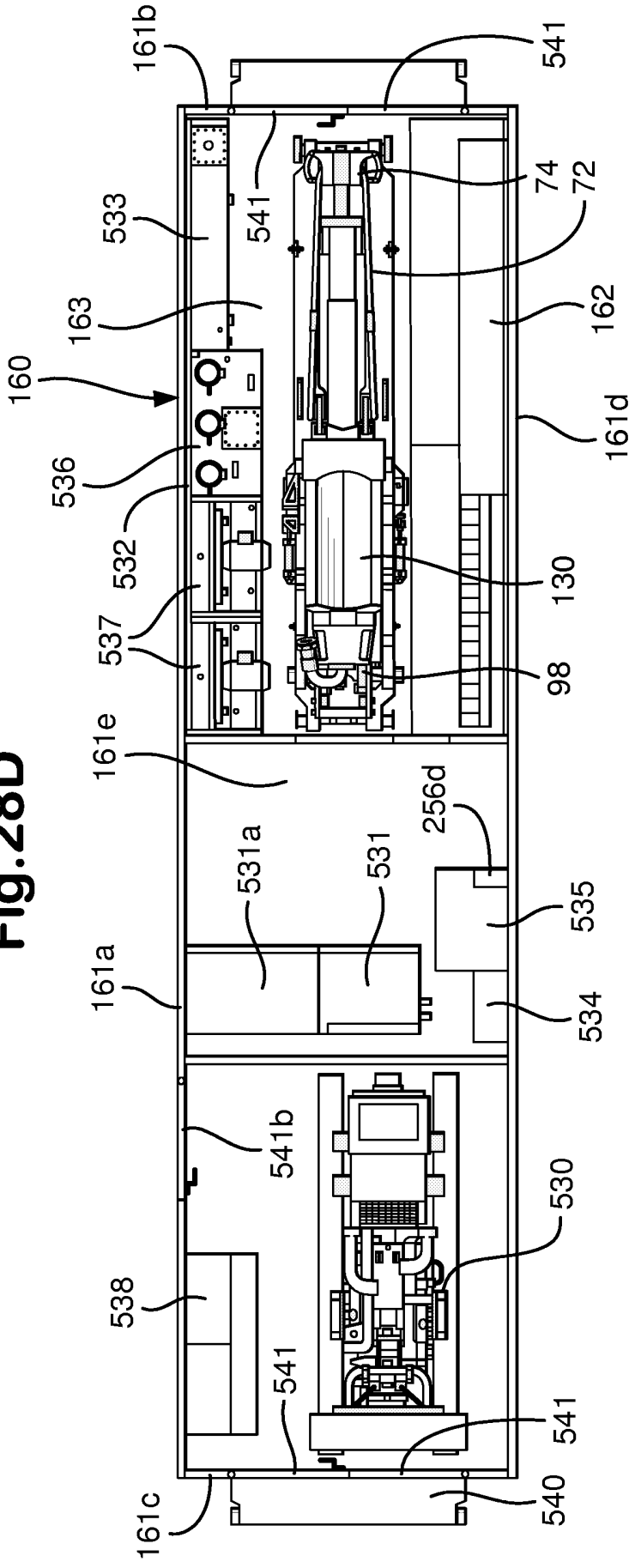


Fig.28D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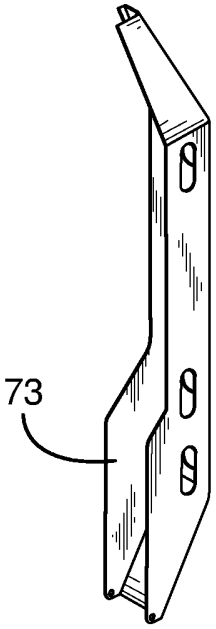

Fig.29A

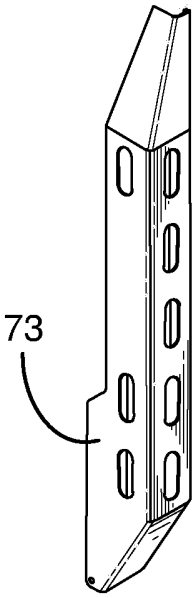

Fig.29B

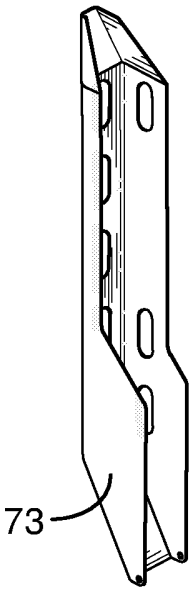

Fig.29C

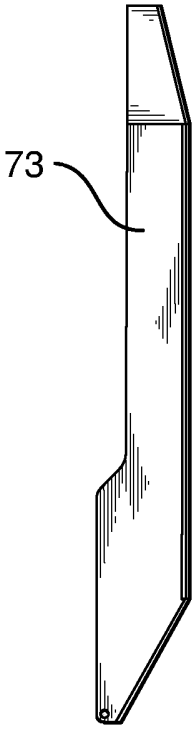

Fig.29D

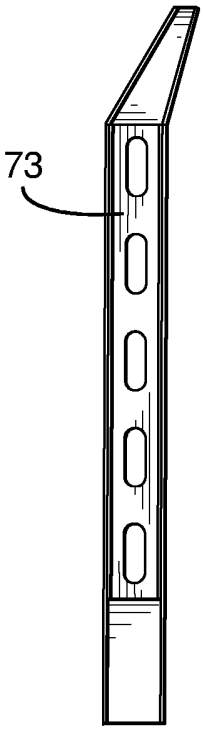

Fig.29E

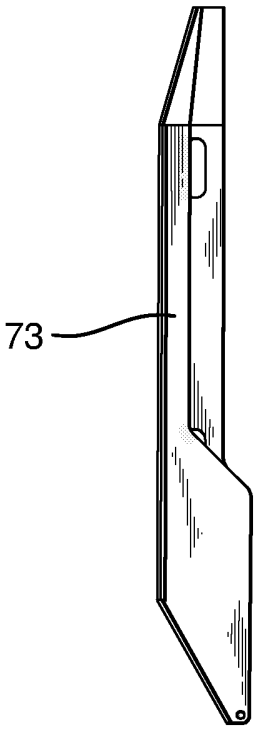

Fig.29F

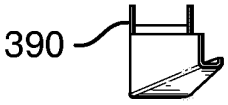

Fig.29G

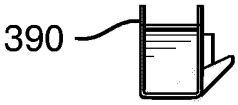

Fig.29H

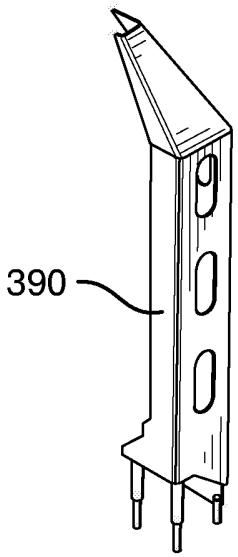

Fig.30A

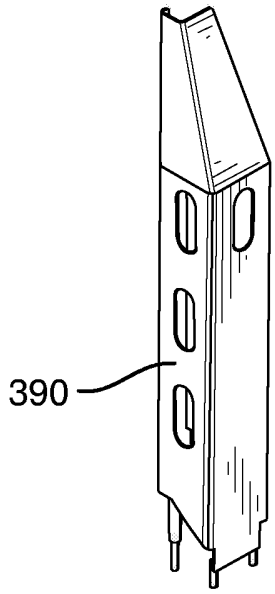

Fig.30B

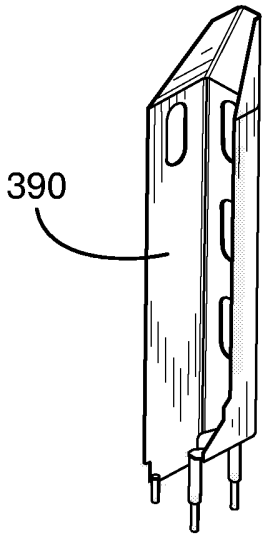

Fig.30C

Fig.30D

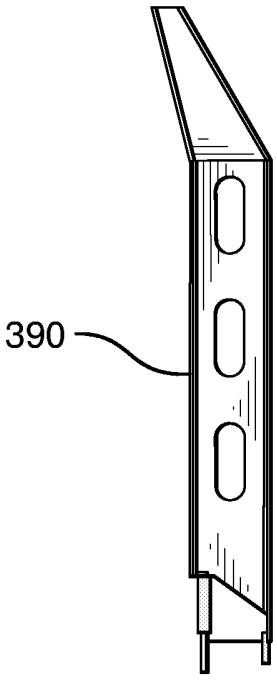

Fig.30E

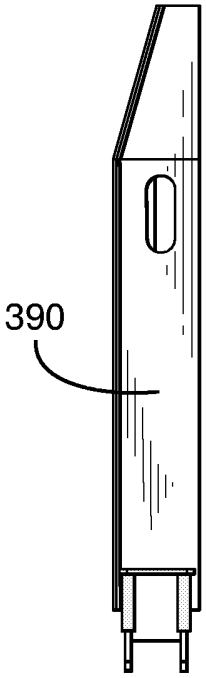

Fig.30F

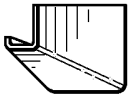

Fig.30G

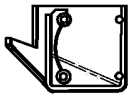

Fig.30H

Fig.31A

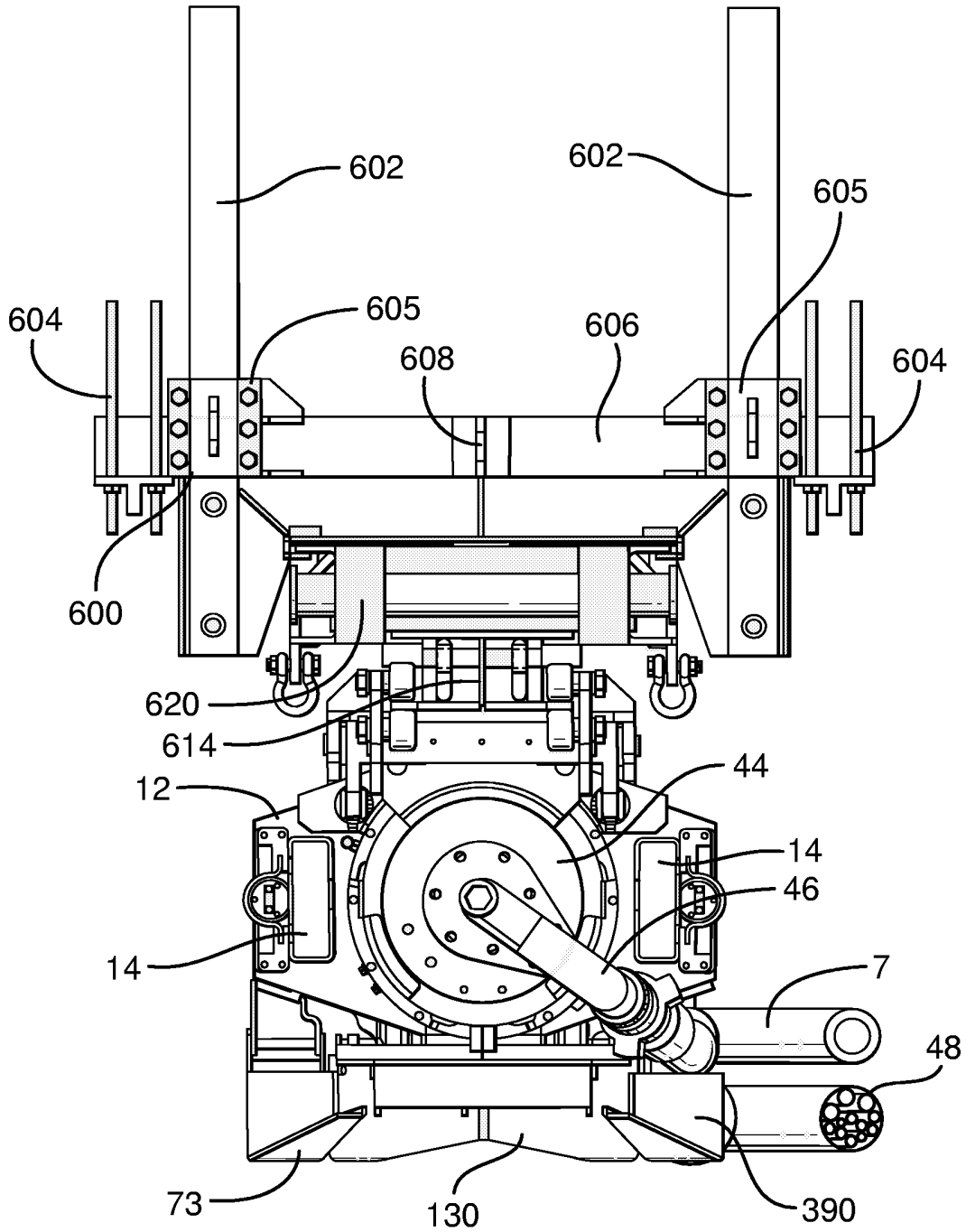
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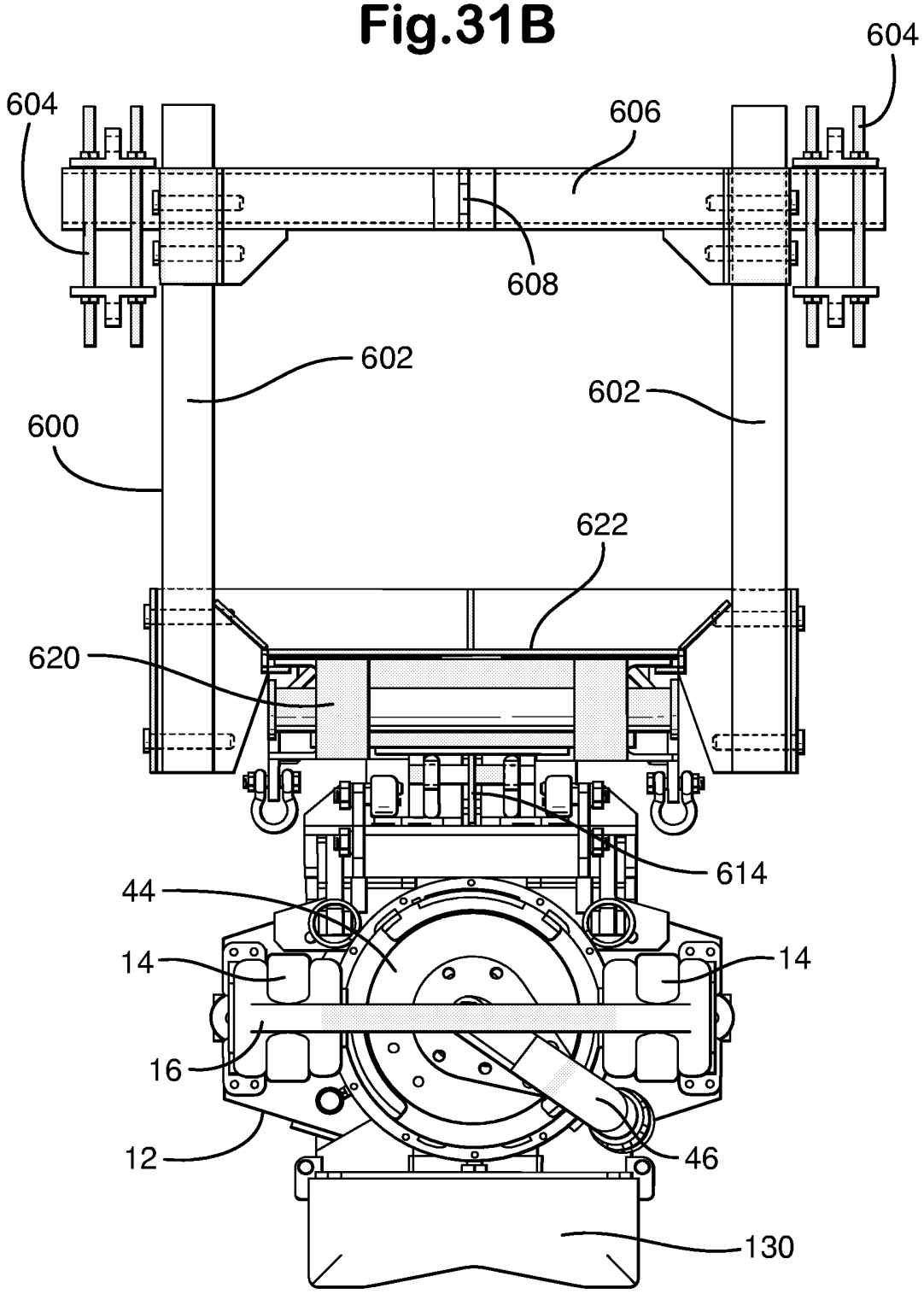
Fig.31B



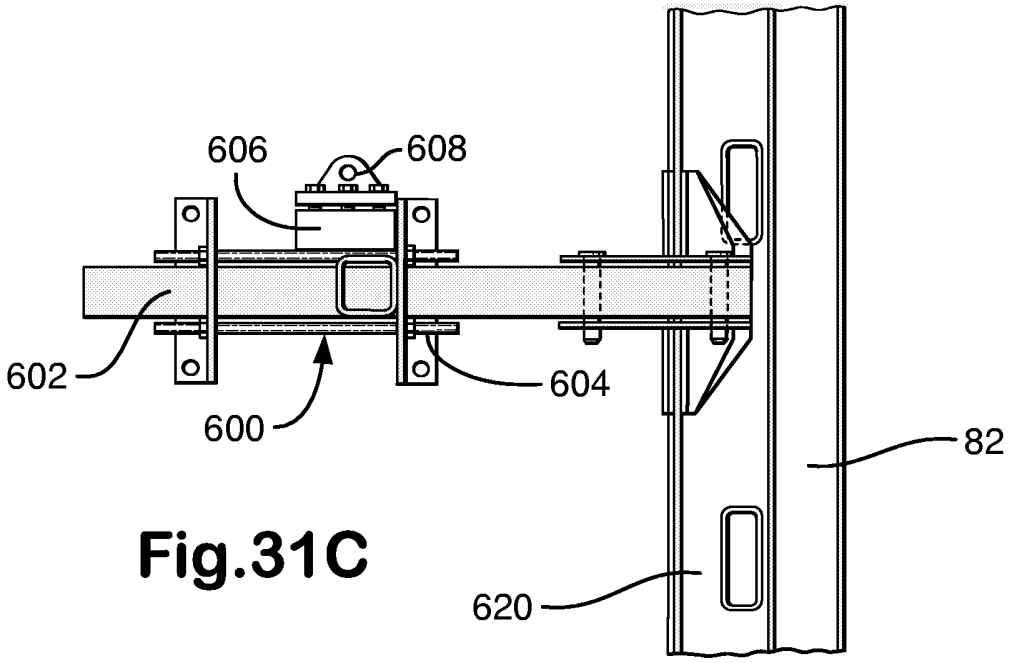


Fig.31C

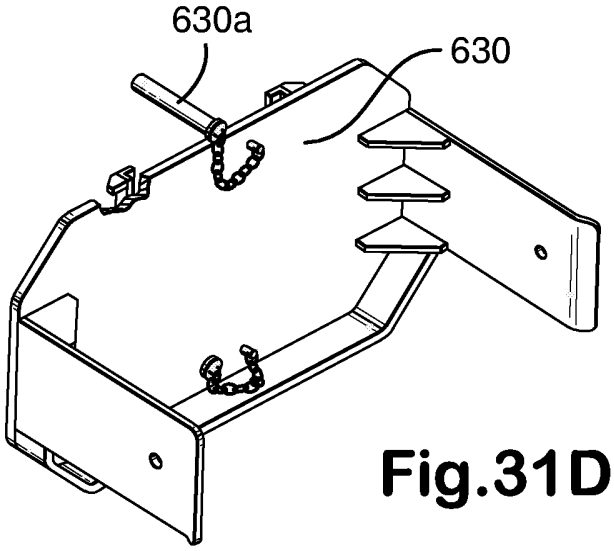


Fig.31D

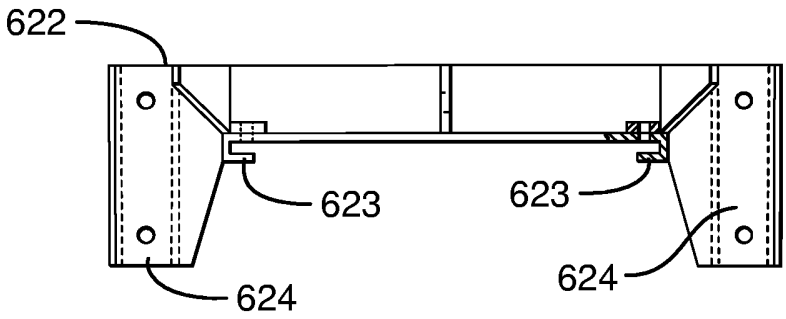


Fig.31E

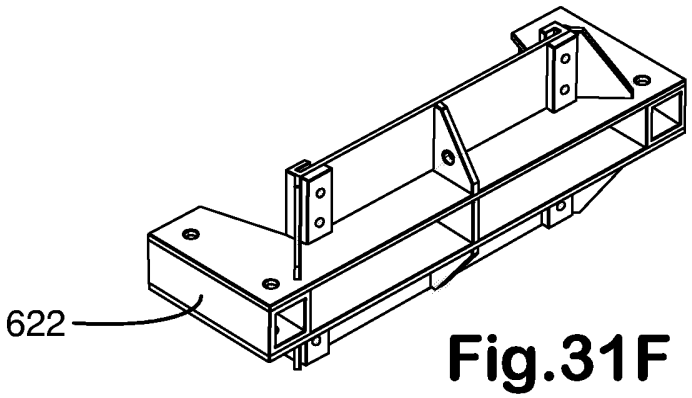


Fig.31F

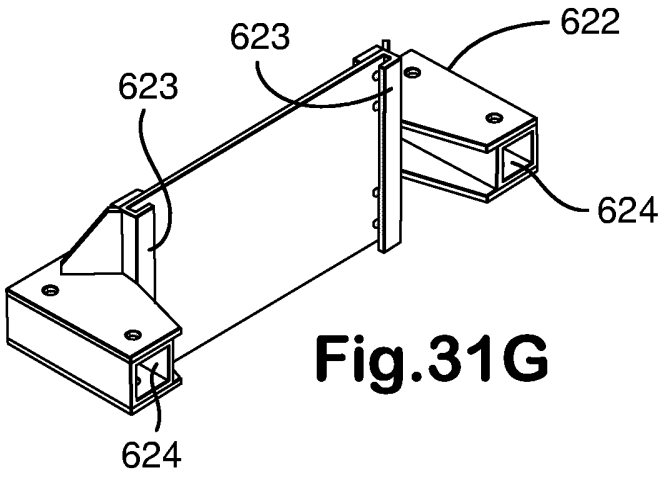


Fig.31G

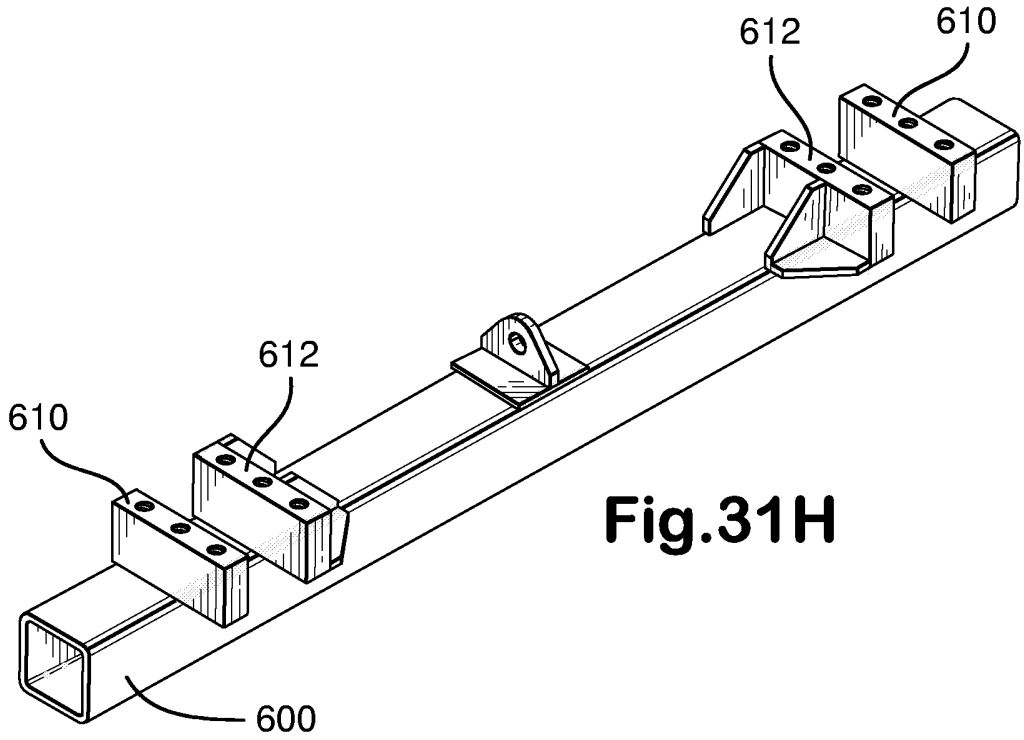


Fig.31H

Fig.32A

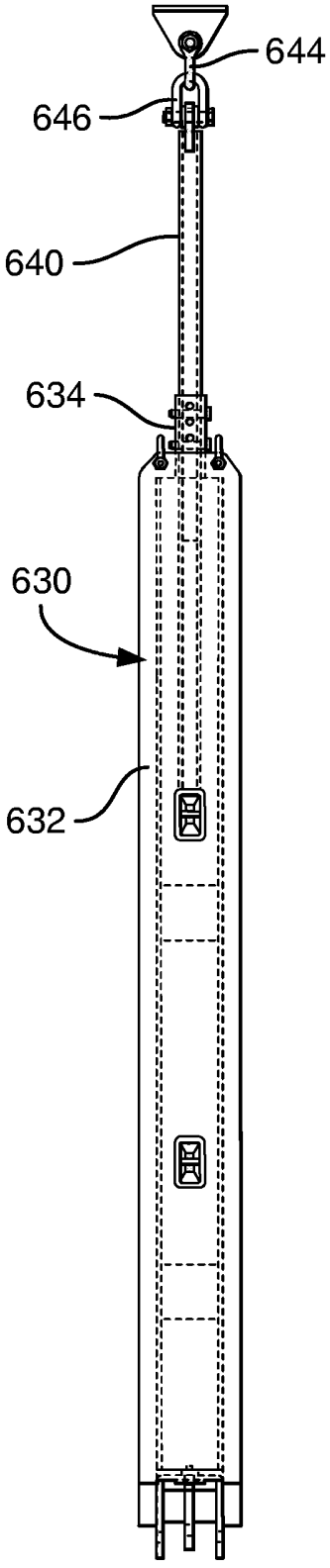


Fig.32B

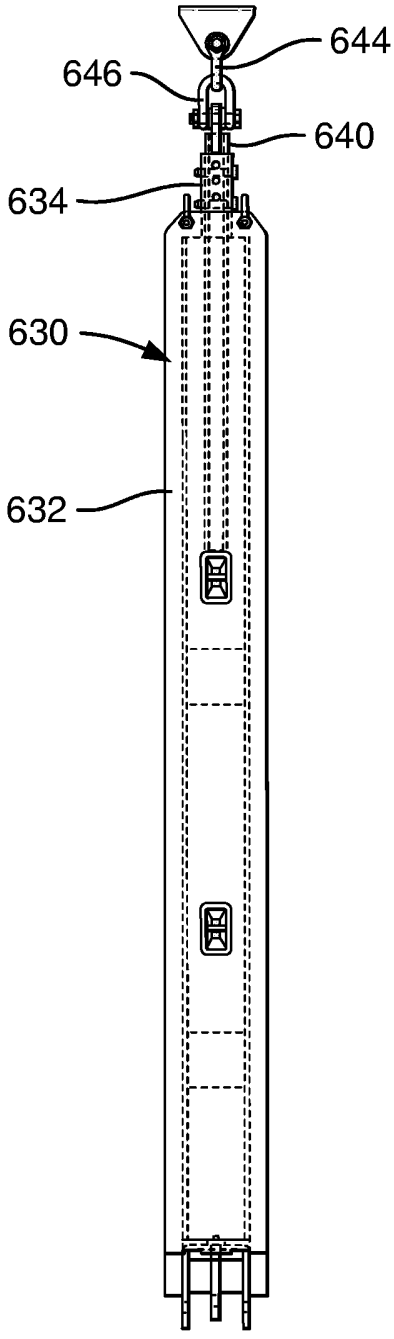


Fig.32C

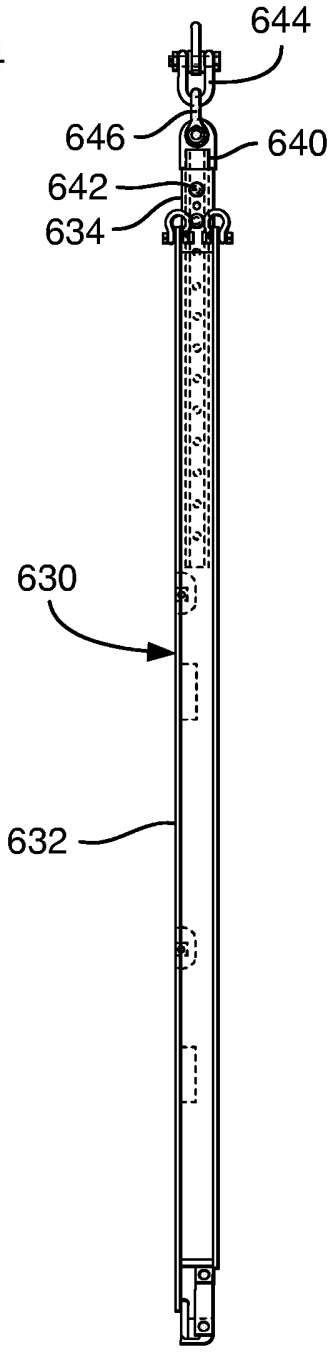


Fig.32D

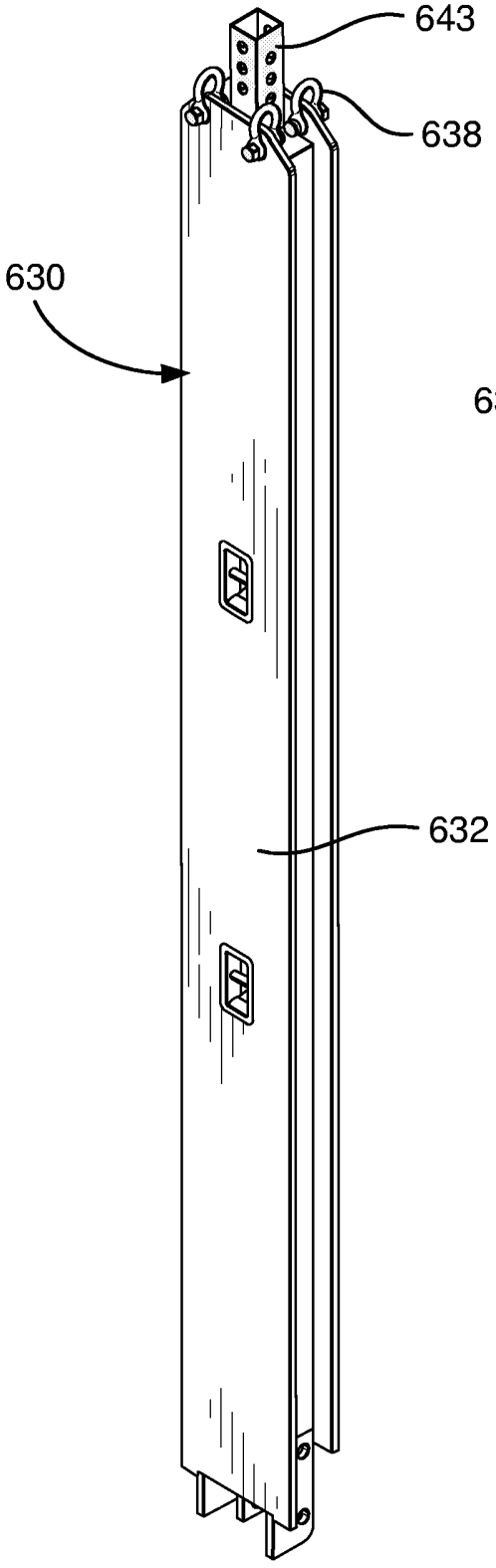


Fig.32E

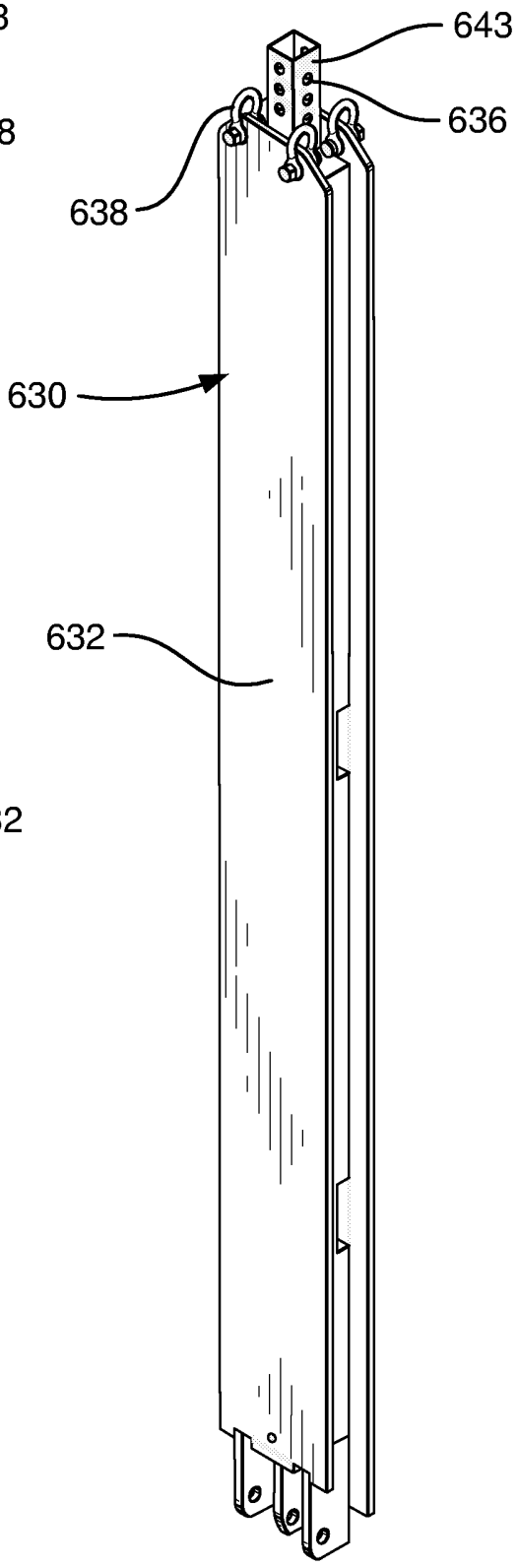


Fig.33A

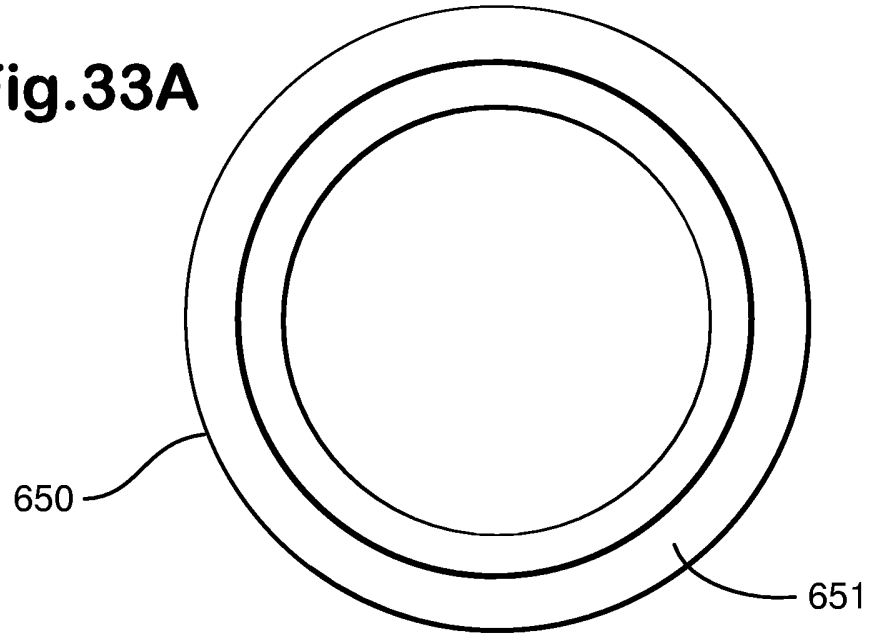


Fig.33B

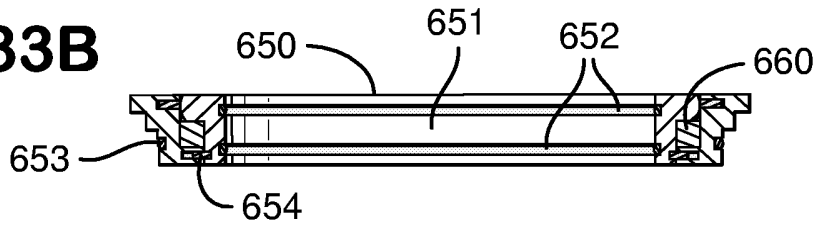


Fig.33C

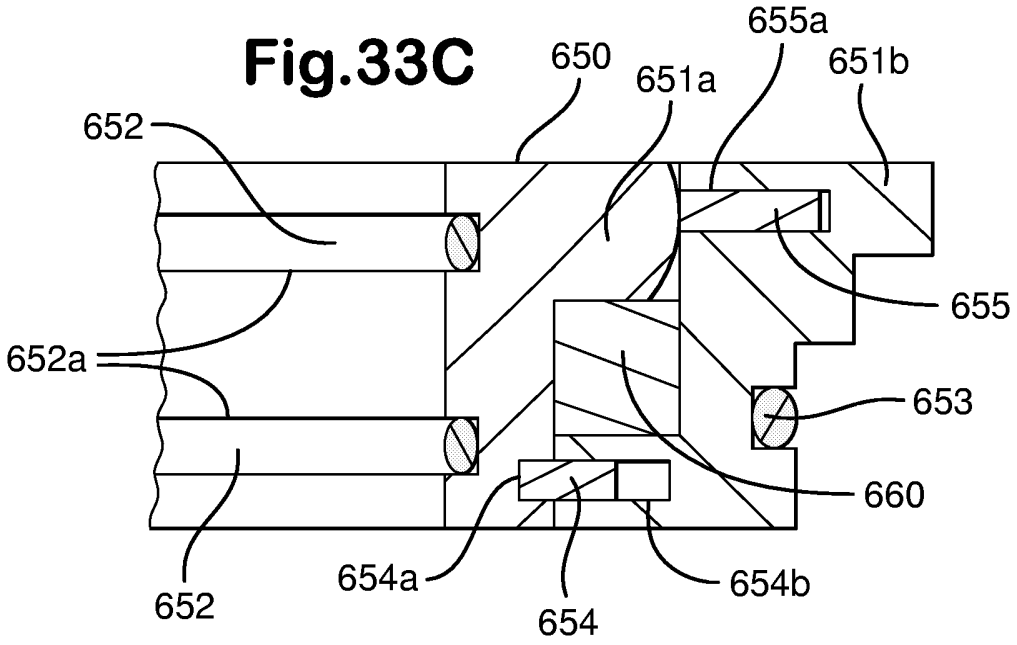


Fig.34A

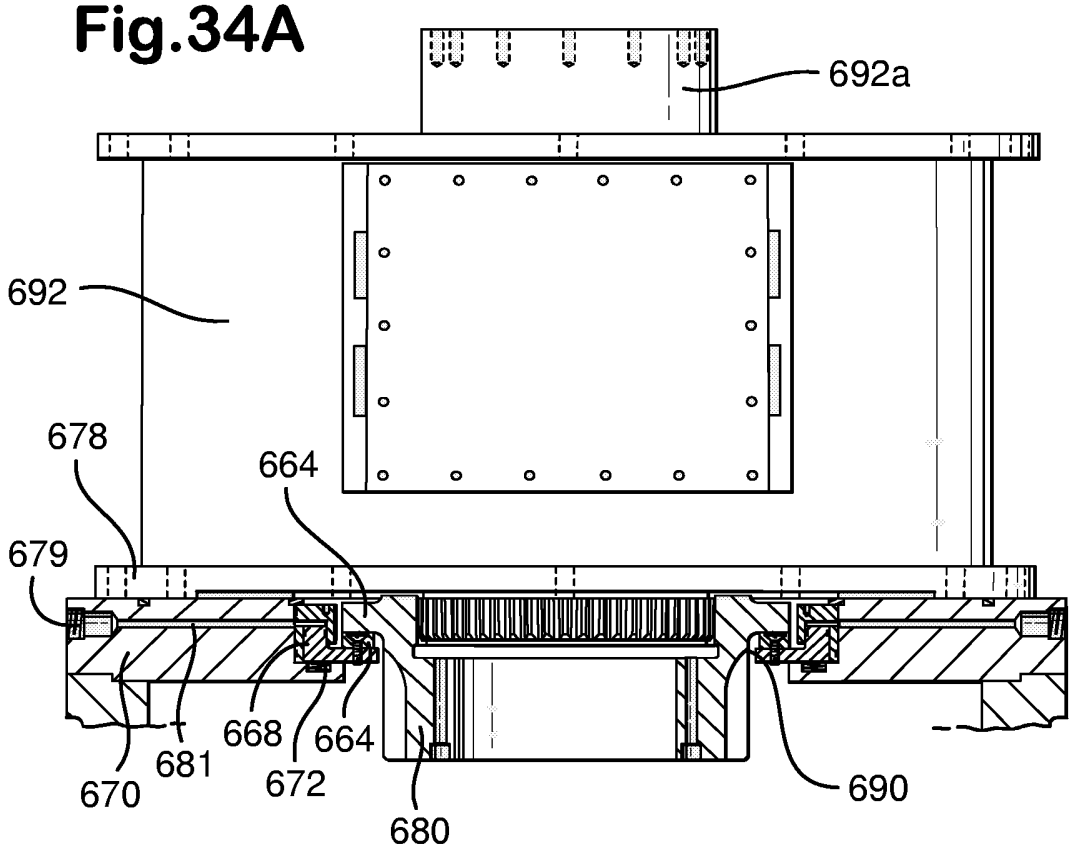


Fig.34B

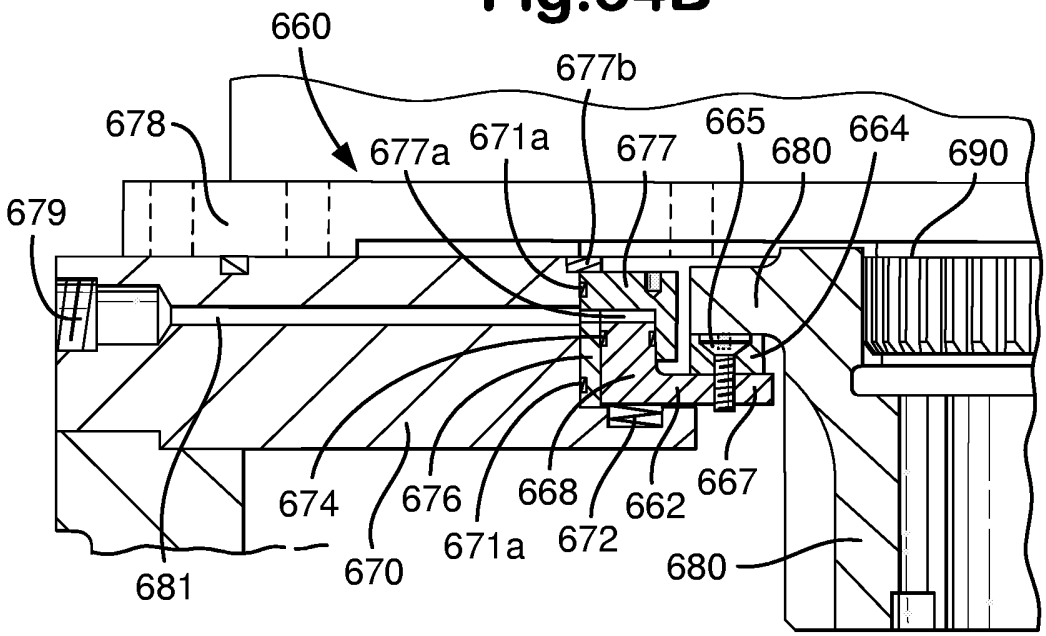


Fig.35A

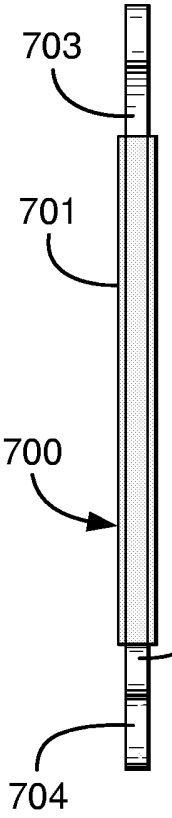


Fig.35B

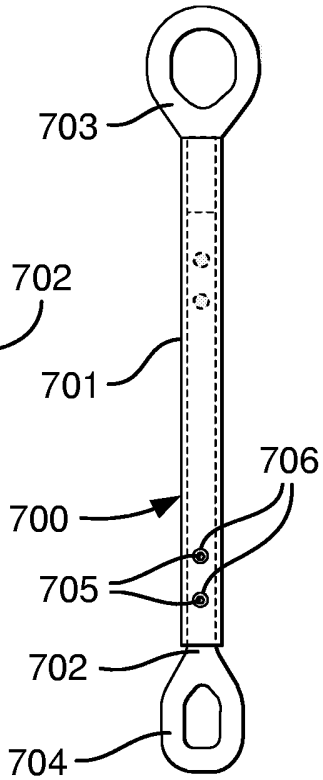


Fig.35C

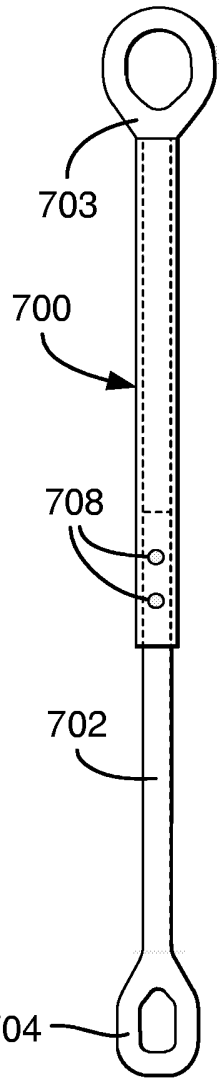


Fig.35E

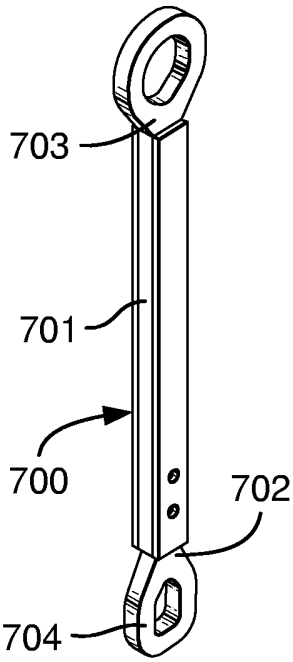


Fig.35F

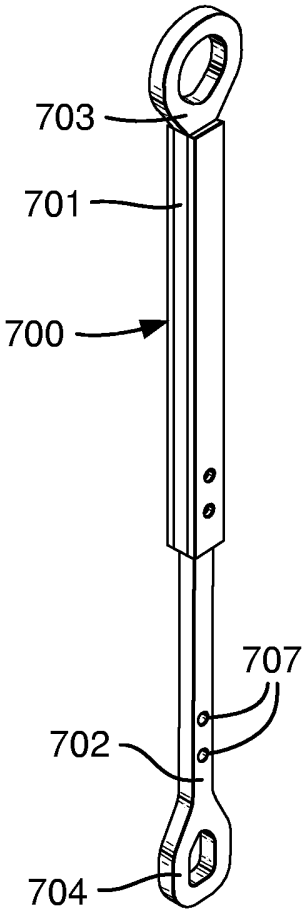


Fig.35D

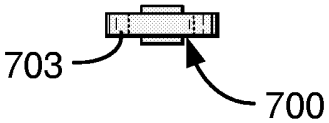


Fig.35G