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(54) **Subsea pinning machine and method for pinning together a tubular member assembly**

Unterwassermaschine und Verfahren zum Verdübeln von rohrförmigen Teilen

Machine sous-marine et procédé pour accoupler un assemblage d'éléments tubulaires

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Description

BACKGROUND

a. Field of the Invention

[0001] The present invention relates to a subsea pinning machine for removing a tubular member extending downwards into a body of water, for example from a drilling platform. The tubular member may, for example, be a conductor assembly from an offshore drilling slot. The invention also relates to a method of pinning together a tubular member assembly.

b. Related Art

[0002] Drilling platform slots are of high value to operators in the offshore oil and gas extraction industry. It can therefore be necessary at times to remove an old conductor casing assembly, including the outer conductor casing and any inner strings of casing, which would normally be cemented or grouted together, as quickly and as safely as possible. Equipment and techniques have therefore been developed to cold-cut a conductor casing assembly into segments of manageable length and to drill a hole through the multiple cemented together strings forming the assembly at the top of each section prior to lifting and laying down each segment on a suitable nearby surface. It is know n to use drill presses, mounted upon the outside of the casing, to drill and pin together the multiple strings which may, or may not, be completely cemented or grouted together. Once the hole is drilled completely through the conductor assembly, the drill press is removed and then a pin is inserted through the drilled hole. The pin is longer than the hole so that the pin projects laterally outwards on opposite sides of the conductor assembly to provide a temporary lifting device. Depending on the outer diameter of the conductor assembly and the weight to be lifted, the drilled hole may be between 1½" (38.1 mm) and 6" (152.4 mm) in diameter.

[0003] The conductor assembly is then cut near the seafloor, following which the cut assembly is lifted using the two ends of the projecting pin. Then the multiple strings forming the assembly are lifted and then cut to a convenient length such that the lifting equipment can handle the cut segment. This operation is repeated until all old casing is removed and the drilling slot is clear and available for the operator to begin his drilling program.

[0004] While this approach is effective in many circumstances, problems can arise if the integrity of a redundant well conductor is threatened by rust or other damage, for example damage to connector integrity. There has to be no possibility that the conductor assembly, which may for example extend over 100 m from just above the seabed to the platform's well deck, would fall to the seafloor during its removal from the platform slot.

[0005] Prior art document GB 140,040 discloses a machine for affixing one or more lifting plates to the side of a sunken ship. The plate is fixed by using one or more drill bits, each of which passes through a previously formed clearance hole in the plate to drill a pilot hole in the side of the ship. The drill bit is the end part of a component having a drill bit portion, which is followed by a tap bit portion and then a threaded bolt portion with a bolt head. After drilling of the hole in the side of the ship, the tap portion taps this drilled hole. Behind the tap portion is a threaded portion which passes freely through the clearance hole in the lifting plate and which engages with the tapped hole until the bolt head engages with the surface of the lifting plate surrounding the clearance hole. The bolt head then disengages with a mechanism used to turn the bolt head as the bolt head is tightened to press the plate against the ship to be raised.

[0006] Prior art document US 4,007,705 shows a clamping mechanism for clamping a tool to an underwater pipeline.

[0007] It is an object of the invention to provide a more convenient and versatile process for removing a tubular member extending downwards from a drilling platform into a body of water, for example a conductor assembly from an offshore drilling slot, and to a drilling slot recovery apparatus for use in such a process.

SUMMARY OF THE INVENTION

[0008] According to the invention, there is provided a subsea pinning machine for pinning together a tubular member assembly having an outer tubular casing and one or more internal tubular casings, comprising:

- a pair of jaws for gripping the outer tubular casing;
- a drill bit, the drill bit having at opposite ends a bit end and a base end;
- an actuator for drilling through the tubular member assembly with the bit end of the drill bit; and
- characterised in that the machine comprises a drill bit release mechanism for releasing the base end of the drill bit once the bit end has drilled through the tubular member assembly so that the released drill bit serves in use as a joining pin to pin together the tubular casings forming the assembly.

[0009] The tubular member assembly may be a conductor assembly having an outer conductor casing and one or more internal casings.

[0010] The release mechanism is preferably remotely operable.

[0011] The pair of jaws, when closed fully encircles the conductor assembly gripped within the pair of jaws.

[0012] The subsea pinning machine comprises a drill bit release mechanism that is automatically activated to release the actuator when the drill bit is turned in an opposite direction to a drilling direction.

[0013] However, in a preferred embodiment of the invention, the subsea pinning machine comprises a drill bit

release mechanism that comprises a draw bar screwed into the base end of the drill bit to connect the drill bit to said actuator and a motor for turning the draw bar to unscrew and disconnect the draw bar from the base end of the drill bit in order to release the drill bit.

[0014] The subsea pinning machine may comprise an engagement mechanism for engaging the drill bit with a bore formed by the drill bit and the actuator may have means for disengaging the actuator from the drill bit. The engagement mechanism then, in use, is automatically activated to engage the drill bit with a bore formed by the drill bit when the actuator is disengaged from the drill bit.

[0015] The subsea pinning machine may comprise a base member for turning the drill bit, and an engagement mechanism that is automatically activated to secure the drill bit when the base member is retracted from the drill bit.

[0016] In preferred embodiment of the invention, the engagement mechanism comprises one or more pins which extend radially outwards to engage with a bore formed by the drill bit. Preferably, the, or each, pin is automatically driven by a spring biasing means once the drill bit is disengaged from said actuator.

[0017] The subsea pinning machine may comprise a drill carriage. The drill bit is then supported on the carriage. A carriage motor may be provided for moving the carriage in a longitudinal direction towards and away from the assembly to be drilled. The subsea pinning machine may also comprise a drill bit motor for turning the drill bit as the carriage is advanced towards the assembly.

[0018] In preferred embodiment of the invention, there is a third motor, a disengagement motor for disengaging the drill carriage from the drill bit after drilling of the assembly.

[0019] At least one, and preferably all, of these motors may be hydraulic.

[0020] The subsea pinning machine may comprise an elongate main frame which supports at one end the pair of jaws and at the other end supports the actuator for drilling through the assembly with the drill bit.

[0021] Also according to the invention, there is provided a method of pinning together a tubular member assembly having an outer tubular casing and one or more internal tubular casings, using a subsea pinning machine comprising a pair of jaws, a drill bit, an actuator, and a release mechanism, the method comprising the steps of:

- using the pair of jaws to grip the outer tubular casing;
- using the actuator to turn the drill bit and drill through a lower end of the tubular member assembly;
- using the release mechanism to release the drill bit once this has drilled through the lower end of the tubular member assembly so that the released drill bit pins together the components forming the tubular member assembly; and
- lifting the pinned together tubular member assembly.

[0022] The tubular member assembly is preferably a conductor assembly having an outer conductor casing and one or more internal casings. Once the conductor assembly is pinned together by the released drill bit, the assembly can be severed just above the seabed, following which the conductor assembly can be lifted from near its top end and, if necessary cut into convenient lengths for further manipulation as the conductor assembly is brought to the surface.

BRIEF DESCRIPTION OF THE DRAWINGS

[0023] The invention will now be further described, by way of example only, and with reference to the accompanying drawings, in which:

Figure 1 is a perspective view of a subsea pinning machine according to a first preferred embodiment of the invention, with a pair of pair of jaws closed and a drill bit retracted and ready to start drilling on a conductor assembly held within the pair of jaws;

Figure 2 is an enlarged perspective view of the pinning machine of Figure 1 showing the bit end of the drill held within an aligning collar;

Figure 3 is a perspective of a subsea pinning machine according to a second preferred embodiment of the invention, with a pair of jaws closed for retaining a held conductor assembly and a drill bit fully extended for drilling fully through the held conductor assembly;

Figure 4 is a perspective of a subsea pinning machine according to a third preferred embodiment of the invention, showing how the pair of jaws opens for releasing a held conductor assembly and with a drill bit fully extended prior to release of the drill bit to serve as a pin to secure the conductor assembly together;

Figure 5 is a perspective view of disengagement motor and a rotational draw bar used in a release mechanism by which the drill bit is released after drilling;

Figure 6 is a perspective view showing in more detail the drill bit, a rotational base member to which the drill bit is releasably fixed, and part of an engagement mechanism for engaging the released drill bit in a drilled bore;

Figure 7 is an enlarged view of a part of Figure 6, showing part of the engagement mechanism in more detail;

Figure 8 is an end view of the drill bit and rotational base member of Figure 6;

Figure 9 is a cross-section taken along line IX-IX of

Figure 8, showing the internal components of the engagement mechanism and part of the release mechanism; and

Figure 10 is an enlarged view of a part of Figure 9, showing part of the engagement mechanism in more detail.

DETAILED DESCRIPTION

[0024] Figures 1 and 2 show a subsea pinning machine 1 according to a first preferred embodiment of the invention. The pinning machine has an elongate main body or frame 8 one end of which supports a conductor clamping mechanism 3 and the other end of which supports a drill and pinning mechanism 10. The clamping mechanism 3 has a pair of jaws 2, shown in a closed position for gripping an underwater conductor assembly 4 which for clarity is illustrated in phantom outline. The pair of jaws 2 is activated by a pair of rams 6, 6' which are attached to a pair of parallel arms 28, 28' which are extensions at one end of the main body or frame 8 of the machine. This attachment is made at a pair of side pivot mounts 9, 9'. When the pair of jaws 2, 2' is closed, this holds the conductor assembly 4 tightly between two pairs of opposed grips 12, 13 and 12', 13'. One of each pair of grips 12, 12' is removeably affixed on the main frame 8 at the base of the arms 28, 28' and the other of which 13, 13' is removeably affixed on an inside of a pivoting arm portion 14, 14' of the pair of jaws 2. Each arm portion 14, 14' is hinged to a side pivot 11, 11' which serves as a hinge mechanism at the free end of the arms 28, 28'.

[0025] The conductor assembly 4 may take many forms but in general has a cylindrical outer pipe or casing 5 which encloses one or more other pipes, or casings 7, which will usually be all be cemented or grouted together.

[0026] The drill and pinning mechanism 10 includes a drill carriage 17 that runs longitudinally on a pair of rails 21, 21' fixed on the main frame 8. The carriage has a pair of runners 38, 38' which slide along the rails and a main body 25 extending between the runners, and the carriage supports a drill bit 15 that is carried by the carriage in the longitudinal direction so that a bit end 16 is initially fully retracted ready to start drilling on the conductor assembly 4 once this is held within the pair of jaws 2. The bit end 16 of the drill bit is initially held within an aligning collar formed by a pair of laterally adjustable clamps 36, 36'. As will be explained in greater detail below, a base end 18 of the drill bit opposite to the bit end 16 is releasably connected to the main body via a mount or base member 33 in such a way that the drill bit can be released from the main body once the drill bit has been drilled through the conductor assembly 4, thereby leaving the drill bit in place and pinning the casings 5, 7 together. The drill bit 15 is therefore a combination drill bit and joining pin or load pin, referred to herein as a "drill pin".

[0027] The sliders 38, 38', main body 25 and drill bit mount 33 are part of a rotary and axial actuator mechanism 20 for turning and moving the drill pin 15, referred to for convenience hereinafter as an actuator mechanism. The actuator mechanism 20 includes three hydraulic motors, namely a carriage drive motor 60, a drill rotation motor 70 and a bit disengagement motor 80. The drill carriage 17 is advanced towards and away from the clamped casing assembly 4 by means of the carriage drive motor 60, which turns a drive screw 47 that engages with a threaded sleeve (not shown) beneath the main body 25.

[0028] The drill bit 15 is turned during drilling by the drill rotation motor 70, which acts through a gearbox 71 to turn the base member 33. The drill rotation motor comprises a motor main body 73, a hydraulic manifold 74 connected to the motor main body.

[0029] As will be explained in greater detail below, when the drill pin 15 is fully drilled through the conductor assembly 4 the bit disengagement motor 80 is activated to disengage the drill pin from the base member 33.

[0030] The main frame 8 also supports a connection manifold 30 by which the pinning machine can be remotely operated. Each motor has a pair of hydraulic couplings 72, 82 (not visible in the case of the carriage drive motor 60). For clarity, not shown in the drawings are flexible connection hoses leading to and from the manifold 30 and to and from each motor 60, 70, 80.

[0031] Figure 3 shows a subsea pinning machine 101 similar to that of the first embodiment 1. Features of Figure 3 which correspond with those of the first embodiment 1 are indicated using reference numerals incremented by 100. The second embodiment 101 differs from the first 1 mainly in that the grips 112, 112', 113, 113' are each mounted on a radially adjustable slider mechanism 22 which can be set in position to accommodate conductor assemblies having differing diameters. The main frame also has a slightly different shape, and has four lifting lugs 39, but otherwise functions in the same way. Apart from these differences, the components of the second embodiment are the same as the first embodiment, and so will not be described again in detail.

[0032] In Figure 3, for clarity the casing assembly 4 is omitted. Also omitted in Figure 3, so that other components can be more clearly viewed, is the main body 73 of the drill rotation motor 70.

[0033] In Figure 3, the carriage drive motor 60 has been activated so that the drill bit or pin 115 is fully extended so that both ends 116, 118 of the drill bit will project radially to the outer surface of the outer conductor cases, but not significantly beyond the hole drilled through the conductor assembly 4. Once the drill pin 115 has been drilled through the casings 5, 7, the drill pin is released by activating the bit disengagement motor 80, thereby pinning the casings 5, 7 together.

[0034] Figure 4 shows a subsea pinning machine according to a third preferred embodiment of the invention 201. Features of Figure 4 which correspond with those of the first embodiment 1 are indicated using reference numerals incremented by 200. The third embodiment is

similar to the first embodiment but has a more robust hinge mechanism 211, 211' where the arms 214, 214' join the main body 208. Apart from these differences, the components of the second embodiment are the same as the first embodiment, and so will not be described again in detail.

[0035] In Figure 4, for clarity the casing assembly 4 is omitted. Also omitted in Figure 3, so that other components can be more clearly viewed, is the hydraulic manifold 74 of the drill rotation motor 70.

[0036] Here, the pair of jaws 202 is open for releasing the conductor assembly 4. The drill bit 215 is fully extended prior to release of the drill bit to serve as a pin to secure together all the components pierced by the pin.

[0037] Unlike conventional drilling and pinning operations, in which the conductor and internal casings are first drilled, the bit then being withdrawn prior to insertion of a separate pin through the series of holes in the pipe walls, the invention leaves the drill bit in place to serve also as a pin. This simplifies the process, particularly when carried out underwater and by remote control.

[0038] Figures 5 to 10 show in more detail various components that together form a release mechanism 40 by which the drill pin 15 of the first embodiment 1 is released. The other embodiments 101, 201 work in exactly the same way as regards the release of the drill pins 115, 215 and so will not be separately described.

[0039] Figure 5 shows how the bit disengagement motor 80 is connected to a shaft 51 that is fixed to the carriage main body 25. The shaft contains a drive mechanism (not shown) by which the disengagement motor 80 turns a draw bar 23 which extends along a central axis of the rotary and axial actuator mechanism 20 from the disengagement motor, through the base member to the drill pin 15. Relative rotation of the disengagement motor 80 with respect to the carriage main body 25 is prevented by an anti-rotation bar 52 a first end 53 of which slots into a groove 54 in an annular flange 55 on the shaft 51. When the conductor assembly is being drilled, the draw bar, which is fixed to the drill pin 15, turns freely, but when the hydraulic disengagement motor 80 is engaged to turn the draw bar in one direction to disengage the draw bar from the drill pin, the annular flange 55 reacts against the anti-rotation bar 52 in order to rotate the draw bar 23. The anti-rotation bar is held in place at a second end 56 where it is fixedly connected to an annular clamp 57 fixed, for convenience, to the motor main body 73 of the drill rotation motor 70. The slot arrangement permits some relative longitudinal travel between the disengagement motor 80 and the drill carriage 17 during this disengagement of the drill pin 15.

[0040] As shown most clearly in Figures 8 to 10, the drill pin 15 is held onto the drilling machine 10 by the mount or base member 33 that supports and drives the turning action of the drill pin. The subsea pinning machine 1 comprises an engagement mechanism for engaging or securing the drill pin 15 in place inside the drilled conductor assembly 4 when the drill pin is to be released from the base member 33. This engaging mechanism includes a cam spindle mechanism 50 that is used to automatically push outwards four spring loaded radially extending and substantially cylindrical dogs 24, so that the dogs dig into and secure the drill pin to the drilled conductor assembly 4.

[0041] During drilling, each of the dogs 24 is held in place within the outer diameter of the drill pin 15 by a compression spring 27 which acts to push the dogs against an internal cam surface 26. The dogs 24 are spaced equidistantly around the circumference of the drill pin 15. The dogs 24 and springs 27 are located in clearance holes 28 in the back end of the drill pin. The cam spindle mechanism 50 includes a main body 34 which is pushed inwards inside a cylindrical recess 35 inside a base end face 29 of the drill bit 15 by the base member 33 that supports and drives the turning action of the drill bit. The main body 34 of the cam spindle mechanism 50 has two cylindrical portions 44, 46 of different diameters but sharing a common axis parallel and radially offset from a drilling axis of the drill pin. The larger diameter cylindrical portion 44 is further from the base member and the smaller diameter cylindrical portion 46 is closer to the base member 33. The main body of the cam spindle mechanism 50 has a conical section which forms the cam surface 26 and which is between the two cylindrical portions 44, 46 where the diameter of the main body tapers. When the cam spindle is pushed forwards by the base member 33 the cam surface 26 allows the dogs 24 to retract fully within the outer circumference of the drill bit 15. The cylindrical recess 35 holds a spring 37 which bears against an end 48 of the larger diameter cylindrical portion 44 and which therefore biases the main body 34 towards the drill bit base end face 29 so that when the base member 33 is retracted from the drill bit at the end of drilling, the cam surface 26 rides up against a similarly angled conical surface 41 of the corresponding dog 24, causing the dog to move outwards so that an outer conical end 43 of the dog projects beyond the bounds of the drill bit outer circumference. The outer conical end 43 of the dog has a pointed end 45 and this pointed end 45 then digs into the inside surface of the bore through the conductor assembly thereby locking the drill bit in place.

[0042] As shown in Figure 11, the drill pin 15 is rotated by a drive pin 31 located in a cross cut groove 32 at the back end 18 of the drill pin. This arrangement acts as a drive key when the base member 33 is pushed forward and turned in the drilling direction. The base member 33 also provides spacing from a drive motor.

[0043] The combined drill bit and pin 15 uses 4" (101.6 mm) diameter, high-tensile-strength steel designed to withstand 100 tonnes of force. The cutting angle on an end face 19 of the bit 15 is lower than normal, as, when acting as the pin, its end faces 19, 29 need to be as flush as possible to the outside wall of the conductor assembly 4.

[0044] During drilling the drill pin 15 is held on to the cross cut groove 32 at the back end 18 of the drill pin by

a threaded end 59 of the draw bar 23 which is screwed into a threaded bore 58 in the end face 29 at the back end 18 of the drill pin 15.

[0045] The preferred embodiments therefore provide a way for the drill pin 15 to be easily detached from the machine's drill carriage 17 once the bit end 16 has penetrated the tubular members forming the conductor assembly 4. As shown in Figures 5 and 9, the preferred embodiments of the invention use the motorised, threaded draw bar 23, 59 that passes through the body 25 of the carriage 17, through an axial channel 89 in the base member 33 and which screws into the threaded bore 58 inside the drill pin 15. Activating the disengagement motor 80 unscrews and retracts draw bar 23 so that the drilling carriage 17 can then be retracted by the carriage drive motor 60 to leave the drill pin 15 in place. Screwing the carriage 17 back from the drill pin 15 then causes the sprung gripper pins 24 set in the side of the drill pin to emerge and engage with the bore drilled inside the conductor assembly outer wall and lock the drill pin in place. The threaded draw bar 23 is then fully unscrewed from the threaded bore 27 at the back end 18 of the drill bit 15, thereby disconnecting the drill pin 15 from the machine 1. Following this, the carriage is fully retracted.

[0046] After drilling through the casings the cam 26 is automatically engaged outwards. The radially extending dogs 24 then move radially outwards due to the biasing springs 27 and the rest of the machine 1 is unclamped and removed fully from the casings 4 leaving the load bearing drill pin 15 in place.

[0047] Once the drill pin 15 is in place and separated from the remainder of the machine 1, various cutting techniques, which are well-known to those skilled in the art and which will therefore not be described in detail, may be used to sever the conductor assembly 4 near the seafloor.

[0048] The cut and pinned conductor assembly 4 can then be lifted in the normal way from above, for example using lifting equipment at the drilling platform. The embodiment therefore makes use of normal lifting practice at the top of the conductor assembly which helps to ensure a safe and reliable process while the conductor outer and inner casings are lifted together. By drilling and pinning them at the bottom, the internal casings effectively bear the weight of the outer conductor casing.

[0049] The machine of the invention is convenient and efficient to use, taking about eight hours to position, drill and pin together a conductor assembly. Thereafter, removing the conductor and its casings is routine, even when the structural integrity of the conductor assembly is in doubt, as there was no chance that any part of the conductor assembly would fail and drop to the seafloor.

[0050] The invention is therefore of interest to many operators involved in well decommissioning or slot recovery when questions exist over the integrity of aged conductors.

[0051] The machine of the invention makes use of a combined drill bit and pin, which minimises subsea manipulation. At the same time, the inventive machine allows the conductor assembly to be pinned together from below, i.e. from the vicinity of the seabed, which provides the maximum support to the to assembly ensuring that this stays intact, even when weakened by rust or when casing connectors have been damaged or not securely cemented or grouted together.

[0052] Therefore, a key advantage of the invention is that the weight of the conductor casing is fully supported while being lifted out of the water, by virtue of being pinned to the internal casing or casings.

[0053] The invention therefore provides a convenient and versatile process of pinning together a tubular member assembly extending downwards from a drilling platform into a body of water, for example a conductor assembly from an offshore drilling platform slot, and to a subsea pinning machine for use in such a process.

Claims

1. A subsea pinning machine (1) for pinning together a tubular member assembly (4) having an outer tubular casing (5) and one or more internal tubular casings (7), comprising:

   - a pair of jaws (2) for gripping the outer tubular casing (5);
   - a drill bit (15), the drill bit having at opposite ends a bit end (16) and a base end (18); and
   - an actuator (20) for drilling through the tubular member assembly (4) with the bit end (16) of the drill bit; wherein

   the machine comprises a drill bit release mechanism (40) for releasing the base end (18) of the drill bit once the bit end (16) has drilled through the tubular member assembly (4) so that the released drill bit (15) serves in use as a joining pin to pin together the tubular casings (5, 7) forming the assembly.

2. A subsea pinning machine (1) as claimed in Claim 1, in which the release mechanism (40) is remotely operable.

3. A subsea pinning machine (1) as claimed in Claim 1 or Claim 2, in which the pair of jaws (2), when closed fully encircles the tubular member assembly (4) gripped within the pair of jaws.

4. A subsea pinning machine (1) as claimed in any preceding claim, in which the drill bit release mechanism (40) is automatically activated to release the base end (18) of the drill bit when the actuator (20) is turned in an opposite direction to a drilling direction.

5. A subsea pinning machine (1) as claimed in any of Claims 1 to 3, in which the drill bit release mechanism

(40) comprises a draw bar (23) screwed into the base end (18) of the drill bit to connect the drill bit to said actuator (20) and a motor (80) for turning the draw bar to unscrew and disconnect the draw bar (23) from the base end (18) of the drill bit in order to release the drill bit (15).

6. A subsea pinning machine (1) as claimed in any preceding claim, comprising an engagement mechanism (24, 50) for engaging the drill bit (15) with a bore formed by the drill bit, the actuator (20) having means (23, 80) for disengaging the actuator from the drill bit, and the engagement mechanism, in use, being automatically activated to engage the drill bit with a bore formed by the drill bit (50) when the actuator (20) is disengaged from the drill bit (15).

7. A subsea pinning machine (1) as claimed in Claim 6, comprising a base member (33) for turning the drill bit (15), the engagement mechanism (24, 50) being automatically activated to secure the drill bit when the base member is retracted from the drill bit (15).

8. A subsea pinning machine (1) as claimed in Claim 6 or Claim 7, in which the engagement mechanism (24, 50) comprises one or more pins (24) which extend radially outwards to engage with a bore formed by the drill bit (15).

9. A subsea pinning machine (1) as claimed in Claim 8, in which the or each pin (24) is automatically driven by a spring biasing means (37, 44) once the drill bit (15) is disengaged from said actuator (20).

10. A subsea pinning machine (1) as claimed in any preceding claim, comprising:

- a drill carriage (17), said drill bit (15) being supported on said carriage;
- a carriage motor (60) for moving the carriage in a longitudinal direction towards and away from the tubular member assembly (4) to be drilled; and
- a drill bit motor (70) for turning the drill bit (15) as the carriage is advanced towards the tubular member assembly (4).

11. A subsea pinning machine (1) as claimed in Claim 10, comprising a third, disengagement motor (80) for disengaging the drill carriage (17) from the drill bit (15) after drilling of the tubular member assembly (4).

12. A subsea pinning machine (1) as claimed in Claim 10 or Claim 11, in which at least one of said motors (60, 70, 80) is a hydraulic motor.

13. A subsea pinning machine (1) as claimed in any preceding claim, comprising an elongate main frame (8), in which said main frame supports at one end said pair of jaws (2) and at the other end supports said actuator (20) for drilling through the tubular member assembly (4) with the drill bit (15).

14. A method of pinning together a tubular member assembly (4) having an outer tubular casing (5) and one or more internal tubular casings (7), using a subsea pinning machine (1) comprising a pair of jaws (2), a drill bit (15), an actuator (20), and a release mechanism (40), the method comprising the steps of:

- using the pair of jaws (2) to grip the outer tubular casing (5);
- using the actuator (20) to turn the drill bit (15) and drill through a lower end of the tubular member assembly (4);
- using the release mechanism (40) to release the drill bit (15) once this has drilled through the lower end of the tubular member assembly (4) so that the released drill bit pins together the components (5, 7) forming the tubular member assembly; and
- lifting the pinned together tubular member assembly (4).

15. A method as claimed in Claim 14, in which the tubular member assembly (4) is a conductor assembly having an outer conductor casing (5) and one or more internal casings (7).

Patentansprüche

1. Unterwasserverbindungsmaschine (1) zum Verbinden einer Anordnung (4) rohrförmiger Teile, diese aufweisend einen äußeren Rohrmantel (5) und einen oder mehrere innere rohrförmige Rohrmäntel (7), umfassend:

- ein Klauenpaar (2) zum Greifen des rohrförmigen Außengehäuses (5);
- einen Bohrer (15), wobei der Bohrer an gegenüberliegenden Enden ein Bohrende (16) und ein Lagerende (18) aufweist; und
- einen Aktuator (20) zum Bohren durch die Anordnung (4) rohrförmiger Teile mit dem Bohrende (16) des Bohrers; wobei

die Maschine einen Bohrerlösemechanismus (40) umfasst, um das Lagerende (18) des Bohrers zu lösen, sobald das Bohrende (16) durch die Anordnung (4) rohrförmiger Teile gebohrt hat, so dass der gelöste Bohrer (15) bei seiner Verwendung als Verbindungsstift zum Verbinden der die Anordnung bilden-

den Rohrmäntel (5, 7) dient.

2. Unterwasserverbindungsmaschine (1) nach Anspruch 1,
bei der der Lösemechanismus (40) fernsteuerbar ist.

3. Unterwasserverbindungsmaschine (1) nach Anspruch 1 oder Anspruch 2,
bei der das Klauenpaar (2) im geschlossenen Zustand die Anordnung (4) rohrförmiger Teile, die innerhalb des Klauenpaares gegriffen sind, vollständig umschließt.

4. Unterwasserverbindungsmaschine (1) nach einer der vorigen Ansprüche,
bei der der Bohrerlösemechanismus (40) automatisch aktiviert wird, um das Lagerende (18) des Bohrers zu lösen, wenn der Aktuator (20) in eine zur Bohrrichtung entgegen gesetzte Richtung gedreht wird.

5. Unterwasserverbindungsmaschine (1) nach einem der Ansprüche 1 bis 3,
bei der der Bohrerlösemechanismus (40) eine in das Lagerende (18) des Bohrers eingeschraubte Zugstange (23) zum Verbinden des Bohrers mit dem Aktuator (20) sowie einen Motor (80) zum Drehen der Zugstange umfasst, um die Zugstange vom Lagerende (18) des Bohrers abzuschrauben und die Verbindung aufzuheben, um den Bohrer (15) zu lösen.

6. Unterwasserverbindungsmaschine (1) nach einem der vorigen Ansprüche,
umfassend einen Eingriffsmechanismus (24, 50), um den Bohrer (15) mit einer durch den Bohrer gebildeten Bohrung in Eingriff zu bringen, wobei der Aktuator (20) Mittel (23, 80) zum Lösen des Aktuators vom Bohrer aufweist, und wobei der Eingriffsmechanismus bei seinem Gebrauch automatisch aktiviert wird, um den Eingriff des Bohrers mit einer durch den Bohrer (15) gebildeten Bohrung zu bewirken, wenn der Aktuator (20) aus dem Eingriff mit dem Bohrer (15) gelöst wird.

7. Unterwasserverbindungsmaschine (1) nach Anspruch 6, umfassend ein Lagerelement (33) zum Drehen des Bohrers (15), wobei der Eingriffsmechanismus (24, 50) automatisch aktiviert wird, um den Bohrer zu sichern, wenn das Lagerelement vom Bohrer (15) zurückgezogen wird.

8. Unterwasserverbindungsmaschine (1) nach Anspruch 6 oder Anspruch 7,
bei der der Eingriffsmechanismus (24, 50) einen oder mehrere Stift(e) (24) umfasst, welche sich radial nach außen erstrecken, um in eine durch den Bohrer (15) gebildete Bohrung einzugreifen.

9. Unterwasserverbindungsmaschine (1) nach Anspruch 8,
bei der jeder Stift (24) automatisch von einem Federvorspannmittel (37, 44) angetrieben wird, sobald der Bohrer (15) von dem Aktuator (20) gelöst wird.

10. Unterwasserverbindungsmaschine (1) nach einem der vorigen Ansprüche, umfassend:

- einen Bohrschlitten (17), wobei der Bohrer (15) auf dem Bohrschlitten gelagert ist;
- einen Schlittenmotor (60) zum Bewegen des Schlittens in einer Längsrichtung auf die zu bohrende Anordnung (4) rohrförmiger Teile zu und von dieser weg; und
- einen Bohrermotor (70) zum Drehen des Bohrers (15) während der Schlitten in Richtung der Anordnung (4) rohrförmiger Teile vorgeschoben wird.

11. Unterwasserverbindungsmaschine (1) nach Anspruch 10, umfassend einen dritten, zum Lösen gedachten, Motor (80) zum Lösen des Bohrschlittens (17) vom Bohrer (15) nach dem Bohren der Anordnung (4) rohrförmiger Teile.

12. Unterwasserverbindungsmaschine (1) nach Anspruch 10 oder Anspruch 11,
bei der wenigstens einer der Motoren (60, 70, 80) ein hydraulischer Motor ist.

13. Unterwasserverbindungsmaschine (1) nach einem der vorigen Ansprüche,
umfassend einen länglichen Hauptrahmen (8), wobei der Hauptrahmen an einem Ende das Klauenpaar (2) hält und an dem anderen Ende den Aktuator (20) hält, um mit dem Bohrer (15) durch die Anordnung (4) aus rohrförmigen Teilen zu bohren.

14. Verfahren zum Verbinden von einer Anordnung (4) rohrförmiger Teile, welche einen äußeren Rohrmantel (5) und einen oder mehrere innere Rohrmäntel (7) aufweist, wobei eine Unterwasserverbindungsmaschine (1) verwendet wird, welche ein Klauenpaar (2), einen Bohrer (15), einen Aktuator (20) und einen Lösemechanismus (40) umfasst, wobei das Verfahren folgende Schritte umfasst:

- Verwenden des Klauenpaares (2), um den äußeren Rohrmantel (5) zu greifen;
- Verwenden des Aktuators (20), um den Bohrer (15) zu drehen und durch ein unteres Ende der Anordnung (4) rohrförmiger Teile zu bohren;
- Verwenden des Lösemechanismus (40), um den Bohrer (15) zu lösen, sobald dieser durch das untere Ende der Anordnung (4) rohrförmiger Teile gebohrt hat, so dass der gelöste Bohrer die die Anordnung rohrförmiger Teile bildenden

Komponenten (5, 7) verbindet; und
- Anheben der verbundenen Anordnung (4) rohrförmiger Teile.

15. Verfahren nach Anspruch 14,
bei dem die Anordnung (4) rohrförmiger Teile eine Leiteranordnung ist, welche einen äußeren Leitermantel (5) und einen oder mehrere innere Leitermäntel (7) aufweist.

Revendications

1. Machine sous-marine de fixation par goupille (1) pour goupiller ensemble un ensemble d'éléments tubulaires (4) comportant un cuvelage tubulaire extérieur (5) et un ou plusieurs cuvelages tubulaires internes (7), comprenant:

- une paire de mâchoires (2) pour saisir le cuvelage tubulaire extérieur (5) ;
- un foret (15), le foret comportant, à des extrémités opposées, une extrémité foret (16) et une extrémité base (18) ; et
- un actionneur (20) pour forer à travers l'ensemble d'éléments tubulaires (4) avec l'extrémité foret (16) du foret; et

dans laquelle la machine comprend un mécanisme de libération de foret (40) pour libérer l'extrémité base (18) du foret une fois que l'extrémité foret (16) a foré à travers l'ensemble d'éléments tubulaires (4) pour que le foret libéré (15) serve, durant l'utilisation, de goupille de jonction pour goupiller ensemble les cuvelages tubulaires (5, 7) formant l'ensemble.

2. Machine sous-marine de fixation par goupille (1) selon la revendication 1, dans laquelle le mécanisme de libération (40) est actionnable à distance.

3. Machine sous-marine de fixation par goupille (1) selon la revendication 1 ou la revendication 2, dans laquelle la paire de mâchoires (2), lorsqu'elle est complètement fermée, encercle l'ensemble d'éléments tubulaires (4) saisi à l'intérieur de la paire de mâchoires.

4. Machine sous-marine de fixation par goupille (1) selon une quelconque revendication précédente, dans laquelle le mécanisme de libération de foret (40) est automatiquement activé pour libérer l'extrémité base (18) du foret lorsque l'actionneur (20) est tourné dans un sens opposé à un sens de forage.

5. Machine sous-marine de fixation par goupille (1) selon une quelconque des revendications 1 à 3, dans laquelle le mécanisme de libération de foret (40) comprend une barre de tirage (23) vissée dans l'extrémité base (18) du foret pour raccorder le foret audit actionner (20) et un moteur (80) pour faire tourner la barre de tirage pour dévisser et séparer la barre de tirage (23) de l'extrémité base (18) du foret afin de libérer le foret (15).

6. Machine sous-marine de fixation par goupille (1) selon une quelconque revendication précédente, comprenant un mécanisme de mise en prise (24, 50) pour mettre le foret (15) en prise avec un alésage formé par le foret, l'actionneur (20) comportant un moyen (23, 80) pour séparer l'actionneur du foret, et le mécanisme de mise en prise, durant l'utilisation, étant automatiquement activé pour mettre le foret en prise avec un alésage formé par le foret (50) lorsque l'actionneur (20) est séparé du foret (15).

7. Machine saus-marine de fixation par goupille (1) selon la revendication 6, comprenant un élément de base (33) pour faire tourner le foret (15), le mécanisme de mise en prise (24, 50) étant automatiquement activé pour fixer le foret lorsque l'élément de base est rétracté du foret (15).

8. Machine sous-marine de fixation par gouille (1) selon la revendication 6 ou la revendication 7, dans laquelle le mécanisme de mise en prise (24, 50) comprend une ou plusieurs goupilles (24) qui s'étendent radialement vers l'extérieur pour entrer en prise avec un alésage formé par le foret (15).

9. Machine sous-marine de fixation par goupille (1) selon la revendication 8, dans laquelle la ou chaque goupille (24) est entraînée automatiquement par un moyen de sollicitation à ressort (37, 44) une fois que le foret (15) est séparé dudit actionneur (20).

10. Machine sous-marine de fixation par goupille (1) selon une quelconque revendication précédente, comprenant:

- un chariot de forage (17), ledit foret (15) étant supporté sur ledit chariot;
- un moteur de chariot (60) pour déplacer le chariot dans un sens longitudinal pour le rapprocher et l'éloigner de l'ensemble d'éléments tubulaires (4) destiné à être foré ; et
- un moteur de foret (70) pour faire tourner le foret (15) lorsque le chariot est avancé vers l'ensemble d'éléments tubulaires (4).

11. Machine sous-marine de fixation par goupille (1) selon la revendication 10, comprenant un troisième moteur de séparation (80) pour séparer le chariot de forage (17) du foret (15) après le forage de l'ensemble d'éléments tubulaires (4).

12. Machine sous-marine de fixation par goupille (1) se-

lon la revendication 10 ou la revendication 11, dans laquelle au moins un desdits moteurs (60, 70, 80) est un moteur hydraulique.

13. Machine sous-marine de fixation par goupille (1) selon une quelconque revendication précédente, comprenant un cadre principal allongé (8), dans laquelle ledit cadre principal supporte, à une extrémité, ladite paire de mâchoires (2) et, à l'autre extrémité, supporte ledit actionneur (20) pour forer à travers l'ensemble d'éléments tubulaires (4) avec le foret (15).

14. Procédé pour fixer ensemble par goupille un ensemble d'éléments tubulaires (4) comportant un cuvelages tubulaire extérieur (5) et un ou plusieurs cuvelages tabulaires internes (7), en utilisant une machine de fixation par goupille (1) comprenant une paire de mâchoires (2), un foret (15), un actionneur (20), et un mécanisme de libération (40), le procécé comprenant les étapes de :

- l'utilisation de la paire de mâchoires (2) pour saisir le cuvelage tubulaire extérieur (5) :
- l'utilisation de l'actiotineur (20) pour faire tourner le foret (15) et forer à travers une extrémité inférieure de l'ensemble d'éléments tubulaires (4) ;
- l'utilisation du mécanisme de libération (40) pour libérer le foret (15) une fois que celui-ci a foré à travers l'extrémité inférieure de l'ensemble d'éléments tubulaires (4) pour que le foret libéré goupille les composants (5, 7) ensemble, formant l'ensemble d'éléments tubulaire ; et
- le levage de l'ensemble d'éléments tubulaires (4) fixé ensemble par goupille.

15. Procède selon la revendication 14, dans lequel l'ensemble d'éléments tubulaires (4) est une ensemble conducteur comportant un cuvelage conducteur extérieur (5) et un ou plusieurs cuvelages internes (7).

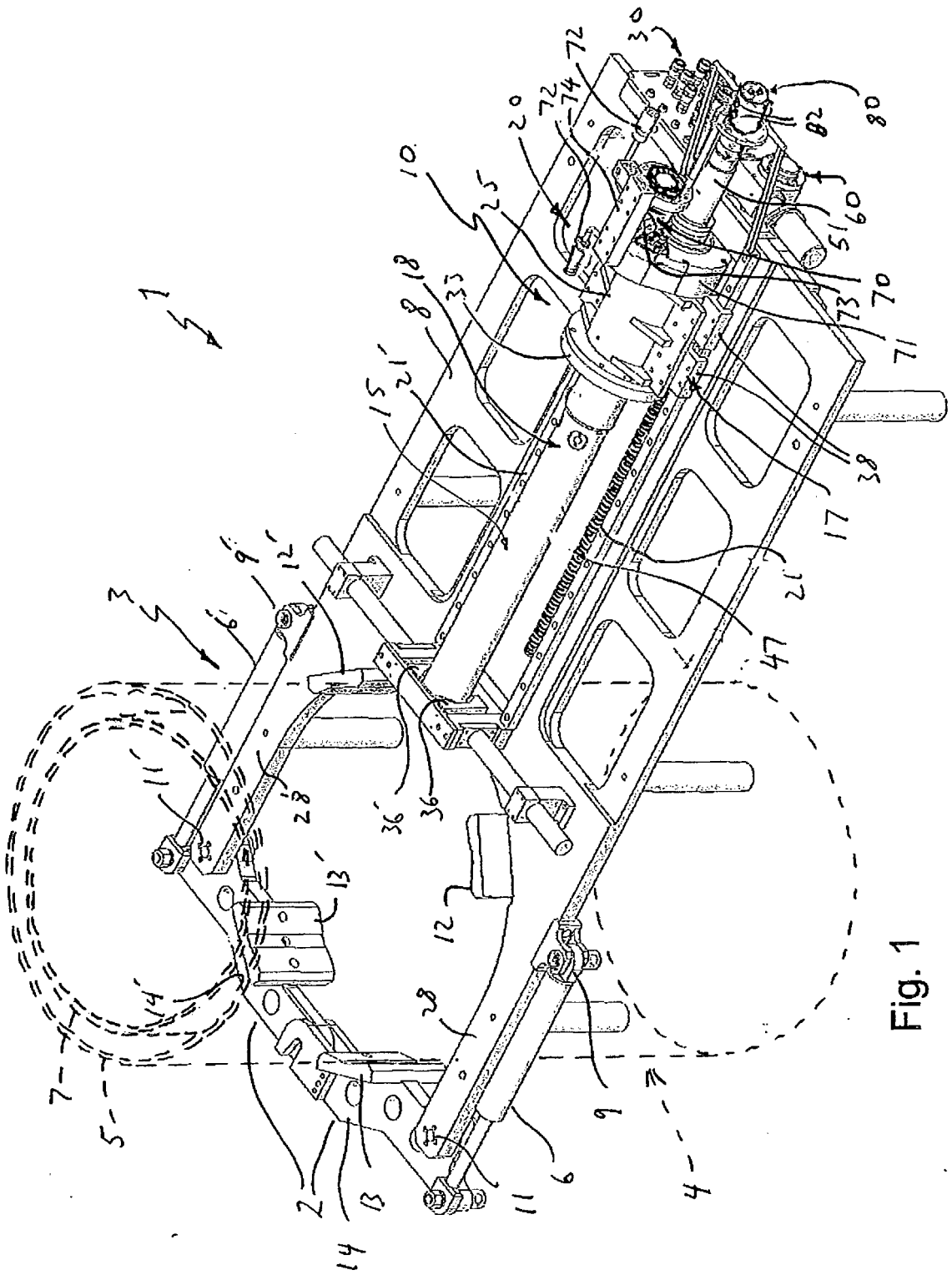
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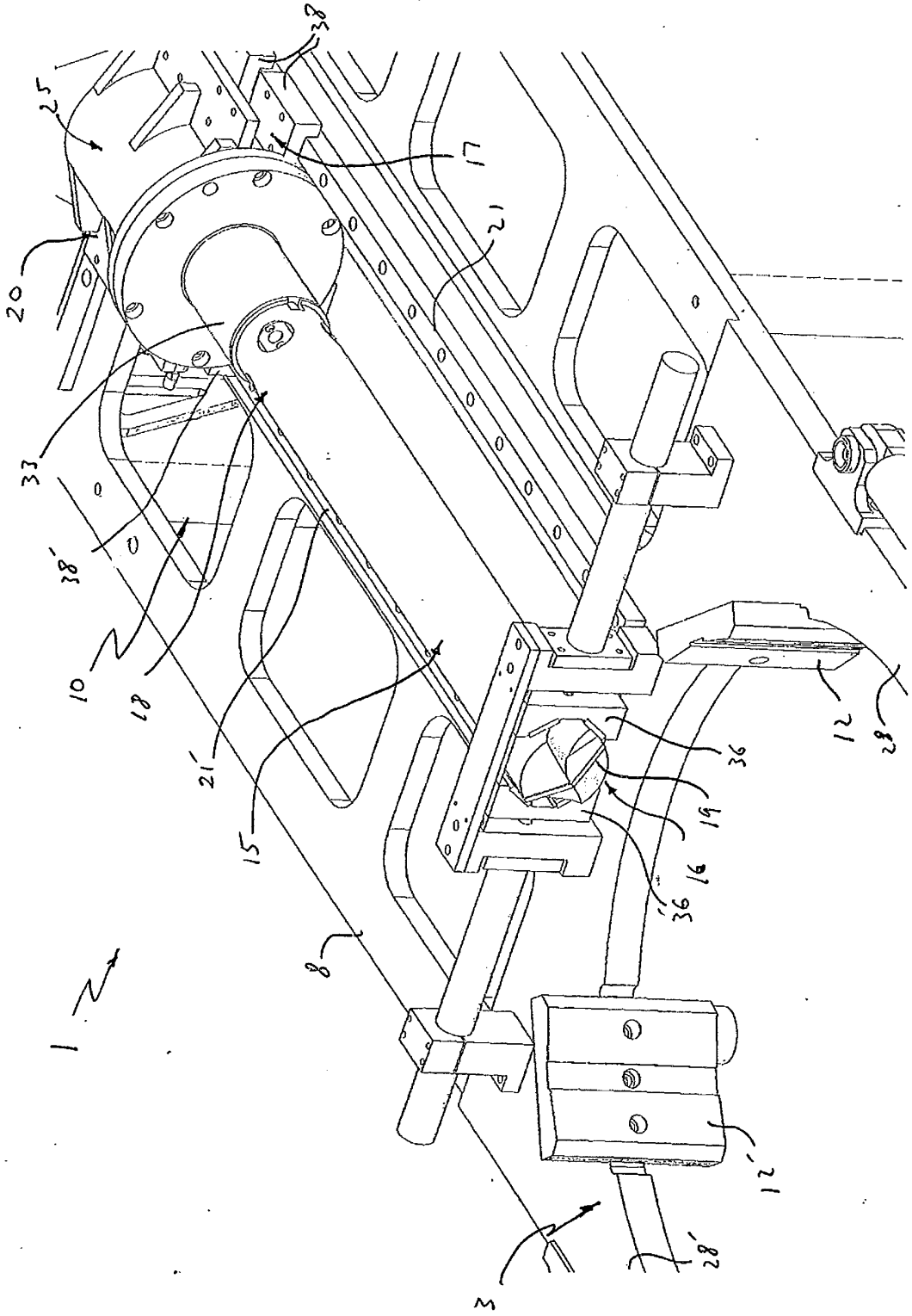
Fig. 1



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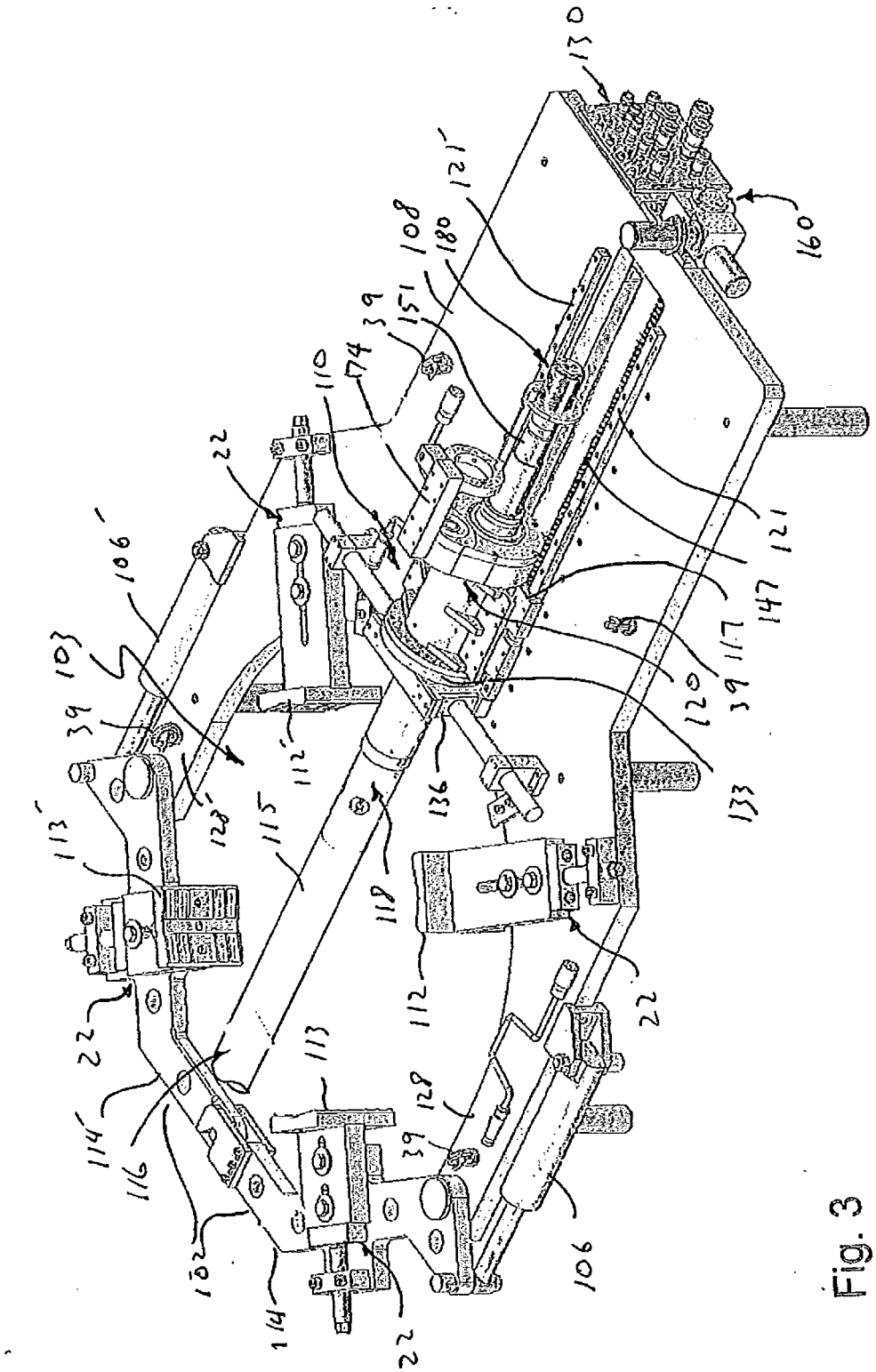
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Fig. 3

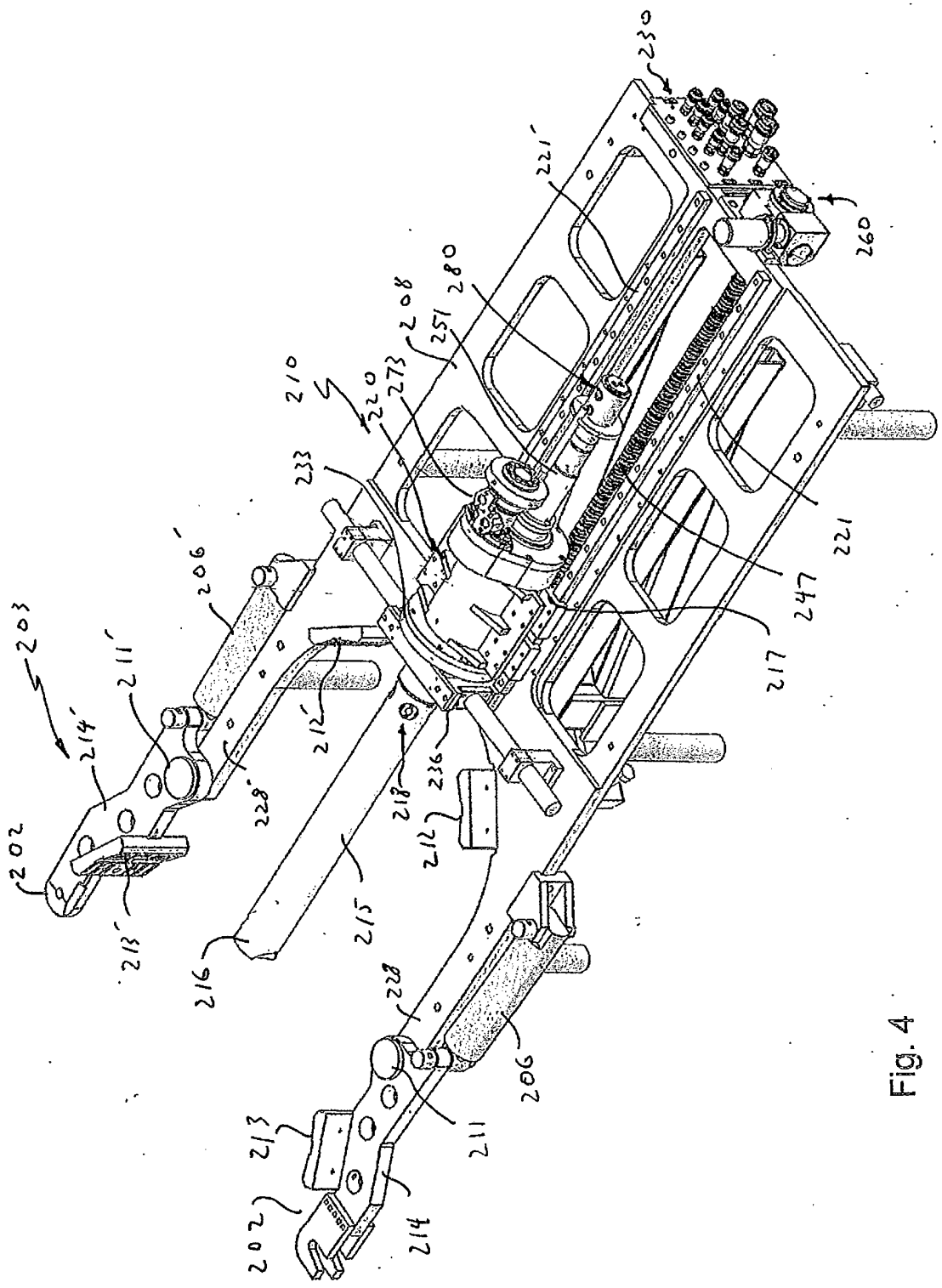
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Fig. 4

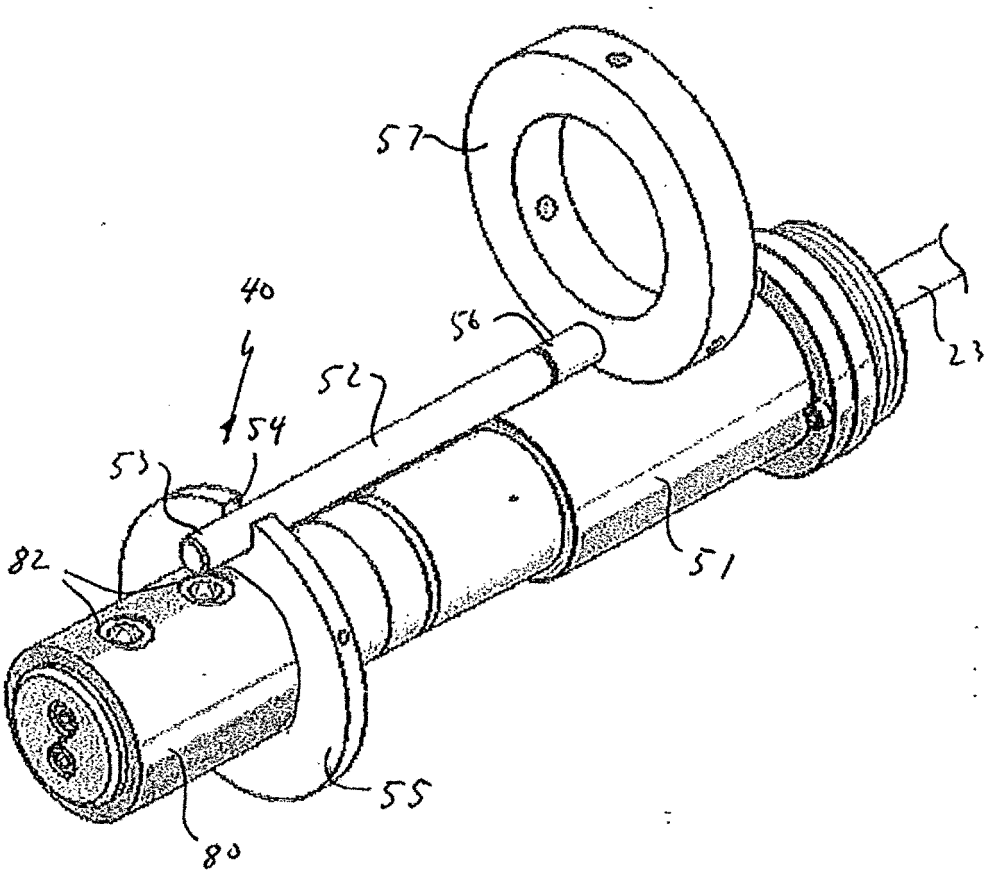

Fig. 5

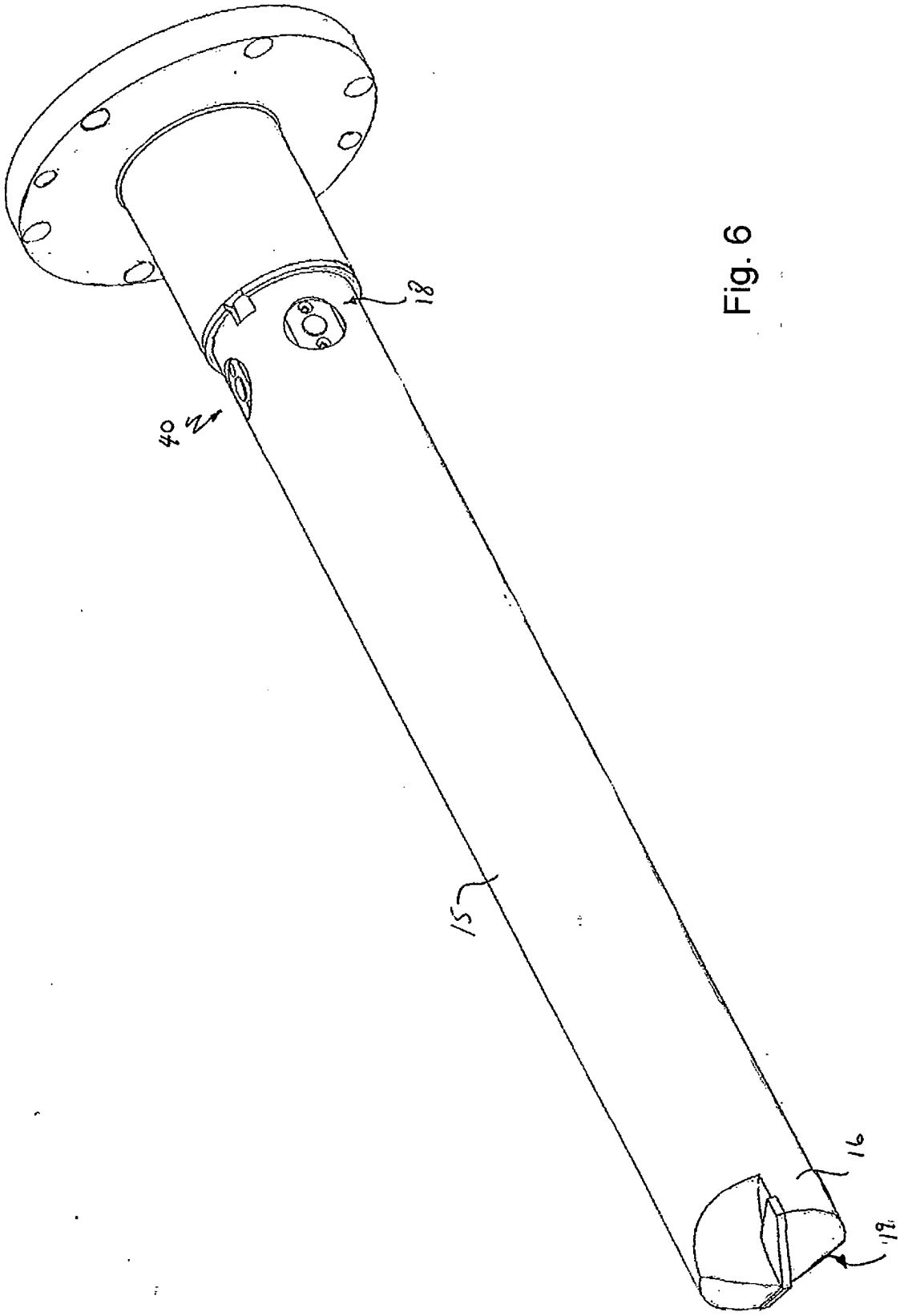

Fig. 6

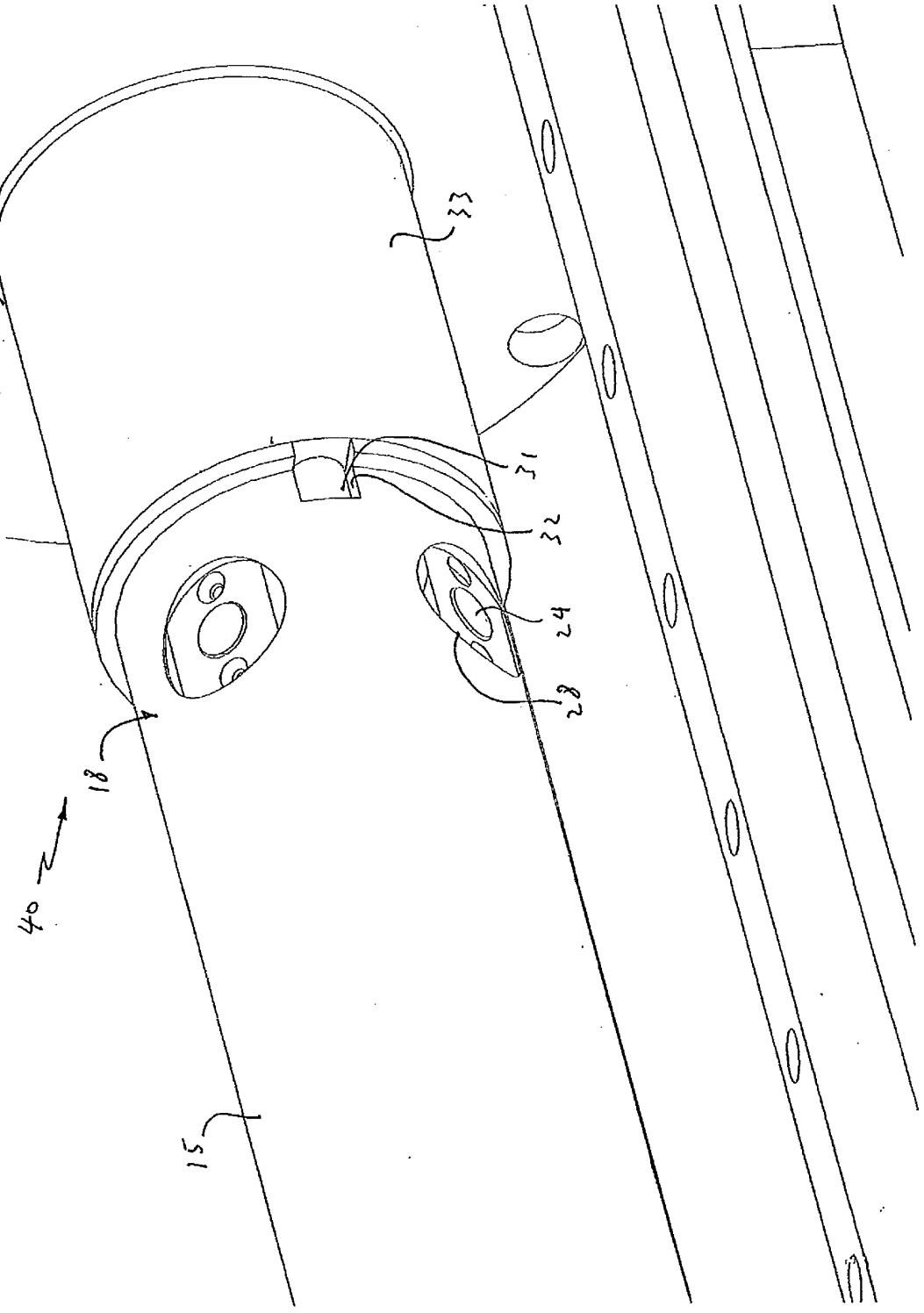

Fig. 7

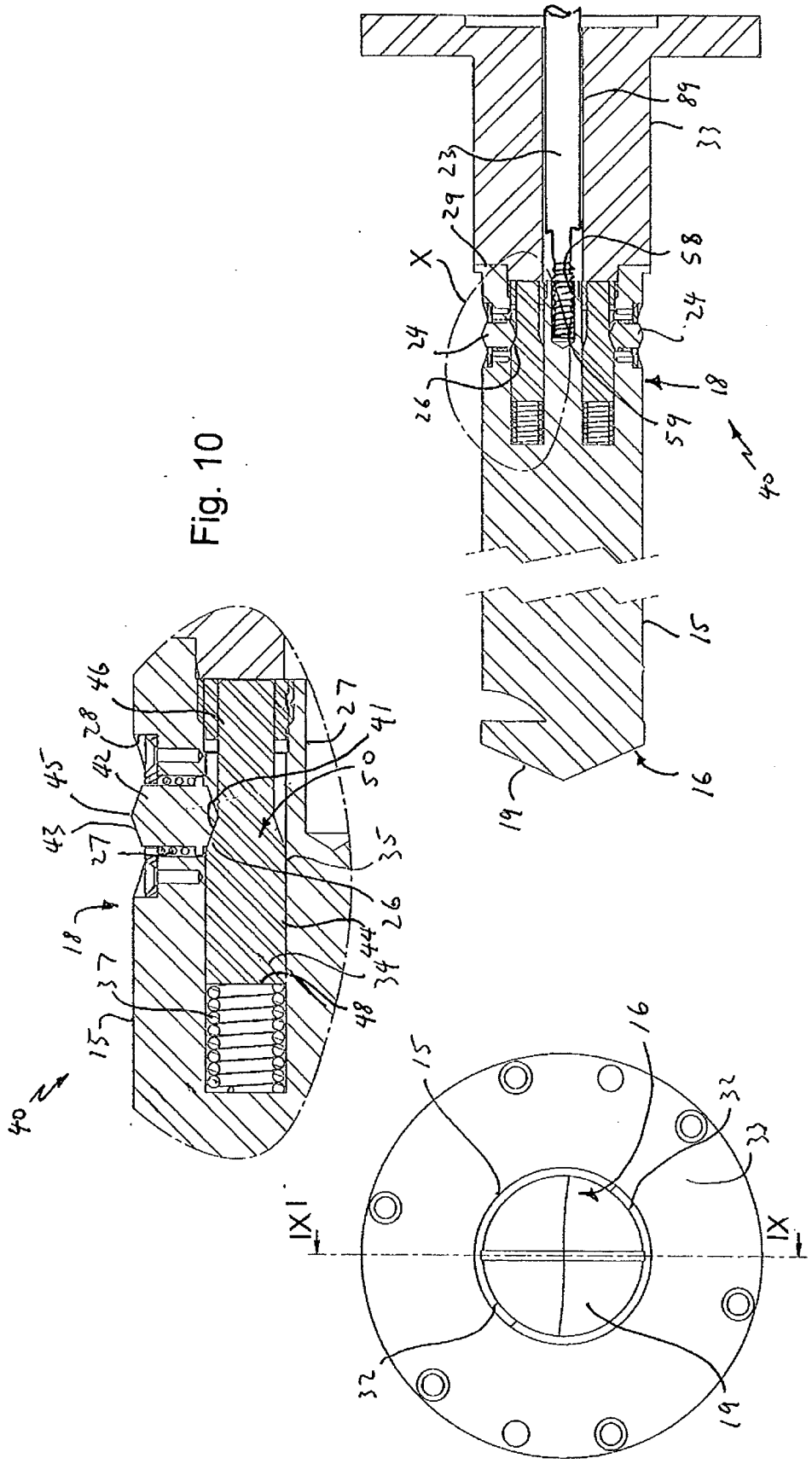

Fig. 8

Fig. 9

Fig. 10

REFERENCES CITED IN THE DESCRIPTION

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