(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) **EP 2 447 463 A1**

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
02.05.2012 Bulletin 2012/18

(21) Application number: **11187205.7**

(22) Date of filing: **28.10.2011**

(51) Int Cl.:
E21B 19/00 *(2006.01)* ***B63C 7/16*** *(2006.01)*
B63C 11/52 *(2006.01)*

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR
Designated Extension States:
BA ME

(30) Priority: **28.10.2010 GB 1018245**

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(54) Platform slot recovery

(57) The present invention relates to a process 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 therefore also relates to a drilling slot recovery apparatus for use in such a process. A subsea pinning machine (1) for pinning together a tubular member assembly (4) that has an outer tubular casing (5) and one or more internal tubular casings (7), comprises a jaws (2) for gripping the outer casing (5), a drill bit (15), an actuator (20) for drilling through the assembly with the drill bit, and a release mechanism (40) for releasing the drill bit once this has drilled through the assembly so that the released drill bit serves in use to pin together the tubular casings forming the assembly.

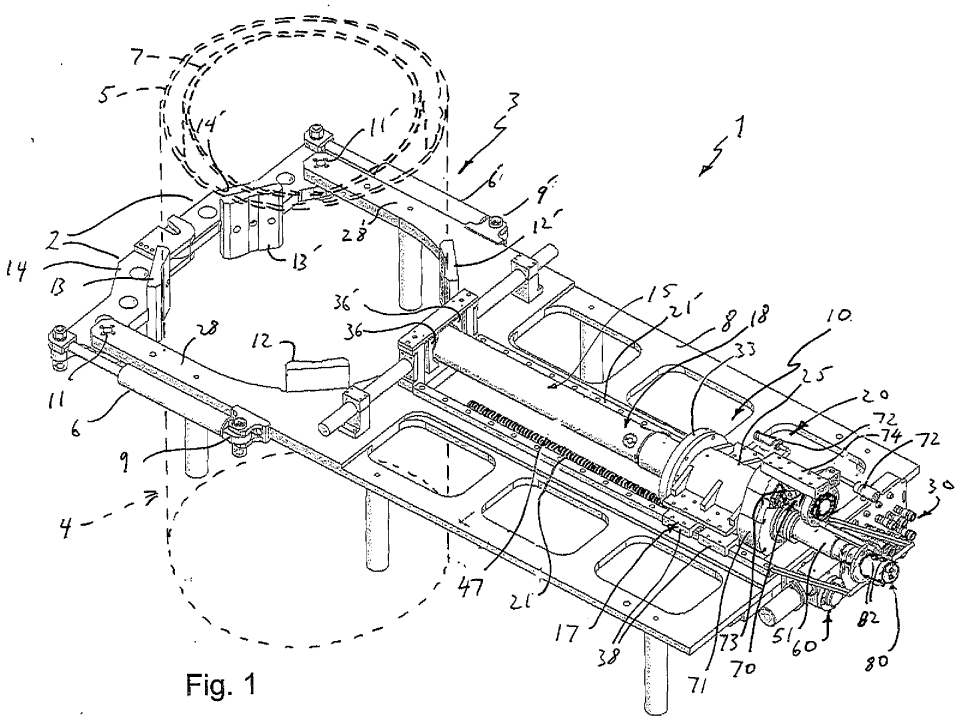

Fig. 1

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Description

BACKGROUND

a. Field of the Invention

[0001] The present invention relates to a process 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 therefore also relates to a drilling slot recovery apparatus for use in such a process.

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 had 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] 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

[0006] 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 jaws for gripping the outer casing, a drill bit, an actuator for drilling through the assembly with the drill bit, and a release mechanism for releasing the drill bit once this has drilled through the assembly so that the released drill bit serves in use to pin together the tubular casings forming the assembly.

[0007] The tubular member assembly may be a conductor assembly having an outer conductor casing and one or more internal casings.

[0008] The release mechanism is preferably remotely operable.

[0009] The jaws, when closed fully encircle the conductor assembly gripped within the jaws.

[0010] The subsea pinning machine comprises a drill bit release mechanism that is automatically activated to release the drill bit when the actuator is turned in an opposite direction to a drilling direction.

[0011] 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 a near 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 actuator in order to release the drill bit.

[0012] 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.

[0013] The subsea pinning machine may comprise a base member for turning the drill bit, and an engagement mechanism being automatically activated to secure the drill bit when the base member is retracted from the drill bit.

[0014] In preferred embodiment of the invention, the engagement mechanism comprises one or more pins which extend radially outwards radially 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.

[0015] 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.

[0016] 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.

[0017] At least one, and preferably all, of these motors may be hydraulic.

[0018] The subsea pinning machine may comprise an elongate main frame which supports at one end the jaws at the other end supports the actuator for drilling through the assembly with the drill bit.

[0019] 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 jaws, a drill bit, an actuator, and a release mechanism for

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

[0020] 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

[0021] 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 jaws closed and a drill bit retracted ready to start drilling on a conductor assembly held within the 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 jaws open 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; and

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

[0022] 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 jaws 2 are 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 jaws 2, 2' are closed, these hold 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 T 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 jaws 2. Each arm portion 14, 14' is hinged to a side pivot 11, which serves as a hinge mechanism at the free end of the arms 28, 28'.

[0023] 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.

[0024] 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 19 is initially fully retracted ready to start drilling on the conductor assembly 4 once this is held within the 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 19 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".

[0025] 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.

[0026] The rotary and axial actuator mechanism 20 additionally comprises 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.

[0027] 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.

[0028] 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,

[0029] 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.

[0030] Figure 3 is 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.

[0031] 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.

[0032] 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.

[0033] 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.

[0034] 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.

[0035] Here, the jaws 202 are 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.

[0036] 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 place to serve also as a pin. This simplifies the process, particularly when carried out underwater and by remote control.

[0037] 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 separately described. 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 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 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.

[0038] 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.

[0039] 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 a 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 a cam surface 26 two cylindrical portions 44, 46 where the diameter of the main body tapers and which, when the cam spindle is pushed forwards by the base member 33 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.

[0040] 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.

[0041] 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 the face 19 of the bit 15 is lower than normal, as, when acting as the pin, its ends 19, 29 need to be as flush as possible to the outside wall of the conductor assembly 4.

[0042] 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.

[0043] The invention in 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 19 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 from the 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.

[0044] 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.

[0045] 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.

[0046] 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 invention 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.

[0047] 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.

[0048] 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.

[0049] The invention makes use of a combined drill bit and pin, which minimises subsea manipulation. At the same time, the invention 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.

[0050] 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.

[0051] The invention therefore provides a 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 platform slot, and to a drilling slot recovery apparatus for use in such a process.

Claims

1. 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 jaws for gripping the outer casing, a drill bit, an actuator for drilling through the assembly with the drill bit, and a release mechanism for releasing the drill bit once this has drilled through the assembly so that the released drill bit serves in use to pin together the tubular casings forming the assembly.

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

3. A subsea pinning machine as claimed in Claim 1 or Claim 2, in which the jaws, when closed fully encircle the conductor assembly gripped within the jaws.

4. A subsea pinning machine as claimed in any preceding claim, comprising a drill bit release mechanism that is automatically activated to release the drill bit when the actuator is turned in an opposite direction to a drilling direction.

5. A subsea pinning machine as claimed in any of Claims 1 to 3, comprising a drill bit release mechanism that comprises a draw bar screwed into a near 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 actuator in order to release the drill bit.

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

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

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

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

10. A subsea pinning machine as claimed in any preceding claim, comprising a drill carriage said drill bit being supported on said carriage, a carriage motor for moving the carriage in a longitudinal direction towards and away from the assembly to be drilled, a drill bit motor for turning the drill bit as the carriage is advanced towards the assembly.

11. A subsea pinning machine as claimed in Claim 10, comprising a third, disengagement motor for disengaging the drill carriage from the drill bit after drilling of the assembly.

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

13. A subsea pinning machine as claimed in any preceding claim, comprising an elongate main frame, said main frame supporting at one end said jaws at the other end supports said actuator for drilling through the assembly with the drill bit.

14. 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 jaws, a drill bit, an actuator, and a release mechanism for

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

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

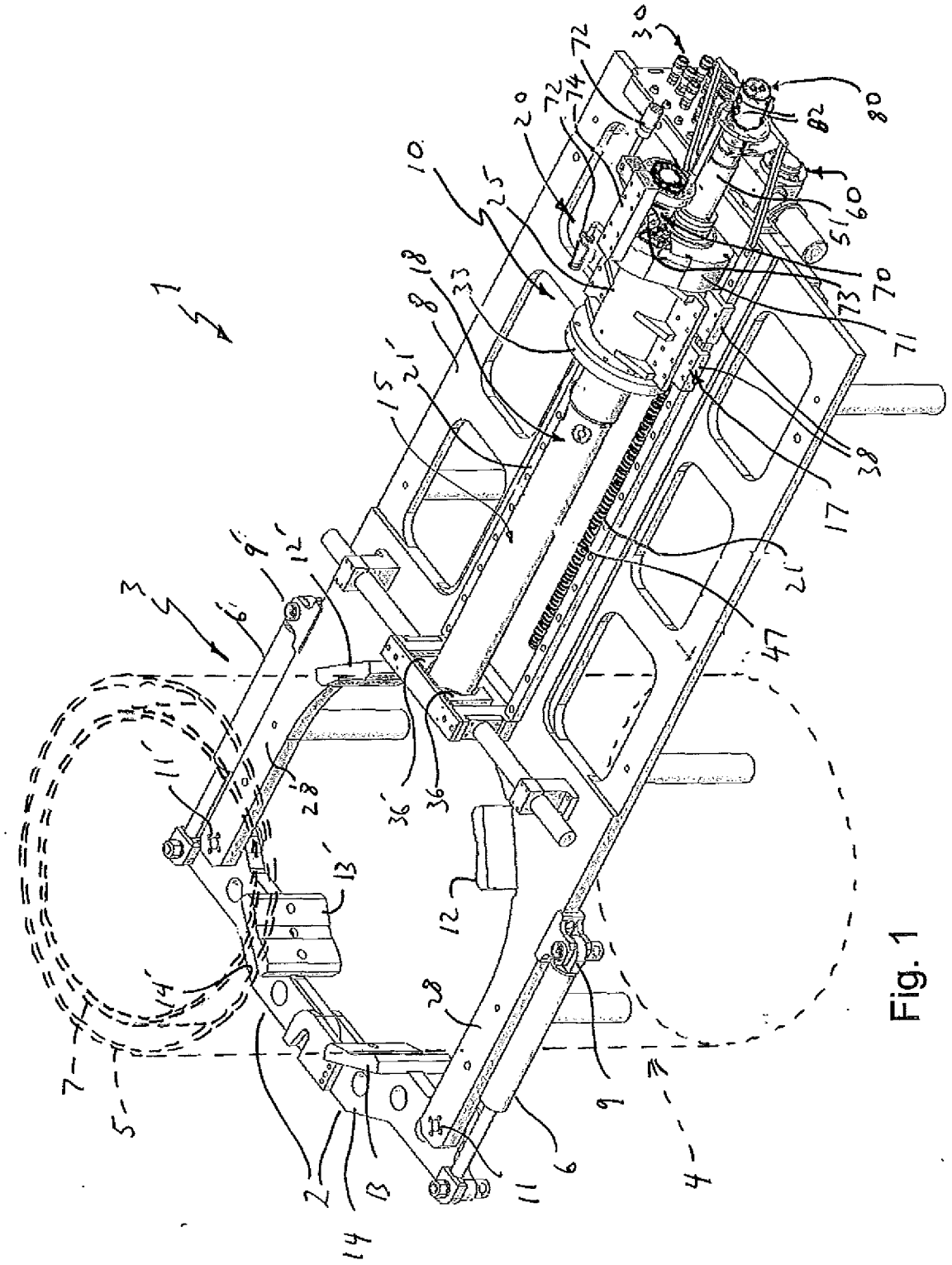
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Fig. 1

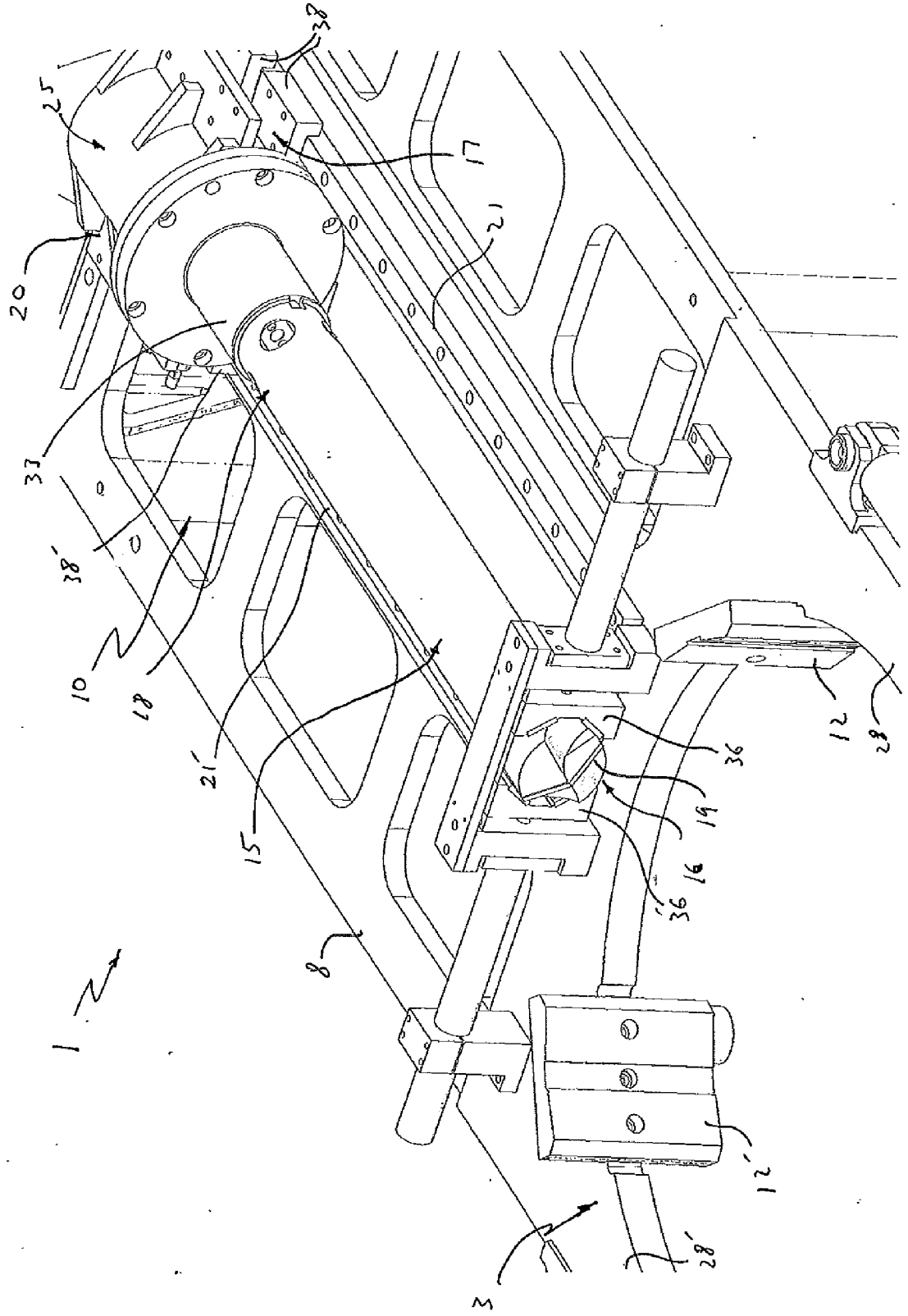

Fig. 2

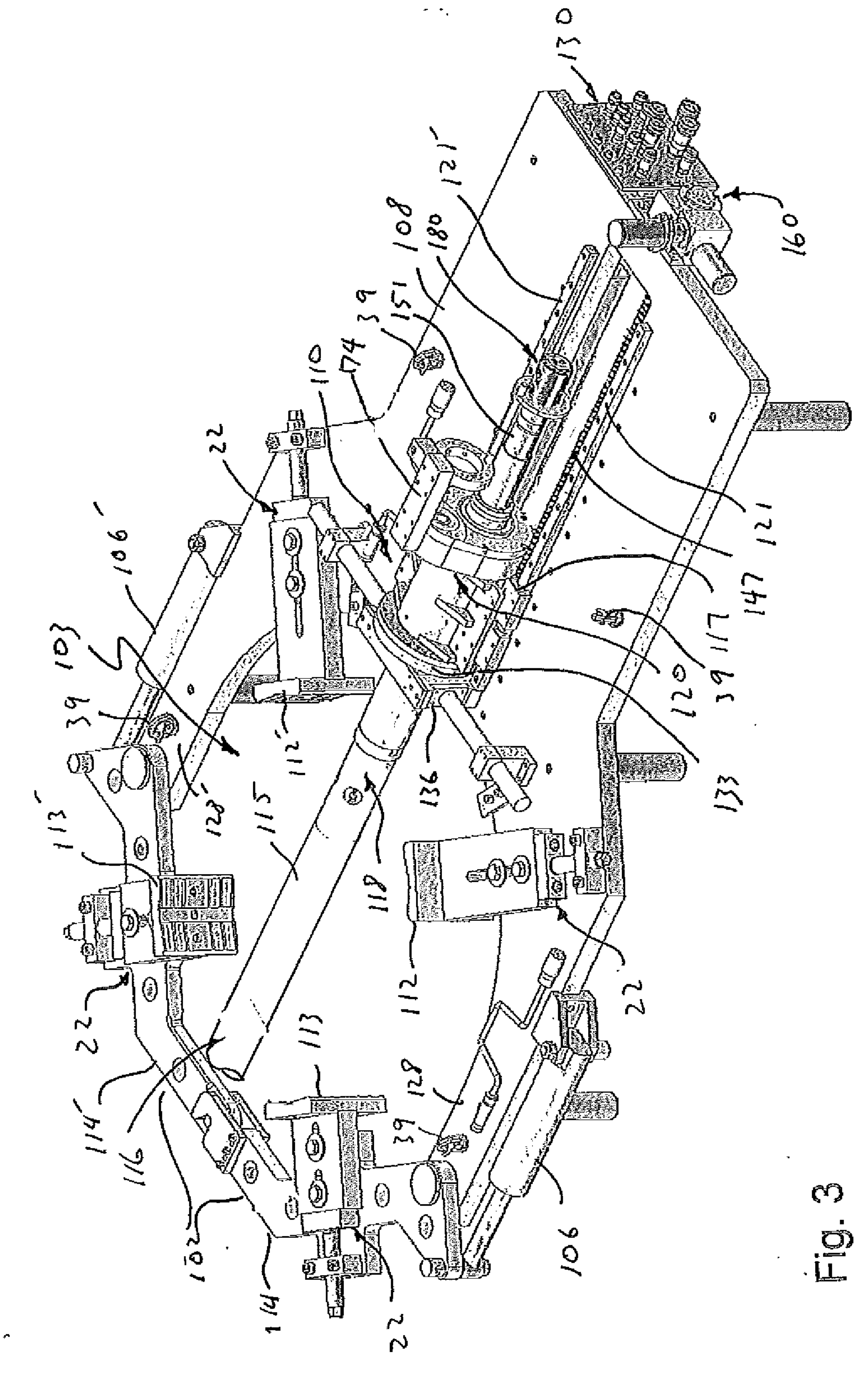
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Fig. 3

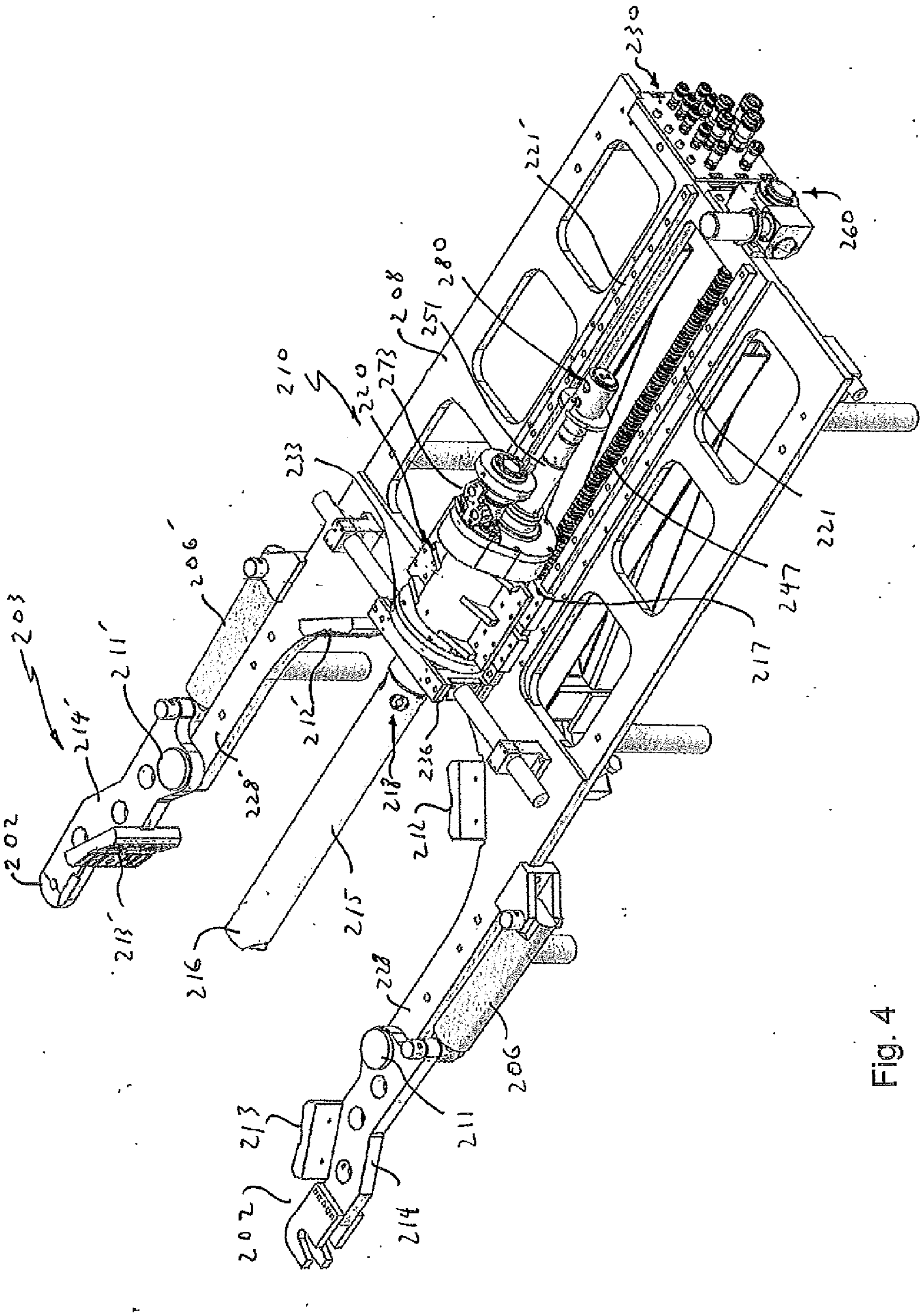
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Fig. 4

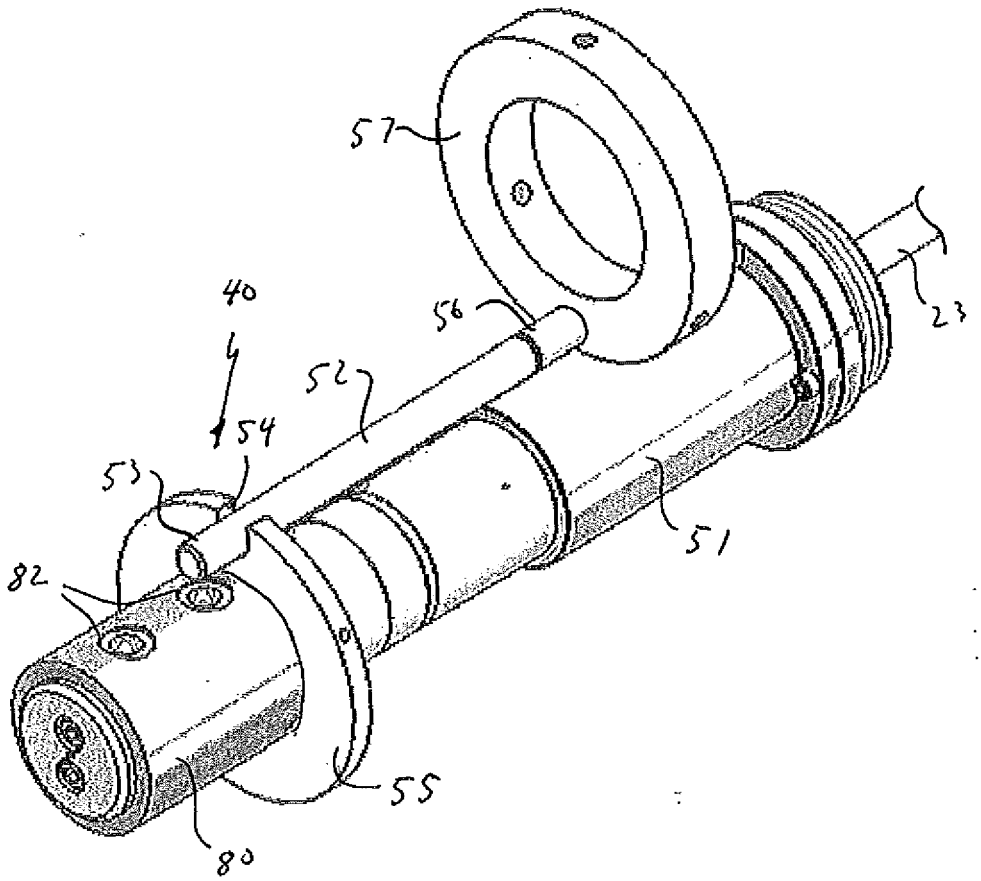

Fig. 5

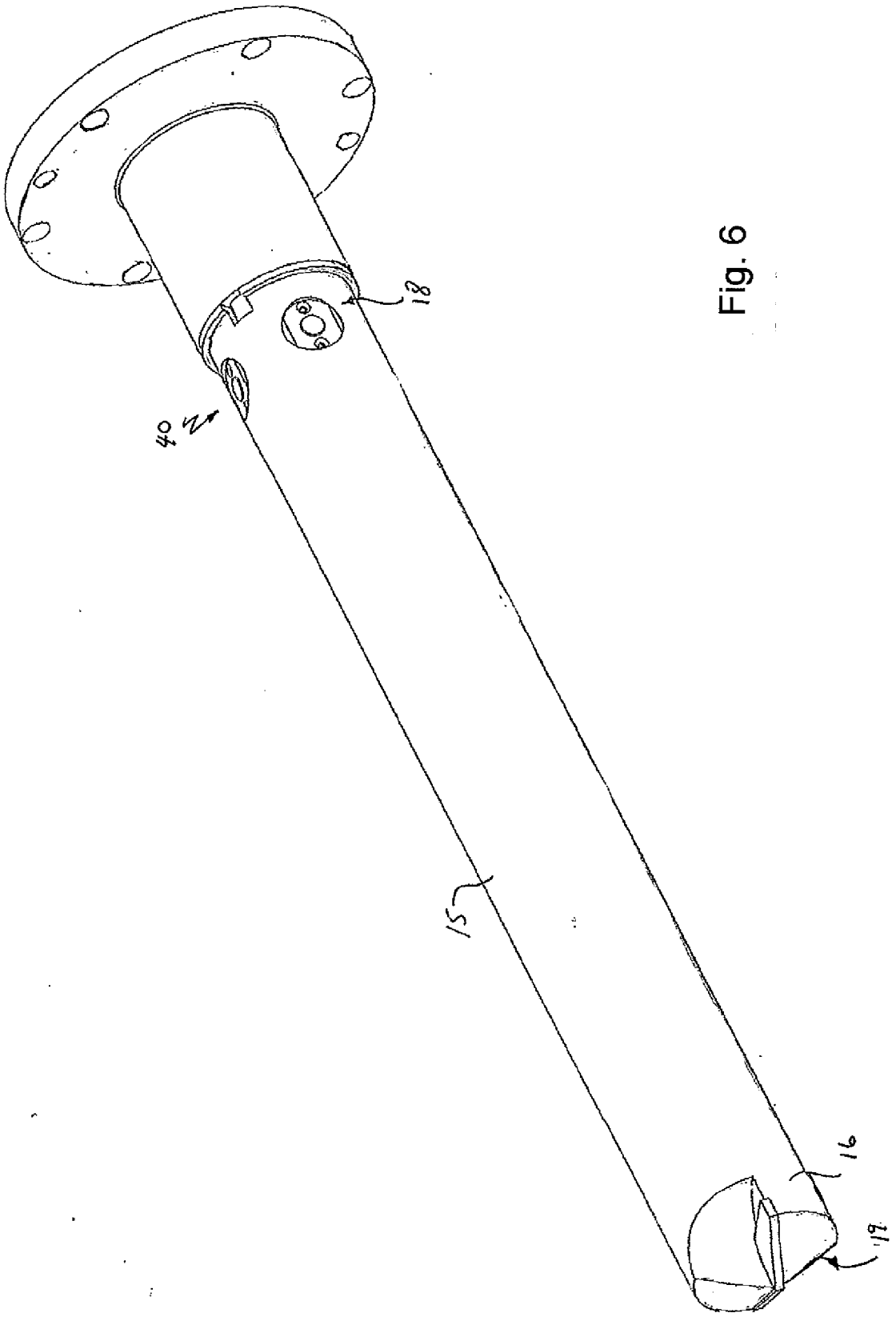

Fig. 6

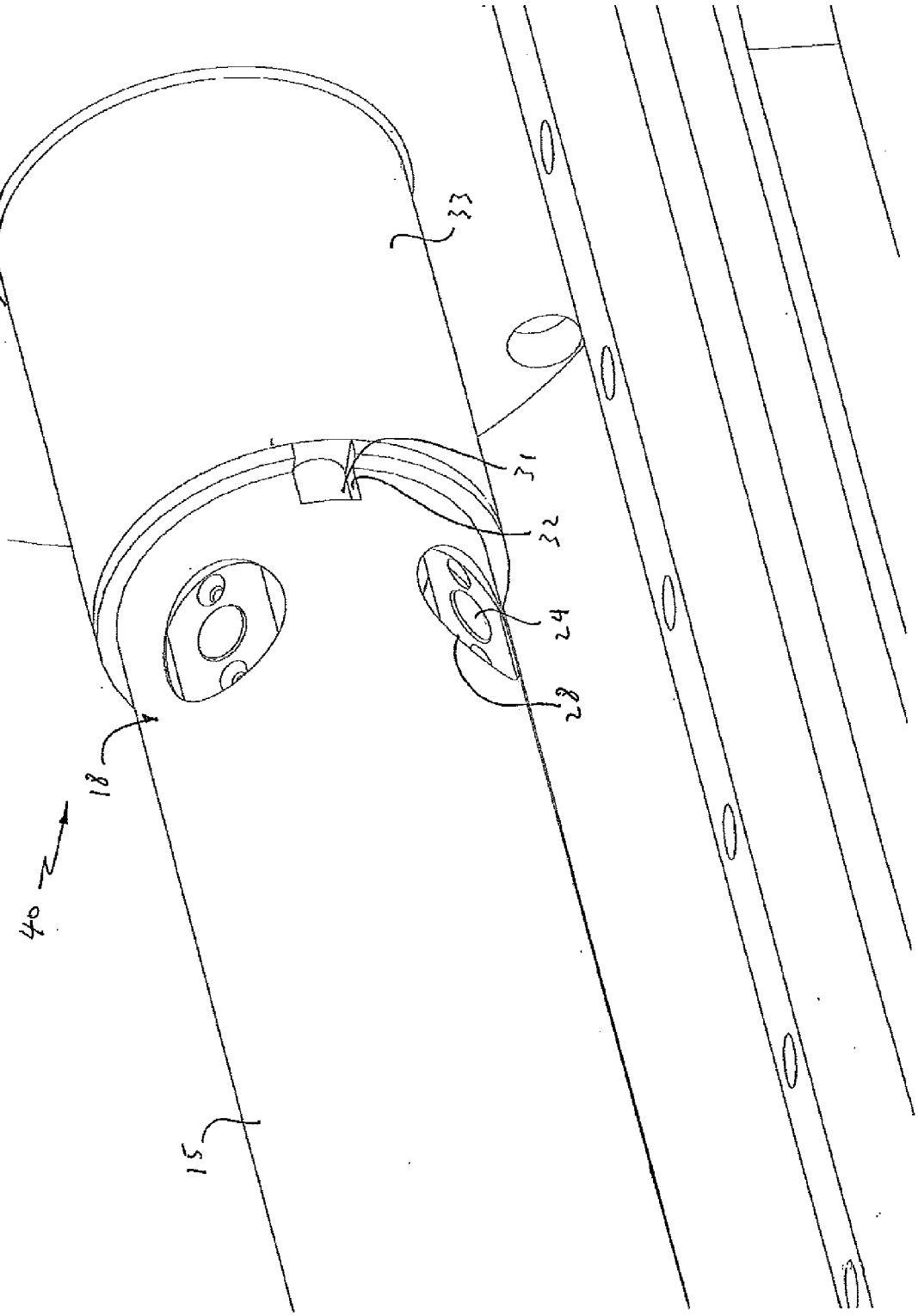

Fig. 7

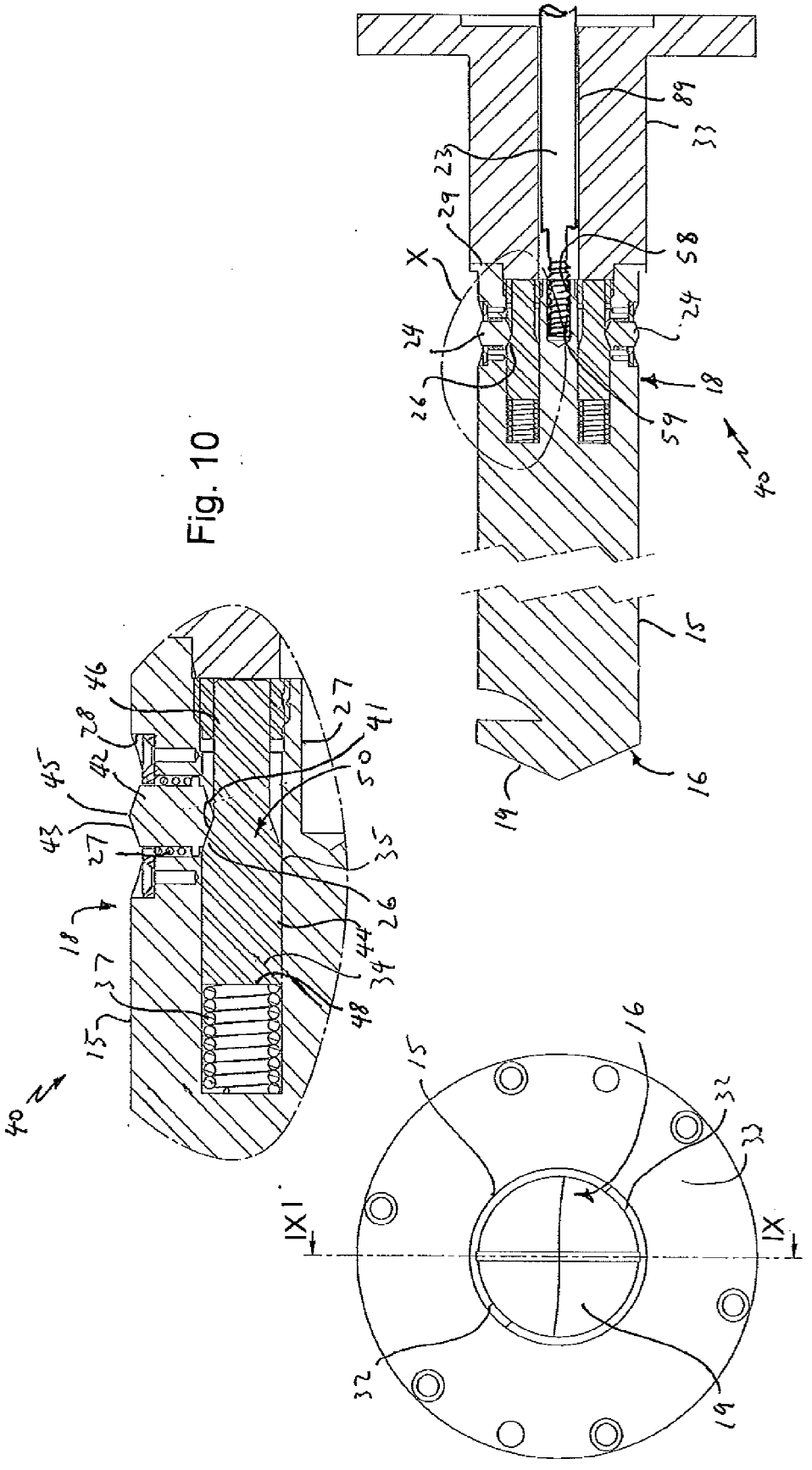

Fig. 9

Fig. 10

Fig. 8

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EUROPEAN SEARCH REPORT

Application Number
EP 11 18 7205

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Place of search	Date of completion of the search	Examiner
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