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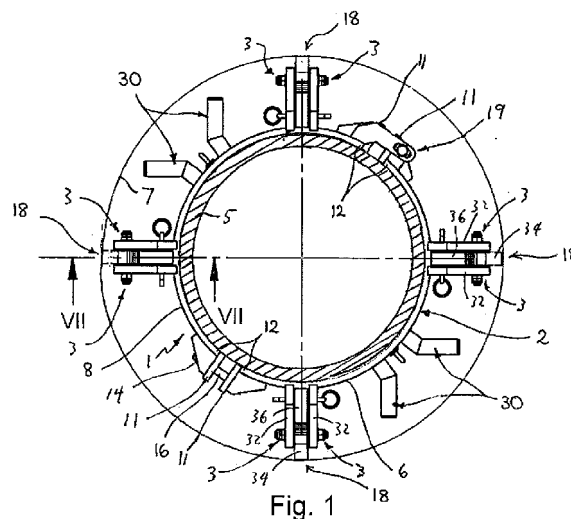
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(54) **Centralizer**

(57) This invention relates to centralizers for use in maintaining a tubular member such a conductor or string in a substantially co-axial arrangement within a bore, for example a platform guide or an outer tubular member or conductor. In particular, this invention relates to a centralizer for use in an oil or gas-drilling or production installation. A centralizer (1) for centralising a tubular member (5) within a bore (7) comprises a main body (2) connectable around a tubular member to be centralised, the main body defining a longitudinal axis (4) of the centralizer, and a plurality of longitudinally extending abutments (18) spaced apart around the main body (2) that extend radially outwards from the main body to abut the bore. At least one of the abutments has an adjustment mechanism (3, 34, 36, 42) for making a radially adjustable abutting contact with the bore. This mechanism comprises a radially movable outer blade (34), a longitudinally movable wedging member (36) located between the outer blade and the main body (2) for moving the blade radially into the abutting contact, at least one guiding mount (3) for guiding the radial movement of the blade, and at least one longitudinally extending ramp surface (42) that is inclined with respect to the axis (4). The outer blade (34) is constrained to move in a substantially radial direction by the at least one guiding mount. The wedging member (36) is constrained between the outer blade and the main body (2) to move in a substantially longitudinal direction. The wedging member and the at least one ramp surface are configured to engage with one another such that as the wedging member moves longitudinally, the wedging member causes the outer blade to move radially. The arrangement of the wedging member and the outer blade is such that when the longitudinal axis (4) is

substantially vertical, the weight of the wedging member (36) automatically causes the wedging member to drop, thereby moving the outer blade (34) in the radially outwards direction.



Description

BACKGROUND

a. Field of the Invention

[0001] This invention relates to the field of centralizers for use in maintaining a tubular member such a conductor or string in a substantially co-axial arrangement within a bore, for example a platform guide or an outer tubular member or conductor. In particular, this invention relates to a centralizer suitable for use in a hydrocarbon drilling or extraction installation.

b. Related Art

[0002] Where one tubular member extends lengthwise within a bore, for example another tubular member, it may be advantageous to maintain the two tubular members substantially co-axial.

[0003] In particular, offshore oil production platforms have vertically extending pipelines, referred to as conductors or casing strings, which connect the platform to the oil or gas resource being extracted from underneath the seabed. Typically the installation will include a number of casing strings arranged concentrically. Additionally, the outermost casing string will pass through a number of guides, each of which may comprise a relatively short sleeve and each of which is securely attached to the structural framework of the platform.

[0004] Usually, one such guide is provided above the water surface and is known as a splash-level jacket conductor guide and, depending upon the depth of water above the well head, one or more further jacket conductor guides may be provided below the water surface.

[0005] It is clearly important for safety reasons, and to ensure that the conductors function for their designed lifetime, that the conductors are securely held concentrically within the guides, even under the influence of waves and storms. It is also preferable if the inner casing strings are also held concentrically with respect to each other and to the outer conductor to prevent damage occurring to any of the casing strings.

[0006] It is, therefore, usual practice to install one or more centralizers between the outer conductor and the guides, and between the inner casing strings. The centralizers act to locate an inner member co-axially with respect to the outer surrounding member. Centralizers typically include a cylindrical main body portion, which is clamped to the inner tubular member, and a number of protrusions, longitudinally extending abutments or fins that are spaced apart around the main body and which each extend radially outwards from the main body portion towards the inner surface of the bore or outer tubular member to minimise the gap for movement between the two members.

[0007] However, due to the manufacturing tolerances and discontinuities which may be encountered on well

platforms and at pipe joints, as well as temperature and pressure effects, it remains necessary to provide such centralizers with relatively large clearances, in order to ensure that binding or seizure between the two tubular members will not occur in use. In the case of an external string, which is exposed to currents in the sea and wave motion, these clearances may allow the outer string to bend and cause excessive flow-line movement at the top of the conductors leading to fatigue damage. Another issue is the tendency of the outer string to vibrate and slam against the external conductor guide, which may in turn transmit significant noise and vibration to the platform. Similarly, when the well is in production, the inner string may also vibrate and generate noise which is transmitted to the platform.

[0008] Centralizers may be one of two distinct types. Fixed centralizers provide a constant radial extension and adjustable centralizers provide a variable radial extension in order to provide a better fit (i.e. a smaller gap) between the inner and outer tubular elements. However, even with the use of adjustable centralizers, such as those described in GB 2381280 A, a gap may still exist between the inner and outer tubular members even when the protrusions are moved outwards to their full extent.

[0009] It is an object of the present invention to provide an improved centralizer, suitable for use in an oil or gas production installation, which minimises the clearance between an inner tubular member and an outer bore and which, in particular, may be used to reduce conductor movement within the bore to a controlled minimum.

SUMMARY OF THE INVENTION

[0010] According to a first aspect of the invention, there is provided a centralizer suitable designed for centralising a tubular member within a bore, the centralizer comprising a main body adapted to be connectable around a tubular member to be centralised, the main body defining a longitudinal axis of the centralizer, and a plurality of longitudinally extending abutments spaced apart around the main body, each abutment extending radially outwards from the main body for making abutting contact with said bore and at least one of said abutments having an adjustment mechanism for making a radially adjustable abutting contact with said bore, said adjustment mechanism comprising a radially movable outer blade for making said abutting contact, a longitudinally movable wedging member located between the outer blade and the main body for moving the outer blade radially into said abutting contact, at least one guiding mount for guiding said radial movement of the outer blade, and at least one longitudinally extending ramp surface, said at least one ramp surface being inclined with respect to said axis, wherein:

- the outer blade is constrained to move in a substantially radial direction by said at least one guiding mount; and

- the wedging member is constrained between the outer blade and the main body to move in a substantially longitudinal direction, the wedging member and said at least one ramp surface being configured to engage with one another such that as the wedging member moves longitudinally, the wedging member causes the outer blade to move radially, **characterized in that** the arrangement of the wedging member and the outer blade is such that when the longitudinal axis is substantially vertical, the weight of the wedging member automatically causes the wedging member to drop, thereby moving the outer blade in said radially outwards direction.

[0011] In this arrangement, the wedging member and the outer blade are both relatively movable with respect to the main body and to each other.

[0012] Because of the gravity-driven movement and engagement of the outer blade with the bore surrounding the centralizer, there is no need to provide a motor or separate drive mechanism to move the wedging member to move the outer blade outwards into engagement with the bore.

[0013] There are preferably at least three of the longitudinally extending abutments. Most conveniently, a minimum of two adjustment mechanisms may be mounted at right angles to each other. In a preferred embodiment of the invention there are four such abutments spaced equidistantly apart around the main body, all of which have the adjustment mechanism for making a radially adjustable abutting contact with the bore. Preferably, these form two opposing pairs of radially extending projections which extend longitudinally along at least half of the length of the centralizer.

[0014] The main body may comprise two separable halves which may be secured together to clamp the main body around the tubular member.

[0015] The, or each, ramp surface is separate from the wedging member. In preferred embodiments of the invention, the at least one ramp surface is provided on the outer blade. It would however, alternatively be possible for the at least one ramp surface to be provided on the main body.

[0016] The wedging member may be in the form of a blade, in which case the wedging member is an inner blade relative to the outer, radially movable blade. The outer blade and wedging member may, for example, be sheet material of the same thickness. Preferably, the outer blade and the inner blade forming wedging member are in-line with each other in the radial direction.

[0017] The wedging member and the ramp surface may have therebetween mating surfaces, which may include a ramp surface on the outer blade or a ramp surface on the main body. In preferred embodiments of the invention, these mating surfaces are inclined relative to the longitudinal axis of the centralizer so that the movement of the wedging member in a first longitudinal direction causes the movement of the outer blade in a radially out-

wards direction as the wedging member moves relative to the ramp surface.

[0018] There may be a plurality of pairs of the inclined mating surfaces, these pairs being spaced longitudinally apart and being separated by substantially radially extending steps in each of the mating surfaces.

[0019] To prevent retraction of the adjustment mechanism after installation of the centralizer, at least one of the wedging member and the outer blade may comprise securing means to prevent movement of the wedging member in the longitudinal direction in which the wedging member would cause or permit the outer blade to move radially inwards.

[0020] The securing means may be provided on opposing surfaces between the wedging member and ramp surface. The opposing surfaces may be textured with a saw-tooth profile such that the opposing surfaces engage to prevent movement of the wedging member in said longitudinal direction in which the wedging member causes or permits the outer blade to move radially inwards. The securing means should not, however, hinder or prevent movement in an opposite longitudinal direction.

[0021] The guiding mount preferably comprises a pair of plates extending radially outwards from the main body, the wedging member and the outer blade being mounted, for example slidably mounted, between this pair of plates.

[0022] The outer blade may then be mounted to the pair of plates in such a way as to limit the extent of radial movement of the outer blade from a retracted position, nearest the main body, to an extended position, furthest from the main body.

[0023] The outer blade may then include a slot, with a pin, for example the shaft of a bolt, carried by the pair of plates extending through the slot so as to adjustably mount the outer blade to the plates.

[0024] To prevent movement of the adjustment mechanism prior to installation of the centralizer, the centralizer may further comprise a wedging member release means connectable to the wedging member. The release means retains the wedging member in a first, retracted position and prevents the wedging member moving in a longitudinal direction under gravity until the centralizer is in position for installation.

[0025] If the wedging member and the outer blade are mounted between a pair of plates, the wedging member release means may comprise a hole in the wedging member, a corresponding hole in at least one of the plates and a removable wedging member release pin extending through these holes when aligned. The wedging member release means may also comprise release cables attached at one end of this pin so that the pin may be pulled out remotely.

[0026] To prevent movement of the adjustment mechanism prior to installation of the centralizer, the centralizer may further comprise outer blade release means connectable to said wedging member and the outer blade, these release means retaining the wedging member in a first, retracted position and preventing the wedg-

ing member moving in a longitudinal direction under gravity.

[0027] If the wedging member and the outer blade are mounted between a pair of plates, then the outer blade release means may comprise a hole in the outer blade, a corresponding hole in at least one of the plates and a removable outer blade release pin extending through these holes when aligned. The outer blade release means may also comprise release cables attached at one end of this pin so that the pin may be pulled out remotely.

[0028] According to a second aspect of the invention, there is provided a deployment collar for temporary mounting to a substantially cylindrical centralizer for centralising a tubular member within a bore, the deployment collar comprising a ring-like main body defining a longitudinal axis of the deployment collar and having mounted to the collar main body a latching mechanism and an activating mechanism, wherein:

- the latching mechanism is provided around the collar main body for latching to and de-latching from an upper end of a centralizer so that, in use, the deployment collar may be temporarily mounted to said centralizer; and
- the activating mechanism includes at least one actuator, said actuator being configured, in use, to applying a force in an axial direction for activating a radial adjustment mechanism of said centralizer.

[0029] The latching mechanism may comprise at least one and preferably a set of hydraulically or electrically operable ram actuators, these ram actuators including a piston for engaging and disengaging with the centralizer, the piston being movable in a tangential direction relative to the axis of the deployment collar as the centralizer deployment assembly latches and de-latches from the centralizer.

[0030] The, or each, actuator of the activating mechanism may include a hydraulically or electrically operable ram actuator, this ram actuator including a piston, the piston being movable in a direction parallel with the axis of the deployment collar as the centralizer deployment assembly activates the radial adjustment mechanism of the centralizer.

[0031] According to a third aspect of the invention, there is provided a centralizer deployment assembly comprising a centralizer suitable for centralising a tubular member within a bore, and a deployment collar for temporary mounting to said centralizer when said centralizer is to be connected to said tubular member, the centralizer being in accordance with the first aspect of the invention and the deployment collar being in accordance with the second aspect of the invention, wherein the deployment collar is temporarily mountable to said centralizer by means of the latching mechanism in such a way that said activating mechanism is configured relative to the centralizer to activate the wedging member of an adjustment

mechanism of one of said abutments in order to make said radially adjustable abutting contact of said abutment with said bore.

[0032] According to a fourth aspect of the invention, there is provided a method of using a centralizer to centralise a tubular member within a bore, the centralizer being in accordance with the first aspect of the invention, the method comprising the steps of:

- fixing the main body of the centralizer to the tubular member to be centralised;
- inserting the tubular member into the bore, the bore presenting a gap between the main body and the bore and the abutments extending partially across said gap so that the centralizer is free to move axially in said bore; and
- moving the wedging member in a substantially longitudinal direction such that the wedging member and said at least one ramp surface engage with one another thereby causing the outer blade to move radially outwards into contact with the bore to centralise the tubular member within the bore.

[0033] According to a fifth aspect of the invention, there is provided a method of using a centralizer deployment assembly to centralise a tubular member within a bore, the centralizer deployment assembly being in accordance with the third aspect of the invention, the method comprising the steps of:

- fixing the main body of the centralizer to the tubular member to be centralised;
- inserting the tubular member into the bore, the bore presenting a gap between the main body and the bore and the abutments extending partially across said gap so that the centralizer is free to move axially in said bore;
- inserting the deployment collar into the bore between the tubular member and the bore;
- using the latching mechanism to temporarily mount the deployment collar to the centralizer in such a way that said activating mechanism is located to activate the wedging member of a corresponding adjustment mechanism;
- using said activating mechanism to move the wedging member in an axial direction so that the wedging member engages with the ramp surface, thereby causing the outer blade to move radially outwards into contact with the bore to centralise the tubular member within the bore;
- using the latching mechanism to dismount the deployment collar from the centralizer; and
- removing the deployment collar from the bore.

BRIEF DESCRIPTION OF THE DRAWINGS

[0034] The invention will now be further described, by way of example only, and with reference to the accom-

panying drawings, in which:

Figure 1 is a perspective view from above of a centralizer according to a first preferred embodiment of the invention, having a main body attached to a tubular member and with four abutments extending radially from the main body, each abutment having an adjustment mechanism including a movable blade member, each of which is in an extended position making contact with a surrounding bore;

Figure 2 is a plan view from the side of the centralizer of Figure 1;

Figure 3 is a perspective view from above of the centralizer of Figure 1 showing the blade members in a retracted position;

Figure 4 a perspective view from above of the centralizer of Figure 1 showing the blade members in an extended position;

Figure 5 is a perspective view from above of the centralizer of Figure 1 showing the blade members in a retracted position;

Figure 6 is a cross-sectional view along the line VI-VI of Figure 5;

Figure 7 is a cross-sectional view along the line VII-VII of Figure 1;

Figure 8 is a perspective view from above of a centralizer according to a second preferred embodiment of the invention, having a main body for attaching to a tubular member and with four abutments extending radially from the main body, each abutment having an adjustment mechanism including a movable blade member, each of which is in a retracted position;

Figure 9 is a plan view from above of the centralizer of Figure 8;

Figure 10 is a side view of the centralizer of Figure 8;

Figure 11 is a cross-sectional view along the line XI-XI of Figure 9;

Figure 12 is a plan view from above of a deployment collar for temporary attachment to the centralizer of Figure 8 when the main body of the centralizer is to be attached to a tubular member;

Figure 13 is a side view of the deployment collar of Figure 12 along the line XIII-XIII of Figure 12;

Figure 14 is a cross-sectional view along the line

XIV-XIV of Figure 12;

Figure 15 is a side view of a centralizer deployment assembly according to a third preferred embodiment of the invention, composed of the deployment collar of Figure 12 connected to an upper end of the centralizer of Figure 8;

Figure 16 is a cross section view through the centralizer deployment assembly of Figure 15, showing one of the abutments and a longitudinal hydraulic ram of the deployment mechanism for activating a wedging member of the adjustment mechanism;

Figure 17 is a perspective view from above of the centralizer deployment assembly of Figure 15, showing the blade members in a retracted position; and

Figure 18 a perspective view from above of the centralizer deployment assembly of Figure 15, showing the blade members in an extended position.

DETAILED DESCRIPTION

[0035] Figures 1 and 2 show a centralizer 1 according to a first preferred embodiment of the present invention. The centralizer 1 is designed to locate between a tubular member 5, for example a conductor or a casing string, and a bore 7, for example a platform guide located either just above or just below the splash zone, in order to reduce conductor movement to a minimum.

[0036] The centralizer 1 comprises a main body 2, which in this example is in the form of a steel split central tube defining a longitudinal axis 4 of the centralizer 1. The central tube 2 is formed from two semi-cylindrical tube portions 6, 8 each including a lip or flange 11 extending radially outwards from each of the four longitudinally extending free edges 12 of the tube portions 6, 8. These flanges 11 are used to secure the two tube portions 6, 8 together to enable the central tube 2 to be clamped around the inner tubular member 5. On one side of the central tube 2, one pair of flanges 11 supports at each of its longitudinal ends 15, 17 a hinge mechanism 19, 21. The hinge mechanism 19, 21 is used to close together the two cylinder halves 6, 8 during clamping of the centralizer to the tubular member 5.

[0037] After clamping of the central tube 2 around the inner tubular member 5, both pairs of flanges 11 are then secured together using suitable fastening means such as nuts 14 and bolts 16 which pass through aligned holes (not shown) in the flanges 11, as shown most clearly in Figure 3.

[0038] The central tube 2 should, ideally, have an inner diameter that is approximately equal to an outer diameter of the tubular member 5 so that, when the central tube 2 is clamped around the tubular member, it may be fastened to grip tightly around the tubular member 5 so that

it remains in position and does not slide longitudinally along the tubular member.

[0039] Four longitudinally extending fin-like abutments 18 are spaced apart around the main body 2. Each abutment extends radially outwards from an external surface 20 of the central tube 2. The abutments 18 extend the complete length of the central tube 2 and, in this embodiment, first and second, or upper and lower, abutment end portions 22, 24 extend beyond first and second, or upper and lower, ends 26, 28 of the central tube 2, as shown most clearly in Figure 2.

[0040] A series of guide members or fairleads 30 also project outwards from the external surface 20 of the central tube 2, the function of which will be described later. There are four such guide members 30, each guide member being located near and associated with one of the abutments 18.

[0041] The arrangement of abutments 18 and guide members 30 is such that there are two abutments 18 and two guide members 30 extending from each of the tube portions 6, 8. Furthermore, the abutments 18 are positioned equidistantly around the central tube 2 so as to form two opposing pairs of abutments 18.

[0042] As shown in Figures 3 to 7, each of the abutments 18 includes guiding mounts 3 and an outer movable member 34 and a movable inner wedging member 36 which cooperate with each other such that the position of the outer movable member is radially adjustable. The movement of these members 34, 26 with respect to both longitudinal and radial directions is guided by the guiding mounts. In this example, the guiding mounts 3 include a pair of parallel guide plates 32 between which the outer and inner movable members 34, 36 are received.

[0043] The guide plates 32 extend parallel to each other and parallel to the longitudinal axis 4 beyond the upper and lower edges 26, 28 of the semi-cylindrical tube portions 6, 8 to provide the upper and lower abutment end portions 22, 24, all of which have a tapered outer edge 31 to aid insertion of the centralizer 1 into the bore 7. The guide plates 32 are spaced apart by a distance approximately equal to the width of the movable members 34, 36 so that there is a sliding fit of the movable members 34, 36 between the guide plates 32.

[0044] The innermost movable member is a wedging member 36, most clearly shown in Figures 6 and 7, and includes a flat longitudinal edge 38 that is in sliding contact with the external surface 20 of the central tube 2 and a second opposing radially outwards edge that includes a series of ramped surfaces 42. The ramped surfaces 42 are inclined with respect to the longitudinal axis 4 of the centralizer 1 and, in this embodiment, each of the ramped surfaces 42 slopes downwards and inwards with respect to the central tube 2 when the axis is vertically oriented, as in the drawings. Relatively short separating steps 44 extend between a lower end 46 of one ramped surface 42 and an upper end 48 of an adjacent ramped surface 42 and, as such, the steps 44 extend generally perpendicular to the ramped surfaces 42 and transverse to the

flat longitudinal edge 38.

[0045] The outermost movable member is a radially movable blade 34 that includes a first radially inwards edge having a series of inclined surfaces 52 and separating steps 54 that correspond and engage with the ramped surfaces 42 and separating steps 44 of the wedging member 36. The outer blade 34 also includes a flat longitudinal edge 56 that forms an outer contact surface of this blade 34.

[0046] As can be seen from the drawings, this arrangement provides a plurality of pairs of inclined mating surfaces 42, 52 separated by the separating steps 44, 54 and together with the guiding plates 32, this constrains both the radial and longitudinal movement of the outer movable member 34, and therefore serves to retain the wedging member to the main body.

[0047] Both the wedging member 36 and outer blade 34 are formed from the same thickness of steel plate material. The wedging member in this example is therefore also in the form of a blade 36, which is radially in-line with the outer blade 34. As will be explained in detail below, both these blade members together form part of an adjustment mechanism for making a radially adjustable abutting contact with an outer bore 7 inside of which the centralizer 1 is to be used.

[0048] When the inner wedging and outer blades 36, 34 are located between the guide plates 32, the flat longitudinal edge 56 of the outer blade 34 is parallel to the flat longitudinal edge 38 of the wedging blade 36.

[0049] As shown in Figures 4 and 5, each of the guide plates 32 includes a plurality of holes 60, 60', 62, 64. A pair of holes 60, 60' is located proximate an outer longitudinal edge 66 of each of the guide plates 32, as shown in Figure 4. One of these holes 60 is located towards the first, tapered upper end 22 of the guide plate 32 and the other one of these holes 60' is located towards the second, tapered lower end 24 of the guide plate 32. As shown in Figure 6, a corresponding pair of holes 72, 72' is formed in the outer blade 34. When the outer blade 34 is in a retracted position, as will be explained below, the pair of holes 60, 60' in each of the guide plates 32 aligns with the pair of holes 72, 72' in the outer blade 34. As shown in Figure 3, a transportation bolt 74 may be located through the aligned holes 60, 60', 72, 72' and fastened with a nut 75 in order to secure the outer blade 34 in position with respect to the guide plates 32 during transportation and storage of the centralizer 1.

[0050] As shown in Figure 4, a single hole 62 is located proximate a radially inner edge 76 of the guide plates 32, and towards the upper end 22 of each of the guide plates 32. As shown in Figure 7, a corresponding hole 78 is formed in the inner wedging blade 36. When the wedging blade 36 is in a retracted position, as will be explained below, these holes 62 in the guide plates 32 align with the hole 78 in the wedging blade 36. A wedging member release pin 80 is preferably a split pin secured at one end with a cotter pin 13. The release pin 80 is located through the aligned holes 62, 78 in the guide plates 32 and inner

wedging blade 36. The function of this release pin will be described further below.

[0051] As shown in Figure 5 in dashed outline, a set of holes 64 is located proximate the outer edge 66 of each of the guide plates 32. In this example, there are three such holes 64, spaced apart along the length of each guide plate. A corresponding series of slots 82 is formed in the outer blade 34 so that, when the outer blade 34 is in a retracted position, a first end 84 of each of the slots 82 aligns with the corresponding hole 64 and, when the outer blade 34 is in an extended position, a second end 86 of each of the slots 82 aligns with the hole 64. A blade guide bolt passes through each of the aligned holes 64 and slots 82. The blade guide bolt includes a pin or shaft 87, a head portion 89 at one end of the shaft and a locking nut 97 that is secured to the other end of the shaft. When in position through the guide plates 32 and the outer blade 34, the head portion 89 locates against an outer surface 91 of one of the guide plates 32 and the locking nut 97 locates against an outer surface 93 of the other one of the guide plates 32. As such, the head portion 89 and locking nut 97 retain the guide bolt shaft 87 through the outer blade 34.

[0052] In this embodiment, and as shown most clearly in Figures 3 and 4, the guide members 30 each include an arm portion 92 that extends from the external surface 20 of the central tube 2 and a loop section 94 located at a free end 95 of the arm portion 92. In addition, the wedging member release pins 80 include a ring portion 96 at one end of the release pin. When the release pin is located through the guide plates 32 and the outer blade 34 it is oriented such that the ring portion 96 is located on the same side of the abutment fin 18 as the corresponding guide member 30.

[0053] Flexible, elongate release cables 98, in the form of a rope or wire, are fixed at their ends 99 to each of the ring portions 96 of the wedging member release pins 80. Each release cable 98 passes through the loop section 94 of the corresponding guide member 30 and extends upwards beyond the upper end 26 of the centralizer 1. Typically the release cable 98 runs up to the surface or up to a production platform (not shown).

[0054] To install the centralizer 1, the central tube 2 is first clamped around an inner tubular member 5, which in this example is a hollow conductor. The transportation bolts 74 are then removed so that the outer and inner blade members 34, 36 are only held in the retracted position by means of the wedging member release pins 80. In this retracted position, upper and lower ends 81, 83 of the inner wedging blade 36 are aligned with the first and second ends 26, 28 of the central tube 2, and the flat longitudinal edge 56 of the outer blade 34 protrudes only slightly from the outer edge 66 of the guide plates 32.

[0055] The conductor 5 is then run and located in the desired position in the sea floor and platform structure. Because the outer and inner blade members 34, 36 are in a retracted position during this procedure there is sufficient clearance between the centralizer 1 and the bore

7, for example a conductor guide, so that the tubular member 5, for example a conductor, passes easily through the conductor guide.

[0056] Once the conductor 5 is in the correct position, the centralizer 1 is lowered within the conductor guide bore 7 by means of steel ropes (not shown) attached to lugs 33. The release cables 98 are then pulled which causes the wedging member release pins 80 to be pulled out of the holes 78, 62 through the guide plates 32 and outer blade 34. By continued pulling on the release cables 98, the wedging member release pins 80 may be retrieved to the surface or the production platform.

[0057] With the wedging member release pins 80 removed there is nothing preventing the inner wedging blade 36 from dropping down under its own weight. As the wedging blade 36 drops, so that the lower end 83 of the wedging blade 36 extends beyond the lower end 28 of the central tube 2, the matching ramped and inclined surfaces 42, 52 on the wedging blade 36 and outer blade 34 slide over each other. Due to the angle of the ramped and inclined surfaces and the fact that the movement of the wedging blade 36 is constrained by the first flat longitudinal edge 38 of the wedging blade sliding along the external surface 20 of the central tube 2, the downward movement of the inner wedging blade 36 causes radially outward movement of the outer blade 34.

[0058] The movement of the outer blade 34 is, in turn, constrained by the sliding of the shafts 87 of the guide bolts along the slots 82, as the outer blade moves from the retracted to an extended position. The shafts and slots therefore comprise together with the parallel guide plates 32 the guiding mounts 3. In this example, the slots are inclined slightly so that as the outer blade 34 moves outwards there is also a small component of movement in the downwards direction. The slots 82 are angled downwards and radially outwards preferably at between about 5° to 15° below horizontal, so that the outwards movement of the outer blade 34 is substantially in a radial direction. The angle of the slot 82 causes the outer blade to move downwards as well as outwards, so the movement of the outer blade is assisted, and not hindered, by gravity and the weight of the outer blade.

[0059] The outer blades 34 move outwards until the outer contact surface 56 of the outer blade 34 contacts the inner surface 7 of the conductor guide. In this extended position, the flat longitudinal edge 56 of the outer blade 34 protrudes significantly from the outer edge 66 of the guide plates 32.

[0060] In this embodiment, the mating ramped and inclined surfaces 42, 52 of the wedging blade 36 and outer blade 34 are serrated in order to provide a securing means to prevent the outer blade from moving radially inwards. As such, each of the ramped and inclined surfaces 42, 52 includes a plurality of projecting, angled teeth 85, as shown most clearly in the insert of Figure 7. Once the wedging inner blade 36 has dropped to its longitudinally extended position, the corresponding saw-tooth projections 85 on each of the ramped and in-

clined surfaces 42, 52 engage with each other in the manner of a ratchet. In this way, the saw-tooth projections 85 form a linear ratchet mechanism to prevent the outer and inner blades 34, 36 moving back to a retracted position.

[0061] Because the centralizer 1 includes four abutments 18 spaced around the circumference of the centralizer 1, the guide plates 32 act to centralise the conductor 5 within the conductor guide bore 7 to some degree while the outer and inner blades 34, 36 are still in a retracted position. The extension of each of the outer blades 34 then further minimises the gap between the centralizer 1 and the conductor guide bore 7 to prevent or minimise lateral movement of the conductor 5 within the conductor guide.

[0062] Typically the loads and force directions on the conductor 5 and the conductor guide are such that the wedging blade 36 will not be pushed in an upwards direction. As such, the outer blade 34 will always fill the gap between the centralizer 1 and the conductor guide bore 7 with minimum clearance and without preload on the centralizer 1 or guide.

[0063] Although in the above embodiment the wedging member release pins 80 were removed by the use of flexible, elongate release cables 98, in other embodiments it may be preferable to use other release means to remove the wedging member release pins 80. For example, the release pins 80 may be removed by the use of remotely operated hydraulic cylinders (not shown).

[0064] Figures 8 to 11 show various views of a centralizer 101 according to a second preferred embodiment of the present invention. Features which are the same as those of the first embodiment are indicated using the same reference numerals, and as such features work in the same way as those of the first embodiment, these will not be described again in full detail. Features which have been modified in some way as compared with the first embodiment are indicated using reference numerals incremented by 100, and will be described insofar the functioning of these features differs from the first embodiment.

[0065] As with the first embodiment, the centralizer 101 is designed to locate between a tubular member 5, for example a conductor, and a bore 7 in order to reduce conductor movement to a minimum. As will be explained below, the centralizer 101 is adapted to be used in more remote locations than the first embodiment, for example near the sea bed.

[0066] The second embodiment of centralizer 101 differs from the first embodiment mainly in that each pair of guiding plates 132 is truncated at the top end 122, and in that each guiding plate is provided with a clearance hole 58. The top ends 122 of the guiding plates 132 together present aligned uppermost surfaces 25 which lie just above and parallel with the upper edge 22 of the tubular main body 102. These uppermost surfaces 25 of the centralizer 101 provide a flat platform on which a deployment collar 10 is located. The deployment collar 10 is shown separately in Figures 12 to 14. During installa-

tion of the centralizer 101, the deployment collar 10 is temporarily attached to the centralizer 101 to form a centralizer deployment assembly 50, as illustrated in Figures 15 to 18.

[0067] The deployment collar 10 is substantially ring-shaped, having a split annular main body 27 formed in two semi-circular rings 23, 29 that define a collar axis 104. Each ring 23, 29 is a flat plate of steel material, extending in a half annulus between opposite ends 35, 35', three of which 35 are square and one of which 35' is partly curved so that the half rings 23, 29 can pivot apart about a hinge 39 by which one pair of opposed ends 35, 35' of the half rings 23, 29 are joined. The hinge includes a pair of joining plates 41 welded on opposite sides to one of the half rings 29 and a pivot, which is provided by a bolt 45, fixed to the other half ring 23. The bolt 45 which passes through aligned holes (not shown) in the joining plates 41 and the rounded end 35' of one half ring 23 to engage with a nut 47.

[0068] The other pair of opposed ends 35 of the half rings may be connected and disconnected by means of a pair of locking plates 43 welded on opposite sides to one of the half rings 29 and by a pair of bolts 49 then extend through holes (not shown) in both the locking plates 43 and one of the half ring ends 35 which slots between the locking plates when the rings 23, 29 are pivoted to a closed orientation. The pair of bolts 45 can then be tightened or released by means of a pair of nuts 51 threaded on the bolts in order to place or remove the deployment ring around the tubular member 5 to which the centralizer 101 is to be secured.

[0069] The deployment collar 10 has a plurality of steel lifting brackets 53, in this example eight, each of which extends in an axial direction from an upper side 55 of the annular main body 27. Each lifting bracket is topped by a lifting lug 57 by which the collar may be lowered into place, after assembling around the tubular member 5 and prior to connection to the centralizer 101. Although not illustrated, steel ropes and shackles would, in use, be connected to each of the lifting lugs 57. A radial inner side of each lifting bracket 53 is provided with a roller 59 to minimise scraping and prevent snagging of the deployment collar 10 on the tubular member as the collar is being lowered or raised.

[0070] Also on the upper side 55 of the annular main body 27 is provided a plurality of cylinders 61, of a hydraulic ram actuator 40 having a longitudinally movable piston 63, shown schematically in Figure 16. In this example, there are four such actuators 40. These actuators are an activating mechanism for controllably applying a force in an axial direction away from the collar main body for activating a radial adjustment mechanism of the centralizer. In this example, this force is applied to the movable wedge plate 136. Parts of the activating mechanism not shown include hydraulic lines and associated hydraulic control equipment. The hydraulic lines will be connected at ports 68 on each cylinder and routed through apertures 69 in each lifting bracket 53 to be fixed to a routing

bracket 71 extending upwards from the upper side 55 of the annular main body 27. From the routing bracket, hydraulic lines may extend back to the surface, or may terminate at a manifold to which a remotely operated vehicle may be connected.

[0071] Two of the actuators 40 for the activating mechanism are mounted to each of the half rings 23, 29, so the ram actuators are spaced equidistantly around the annular main body 27 of the deployment collar 10. As shown in Figure 16, each piston 63 when activated moves axially downwardly through a corresponding clearance hole 65 in the flat plate of steel material forming the half ring 23, 29.

[0072] A plurality of latching mechanisms, in this example four, are provided around the ring of the collar main body 27 for latching to and de-latching from the upper end 26 of the centralizer main body so that, in use, the deployment collar 10 may be temporarily mounted to the centralizer. In this example, the latching mechanism includes a plurality of ram actuators 90 each having a cylinder 73 and a tangentially movable piston 70. Each of the latching ram actuators is oriented in a circumferential direction, being mounted on a first steel flange plate 77. A second steel flange plate 79 is provided on an opposite side of the first flange plate 77 from the cylinder 73. The first and second flange plates 77, 79 are parallel with each other and extend downwardly from a lower side 67 of the annular main body 27.

[0073] Each pair of flange plates 77, 79 is directly beneath and radially inside one of the clearance holes 65 in the half rings 23, 29. Each flange plate 77, 79 lies in an approximately radial plane and is parallel with the collar axis 104. Each flange plate has a clearance hole 37, the location of which is indicated by dots in Figure 15, these clearance holes being aligned to receive the piston 70 when the latching ram actuator is activated. Parts of the latching mechanism not shown include hydraulic lines, would be connected to inlet and outlet ports 88 and associated hydraulic control equipment. The hydraulic lines will be routed back to the routing bracket 71.

[0074] The deployment collar 10 also includes four cameras 9, mounted on the lower side 67 of the collar main body 27. Although electrical wiring to each camera is not illustrated, this wiring will be routed back to the routing bracket 71.

[0075] The deployment collar 10 is lowered towards the centralizer with the pistons 70 of the latching rams 90 fully retracted into the corresponding cylinders 73. The separation between the flange plates 77, 79 is just wider than the distance between the opposite faces 191, 193 of the pair of guiding plates 132, so that as the deployment collar 10 is lowered towards the upper edges 25 of the guiding plates 132, the upper end 122 of each guiding plate 132 slots in between the flange plates 77, 79. The correct positioning of the deployment collar 10 relative to the centralizer 101 may then be verified using the camera 9. When correctly aligned, the latching clearance holes 58 in the guiding plates 132 will be aligned with the

clearance holes 83 in the flange plates 77, 79.

[0076] Once in place, the latching mechanism 90 is used to temporarily secure the deployment collar 10 to the centralizer, as shown in Figure 17, thereby forming the centralizer deployment assembly 50. When the latching mechanism pistons 70 are extended, these pass through the latching holes 58 in each guiding member 132 and through each of the clearance hole 83 in the flange plates 77, 79. The top edge 181 of the movable wedge plate 136 is also shaped to accommodate the piston 70, but does not engage with the piston, so that the wedge plate is free to be driven downwards by the activating piston 63 once the wedging member release pin 80 has been withdrawn, for example by a remotely operated vehicle. Alternatively, the force applied to the movable wedge plate 136 by the cylinder 73 could be sufficient to shear through the pin.

[0077] As with the first embodiment 1, the outer blade 134 then moves outwards with the meshed saw teeth providing a ratchet effect which, together with the ambient force of gravity on the wedge plate 136, prevents the outer blade from becoming disengaged with the bore 7 once the adjustable abutments 118 of the centralizer 101 have been fully extended, as shown in Figure 18.

[0078] During this operation, the four cameras 9 can also be used to make a visual check that each of the outer blades contact surfaces 56 is making a proper contact with the bore 7.

[0079] The pistons 75 can then be retracted, thereby releasing the deployment collar 10 from the centralizer 101. The deployment collar can then be pulled up to the surface, and, if necessary, disengaged from the tubular member 5.

[0080] Typically, the centralizer 1, 101 will include four abutments 18, 118, however, it will be appreciated that the centralizer may include more than four abutments, or may include only two or three abutments, at least two of which are adjustable. If a centralizer includes only two abutments then these are preferably located on opposite sides of the centralizer at right angles or thereabouts to one another.

[0081] The present invention, therefore, provides an improved centralizer, suitable for use in an oil or gas production installation, which minimises the clearance between inner tubular member and an outer bore such as a platform guide or outer tubular member or guide, and which, in particular, may be used to reduce to a minimum any conductor movement within a conductor guide.

Claims

1. A centralizer (1, 101) suitable for centralising a tubular member (5) within a bore (7), the centralizer comprising a main body (2, 102) adapted to be connectable around a tubular member (5) to be centralised, the main body defining a longitudinal axis (4) of the centralizer, and a plurality of longitudinally ex-

tending abutments (18, 118) spaced apart around the main body (2, 102), each abutment extending radially outwards from the main body for making abutting contact with said bore and at least one of said abutments having an adjustment mechanism (3, 103, 34, 134, 36, 136, 42) for making a radially adjustable abutting contact with said bore, said adjustment mechanism comprising a radially movable outer blade (34, 134) for making said abutting contact, a longitudinally movable wedging member (36, 136) located between the outer blade and the main body (2, 102) for moving the outer blade radially into said abutting contact, at least one guiding mount (3, 103) for guiding said radial movement of the outer blade, and at least one longitudinally extending ramp surface (42), said ramp surface being inclined with respect to said axis (4), wherein:

- the outer blade (34, 134) is constrained to move in a substantially radial direction by said at least one guiding mount (3, 103); and

- the wedging member is constrained between the outer blade and the main body (2, 102) to move in a substantially longitudinal direction, the wedging member and said at least one ramp surface being configured to engage with one another such that as the wedging member moves longitudinally, the wedging member causes the outer blade to move radially,

characterized in that the arrangement of the wedging member (36, 136) and the outer blade (34, 134) is such that when the longitudinal axis (4) is substantially vertical, the weight of the wedging member automatically causes the wedging member to drop, thereby moving the outer blade in said radially outwards direction.

2. A centralizer (1, 101) as claimed in Claim 1, in which the wedging member (36, 136) and said ramp surface (42) have therebetween mating surfaces (42, 52) including said at least one ramp surface, said mating surfaces being inclined relative to said longitudinal axis (4) so that said movement of the wedging member (36, 136) in a first longitudinal direction causes said movement of the outer blade (34, 134) in a radially outwards direction as the wedging member moves relative to said ramp surface, there being a plurality of pairs of said inclined mating surfaces, said pairs being spaced longitudinally apart and being separated by substantially radially extending steps in each of said mating surfaces.
3. A centralizer (1, 101) as claimed in Claim 2, in which said at least one guiding mount comprises a pair of guiding plates and said plurality of pairs of said inclined mating surfaces and said plurality of separating steps, together with said pair of said guiding plates, serve to retain the wedging member to the

main body (2, 102).

4. A centralizer (1, 101) as claimed in any preceding claim, in which at least one of the wedging member (36, 136) and the outer blade (34, 134) comprise securing means (85) to prevent movement of the wedging member in a longitudinal direction in which the wedging member causes or permits the outer blade to move radially inwards, said securing means being provided on opposing surfaces (42, 52) between the wedging member (36, 136) and ramp surface said opposing surfaces being textured with a saw-tooth profile (85) such that the opposing surfaces engage to prevent movement of the wedging member in said longitudinal direction in which the wedging member causes or permits the outer blade to move radially inwards but does not prevent movement in an opposite longitudinal direction.
5. A centralizer (1, 101) as claimed in any preceding claim, in which said at least one guiding mount (3, 103) comprises a pair of plates (32, 132), said plates extending radially outwards from the main body (2, 102), the wedging member and the outer blade being mounted between said pair of plates.
6. A centralizer (1, 101) as claimed in Claim 5, in which the outer blade (34, 134) is mounted to the pair of plates (32, 132) in such a way as to limit the extent of radial movement of the outer blade from a retracted position, nearest the main body (2, 102), to an extended position, furthest from the main body.
7. A centralizer (1, 101) as claimed in Claim 6, in which the outer blade (34, 134) includes a slot (82), and a pin (87) carried by the pair of plates (32, 132) extends through the slot so as to adjustably mount the outer blade to the plates.
8. A centralizer (1, 101) as claimed in any preceding claim, in which the centralizer further comprises a wedging member release means (13, 62, 78, 80) connectable to said wedging member (36, 136), said release means retaining the wedging member in a first, retracted position and preventing the wedging member moving in a longitudinal direction under gravity.
9. A centralizer (1, 101) as claimed in Claim 8, in which the wedging member (36, 136) and the outer blade (34, 134) are mounted between a pair of plates (32, 132), and the wedging member release means comprises a hole (78) in the wedging member, a corresponding hole (62) in at least one of the plates and a removable wedging member release pin (80) extending through said holes in the wedging member and at least one of the plates.

10. A centralizer (1, 101) as claimed in any preceding claim, in which the centralizer further comprises outer blade release means (60, 60', 72, 72', 74, 75) connectable to said wedging member (36, 136) and the outer blade (34, 134), said release means retaining the wedging member in a first, retracted position and preventing the wedging member moving in a longitudinal direction under gravity.
11. A centralizer (1, 101) as claimed in Claim 10, in which the wedging member and the outer blade are mounted between a pair of plates (32, 132), and the outer blade release means comprises a hole (72, 72') in the outer blade, a corresponding hole (60, 60') in at least one of the plates (32, 132) and a removable outer blade release pin (74, 75) extending through said holes in the outer blade and at least one of the plates.
12. A deployment collar (10) for temporary mounting to a substantially cylindrical centralizer (101) for centralising a tubular member (5) within a bore (7), the deployment collar comprising a ring-like main body (27) defining a longitudinal axis (104) of the deployment collar and having mounted to the collar main body (27) a latching mechanism (70, 73, 77, 79, 90) and an activating mechanism (40, 61, 63), wherein:
- the latching mechanism is provided around the collar main body (27) for latching to and de-latching from an upper end (26) of a centralizer so that, in use, the deployment collar may be temporarily mounted to said centralizer (101); and
 - the activating mechanism includes at least one actuator (40), said actuator being configured, in use, to applying a force in an axial direction for activating a radial adjustment mechanism of said centralizer (101).
13. A deployment collar (10) as claimed in Claim 12, in which the latching mechanism comprises at least one hydraulically or electrically operable ram actuators (90), said ram actuators including a piston (70) for engaging and disengaging with said centralizer (101), the piston being movable in a tangential direction relative to said axis (104) of the deployment collar as the centralizer deployment assembly latches and de-latches from said centralizer (101).
14. A deployment collar (10) as claimed in Claim 12 or Claim 13, in which said at least one actuator of the activating mechanism includes a hydraulically or electrically operable ram actuator (40), said ram actuator including a piston (63), the piston being movable in a direction parallel with said axis (104) of the deployment collar as the centralizer deployment assembly activates the radial adjustment mechanism of said centralizer (101).
15. A centralizer deployment assembly (50) comprising a centralizer (101) suitable for centralising a tubular member (5) within a bore (7), and a deployment collar (10) for temporary mounting to said centralizer when said centralizer is to be connected to said tubular member (5), the centralizer (101) being as claimed in any one of Claims 1 to 11 and the deployment collar (10) being as claimed in any one of Claims 12 to 14, wherein the deployment collar is temporarily mountable to said centralizer by means of the latching mechanism (70, 73, 77, 79, 90) in such a way that said activating mechanism (40, 61, 63) is configured relative to the centralizer to activate the wedging member (136) of an adjustment mechanism of one of said abutments (118) in order to make said radially adjustable abutting contact of said abutment with said bore.
16. A method of using a centralizer (1, 101) to centralise a tubular member (5) within a bore (7), the centralizer being as claimed in any one of Claims 1 to 11, the method comprising the steps of:
- fixing the main body (2, 102) of the centralizer to the tubular member (5) to be centralised;
 - inserting the tubular member (5) into the bore (7), the bore presenting a gap between the main body (2, 102) and the bore and the abutments (18, 118) extending partially across said gap so that the centralizer is free to move axially in said bore; and
 - moving the wedging member (36, 136) in a substantially longitudinal direction such that the wedging member and said at least one ramp surface (42) engage with one another thereby causing the outer blade (34, 134) to move radially outwards into contact with the bore to centralise the tubular member (5) within the bore (7).
17. A method of using a centralizer deployment assembly (50) to centralise a tubular member (5) within a bore (7), the centralizer deployment assembly being as claimed in Claim 15, the method comprising the steps of:
- fixing the main body (102) of the centralizer (101) to the tubular member (5) to be centralised;
 - inserting the tubular member (5) into the bore (7), the bore presenting a gap between the main body (102) and the bore and the abutments (118) extending partially across said gap so that the centralizer is free to move axially in said bore;
 - inserting the deployment collar (10) into the bore between the tubular member and the bore;
 - using the latching mechanism to temporarily mount the deployment collar (10) to the centralizer (101) in such a way that said activating

mechanism (40, 61, 63) is located to activate the wedging member (136) of a corresponding adjustment mechanism;

- using said activating mechanism to move the wedging member in an axial direction so that the wedging member engages with the ramp surface (42), thereby causing the outer blade (134) to move radially outwards into contact with the bore to centralise the tubular member (5) within the bore (7);
- using the latching mechanism (70, 73, 77, 79, 90) to dismount the deployment collar (10) from the centralizer (101); and
- removing the deployment collar from the bore (7).

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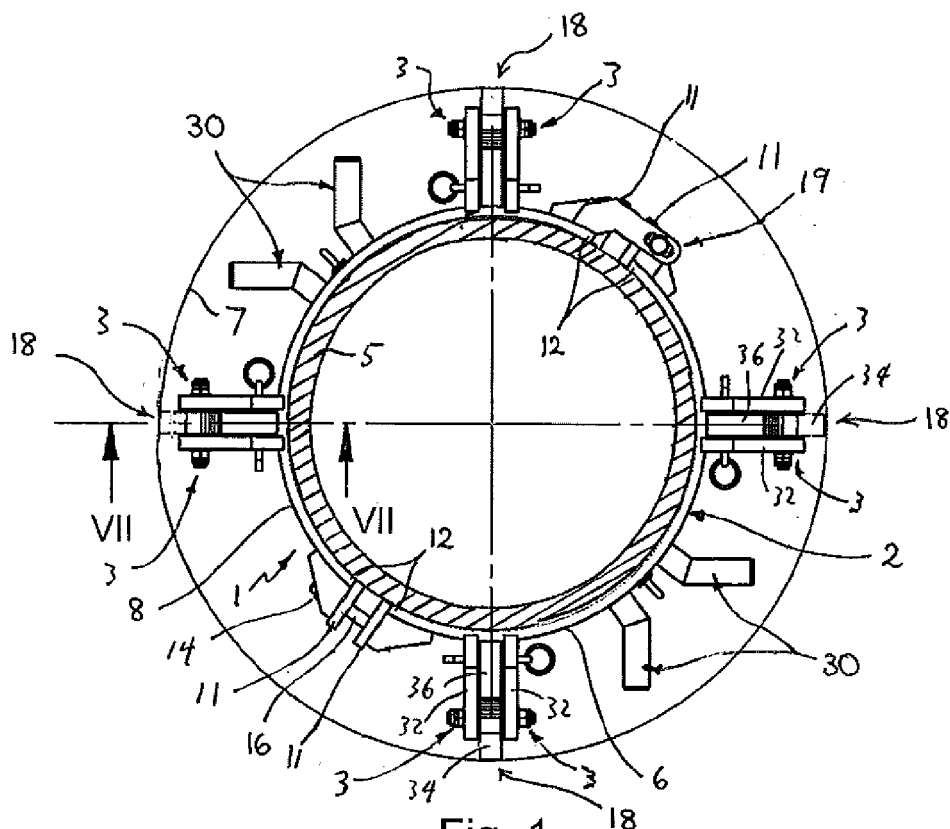


Fig. 1

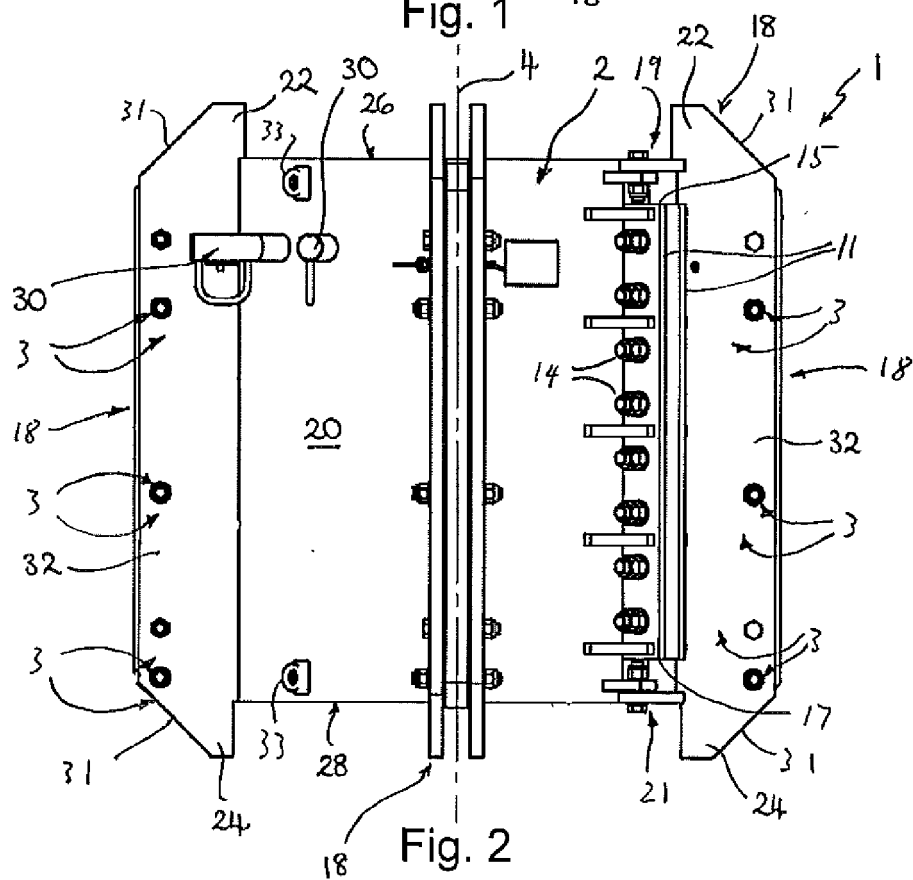


Fig. 2

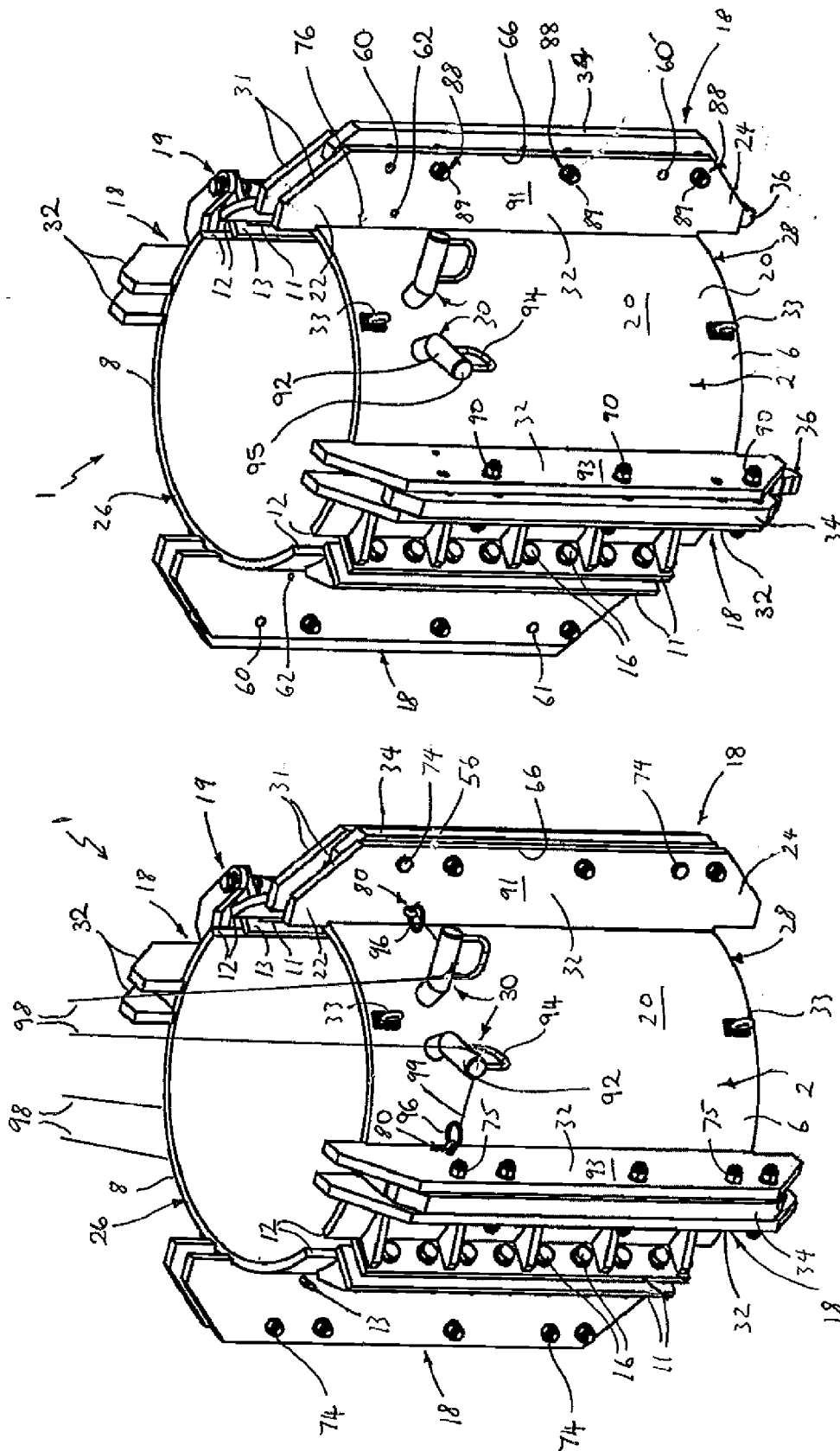


Fig. 4

Fig. 3

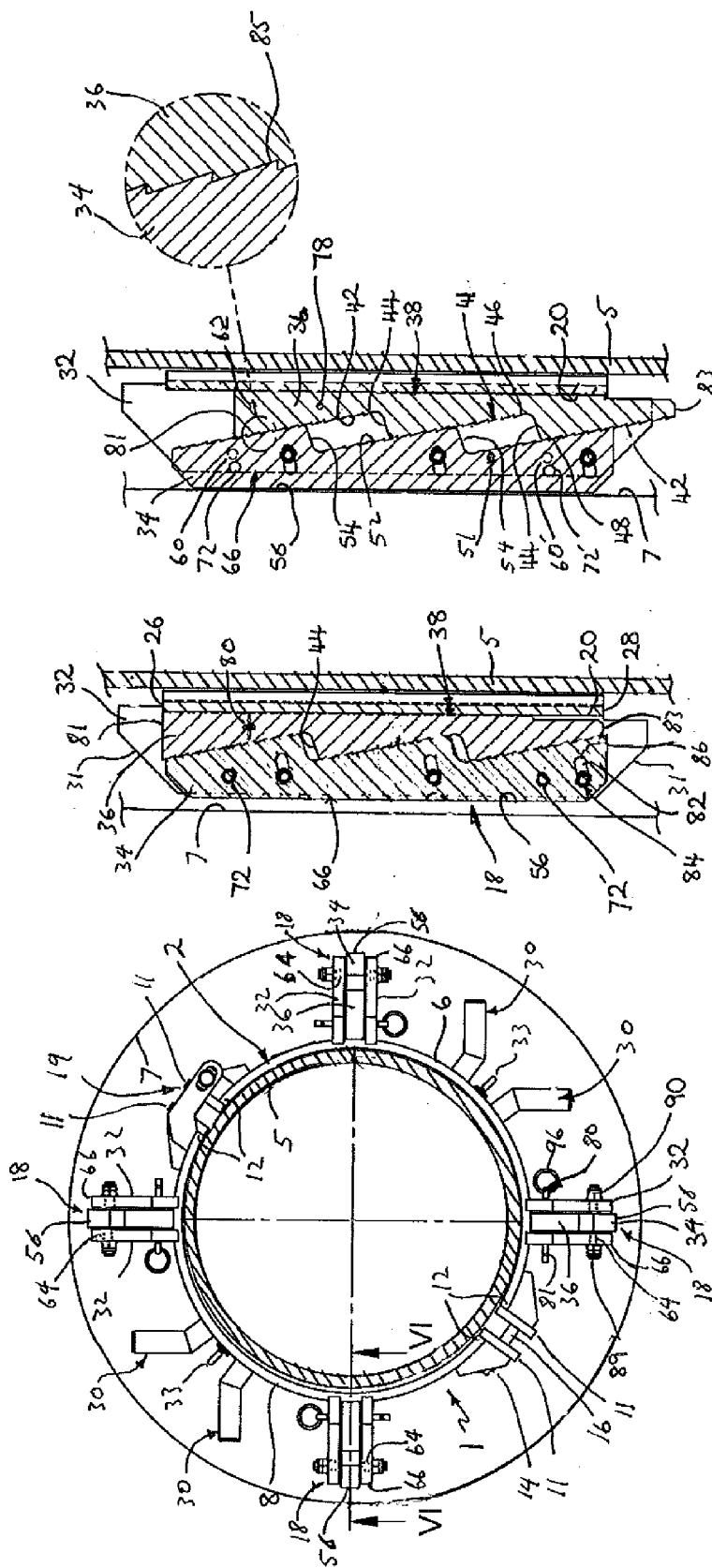
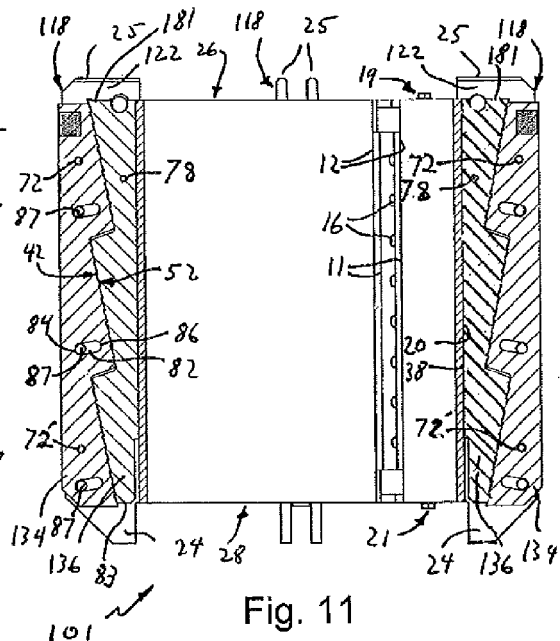
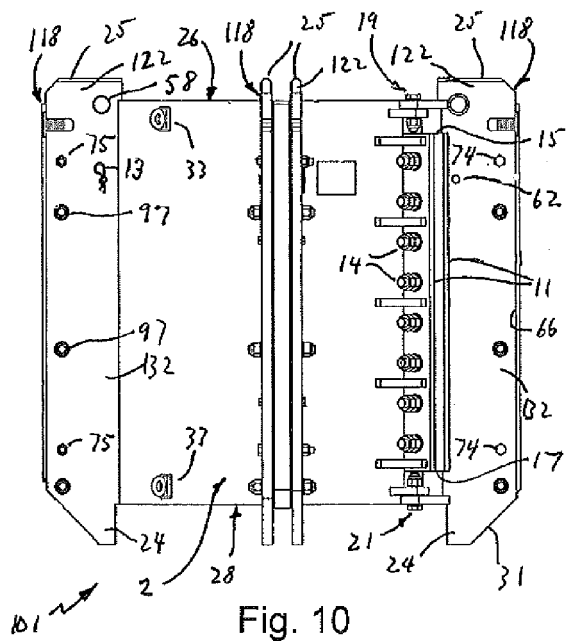
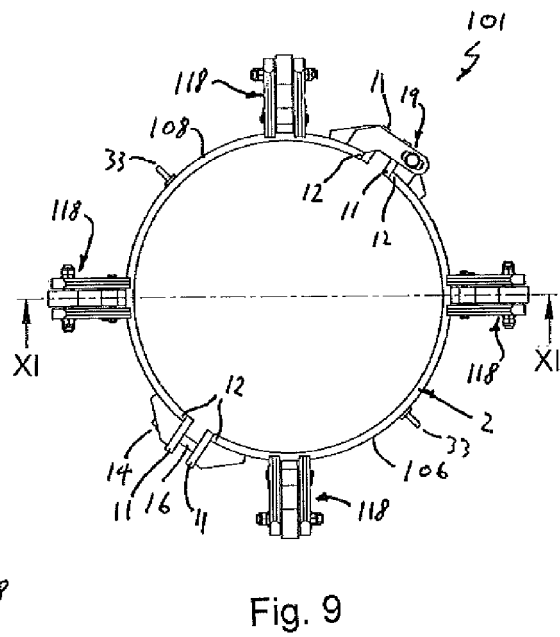
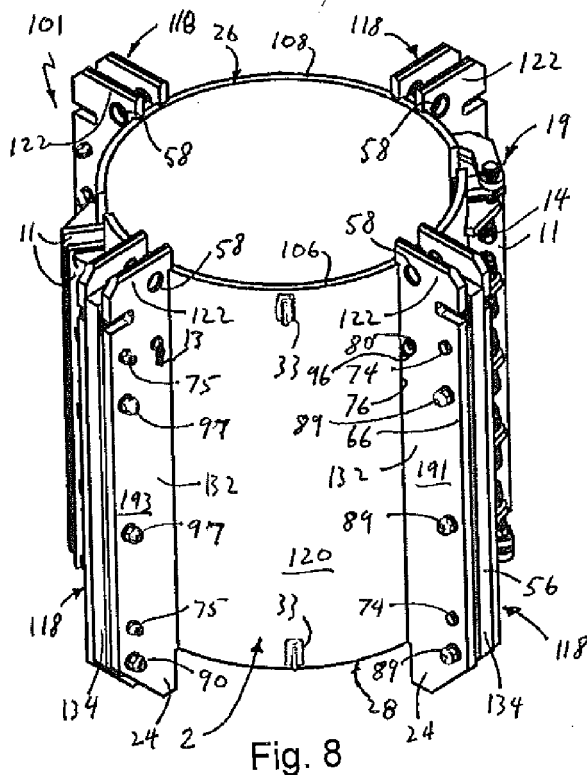
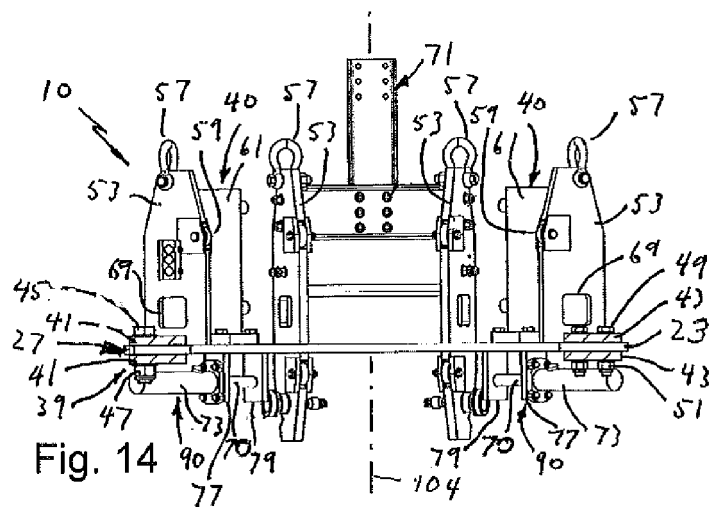
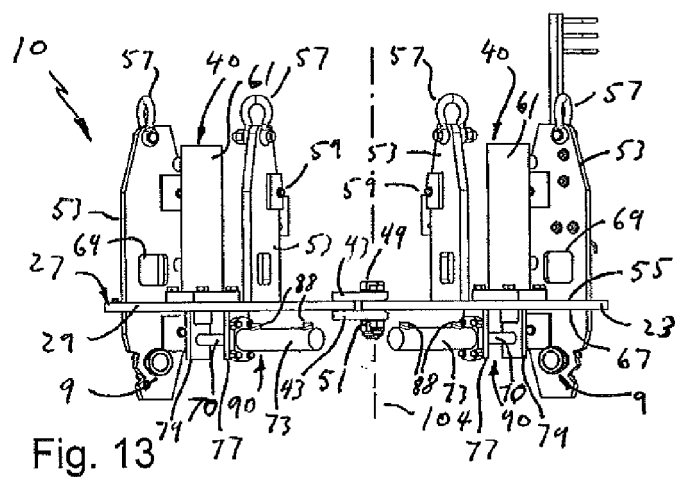
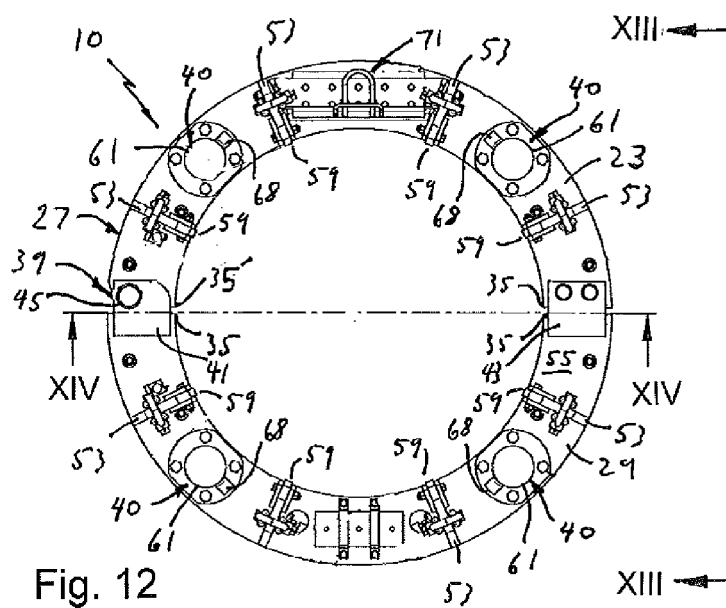


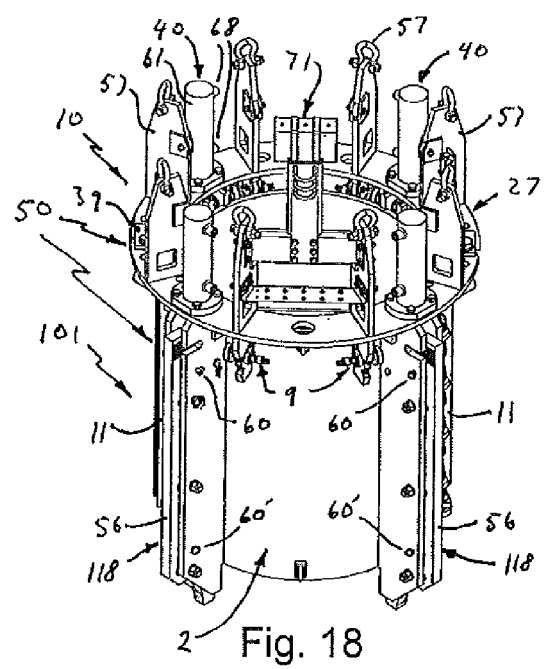
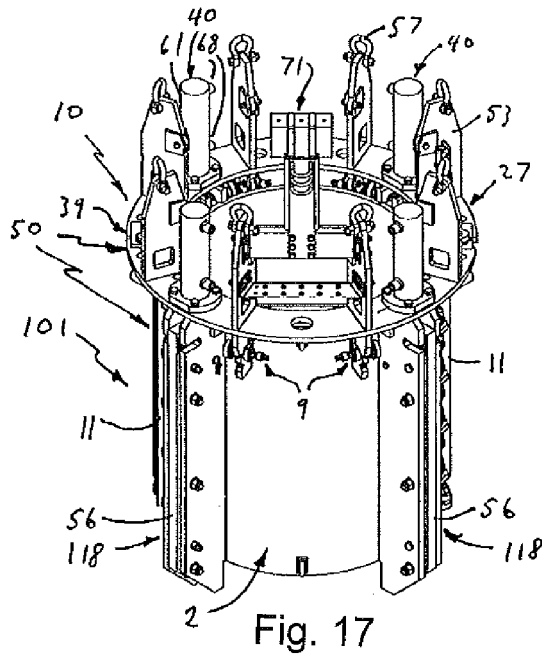
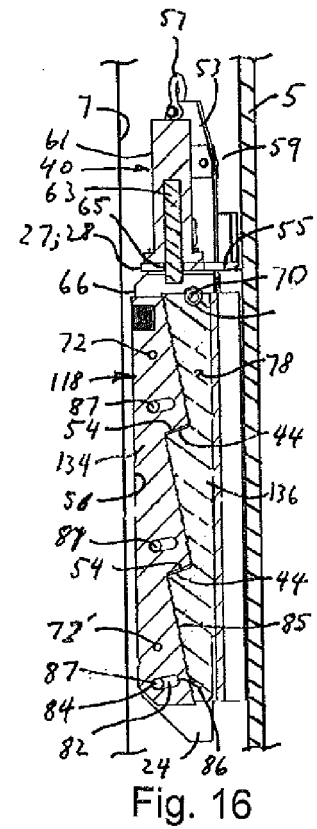
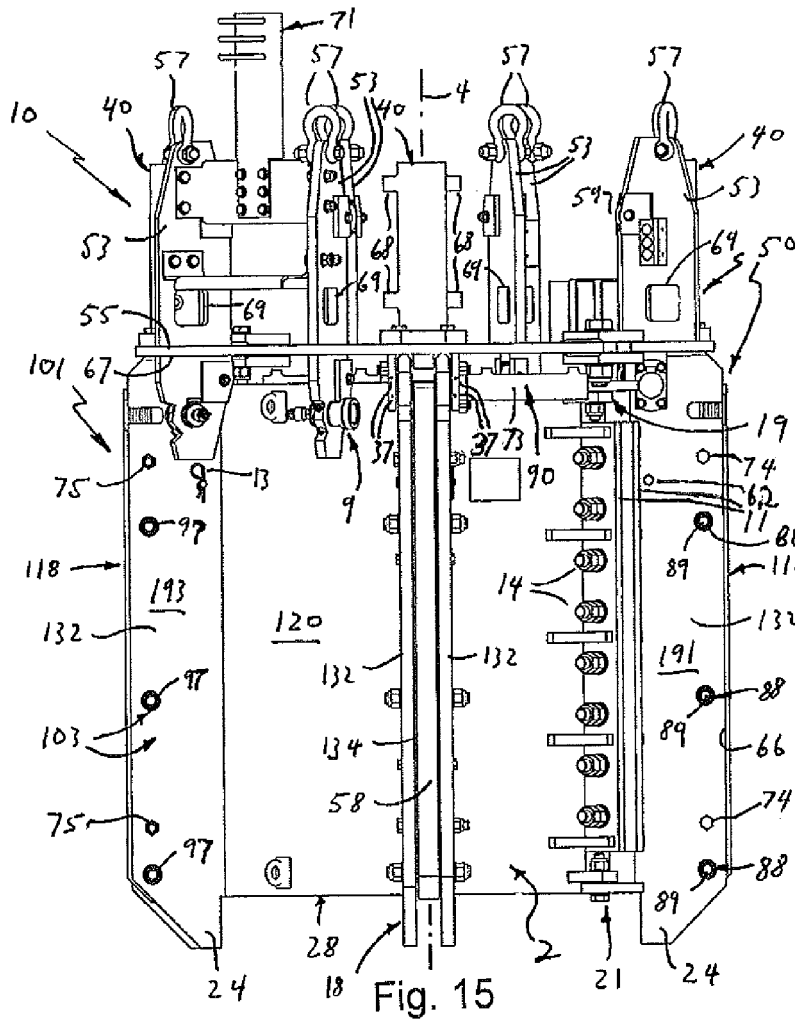
Fig. 5

Fig. 6

Fig. 7







REFERENCES CITED IN THE DESCRIPTION

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