



(22) Date de dépôt/Filing Date: 1999/08/16

(41) Mise à la disp. pub./Open to Public Insp.: 2000/03/02

(45) Date de délivrance/Issue Date: 2010/10/19

(62) Demande originale/Original Application: 2 340 995

(30) Priorité/Priority: 1998/08/24 (GB9818360.1)

(51) Cl.Int./Int.Cl. *E21B 19/16* (2006.01)

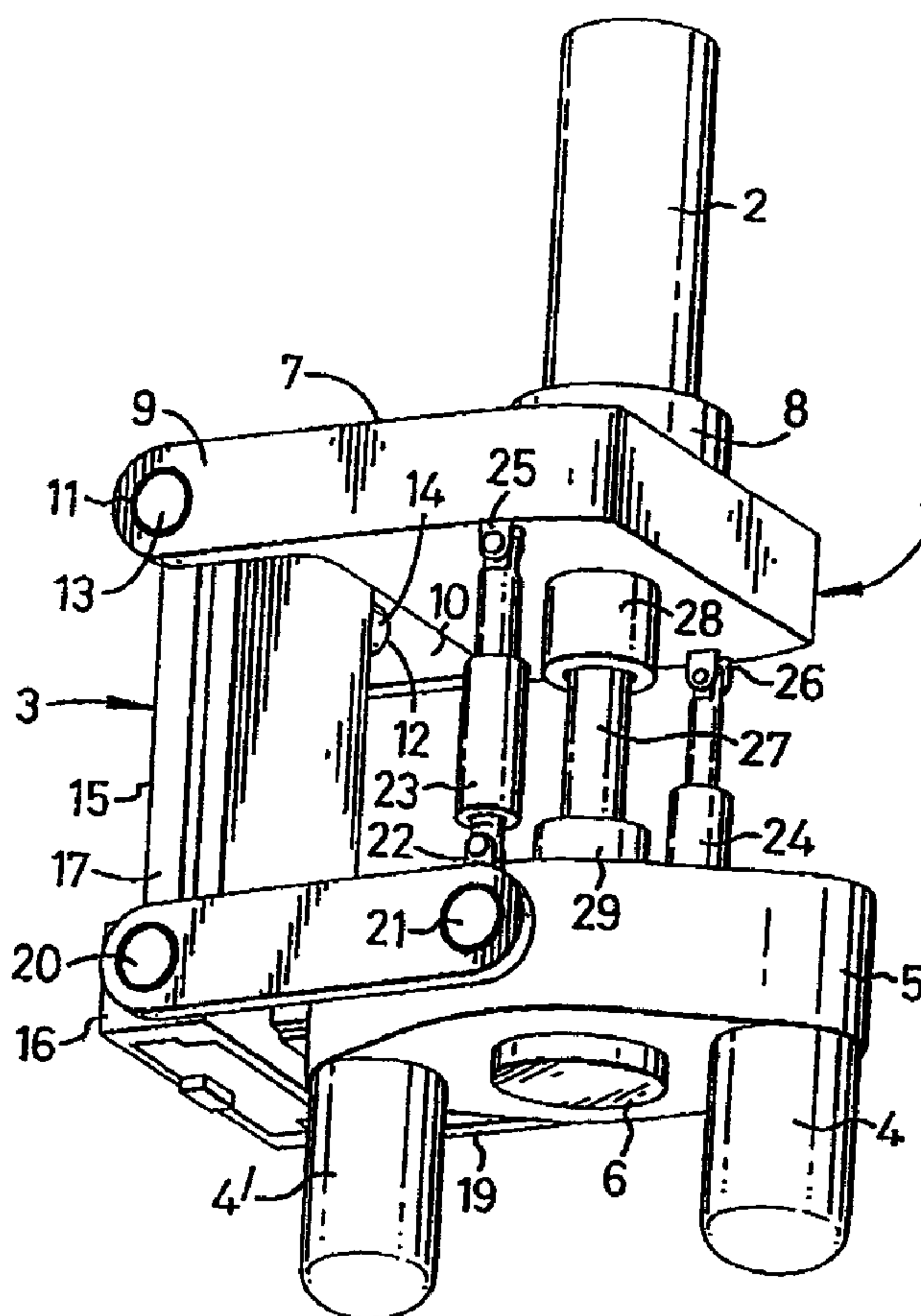
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(54) Titre : APPAREIL DE RACCORDEMENT DE TUBAGES UTILISANT UNE COMMANDE SUPERIEURE

(54) Title: AN APPARATUS FOR CONNECTING TUBULARS USING A TOP DRIVE



(57) Abrégé/Abstract:

An apparatus for facilitating the connection of tubulars using a top drive, said apparatus comprising a motor (4,4') for rotating a tool (30) for drivingly engaging a tubular, and means (3) for connecting said motor (4,4') to said top drive, the apparatus being such that, in use, said motor (4,4') can rotate one tubular with respect to another to connect said tubular.

ABSTRACT

An apparatus for facilitating the connection of tubulars using a top drive, said apparatus comprising a motor (4, 4') for rotating a tool (30) for drivingly engaging a tubular, and means (3) for connecting said motor (4, 4') to said top drive, the apparatus being such that, in use, said motor (4, 4') can rotate one tubular with respect to another to connect said tubular.

AN APPARATUS FOR CONNECTING TUBULARS
USING A TOP DRIVE

This is a divisional application of Canadian Patent Application Serial Number 2,340,995 filed on August 16, 1999.

This invention relates to an apparatus for facilitating the connection of tubulars using a top drive and is more particularly, but not exclusively, intended for facilitating the connection of a section or stand of casing to a string of casing. It should be understood that the expression "the invention" and the like encompasses the subject matter of both the parent and the divisional applications.

In the construction of oil or gas wells it is usually necessary to line the borehole with a string of tubulars known as a casing. Because of the length of the casing required, sections or stands of say two sections of casing are progressively added to the string as it is lowered into the well from a drilling platform. In particular, when it is desired to add a section or stand of casing the string is usually restrained from falling into the well by applying the slips of a spider located in the floor of the drilling platform. The new section or stand of casing is then moved from a rack to the well centre above the spider. The threaded pin of the section or stand of casing to be connected is then located over the threaded box of the casing in the well and the connection is made up by rotation there between. An elevator is then connected to the top of the new section or stand and the whole casing string lifted slightly to enable the slips of the spider to be released. The whole casing string is then lowered until the top of the section is adjacent the spider whereupon the slips of the spider are re-applied, the elevator disconnected and the process repeated.

It is common practice to use a power tong to torque the connection up to a predetermined torque in order to make the connection. The power tong is located on a platform, either on rails, or hung from a derrick on a chain. However, it has recently been proposed to use a top drive for making such connection. The normal use of such a top drive may be the driving of a drill string.

A problem associated with using a top drive for rotating tubulars in order to obtain a connection between tubulars is that some top drives are not specifically designed for rotating tubulars are not able to rotate at the correct speed or have non standard rotors.

According to the present invention there is provided an apparatus for facilitating the connection of tubulars using a top drive, said apparatus comprising a motor for rotating a tool for drivingly engaging a tubular, and means for connecting said motor to said top drive, the apparatus being such that, in use, said motor can rotate one tubular with respect to another to connect said tubulars.

The motor can be hydraulically operable, and the suspension unit can, in use, move the motor relative to the axis of the top drive to facilitate aligning the tubulars. In one embodiment, the suspension unit is provided with at least one piston and cylinder in order to raise and lower the motor. The at least one piston and cylinder can be pneumatically actuated to compensate for the weight of the tubular. Furthermore, suspension unit can comprise spherical bearings to allow movement of the motor in two planes, and the suspension unit can comprise adjustable pistons and cylinders to position the motor.

In one embodiment, the apparatus can further comprise a mud pipe for delivering mud to said tubular. The mud pipe can be provided with a ball joint at both ends thereof.

In one embodiment, the apparatus can be supported by a top drive.

The present invention also provides a method of connecting first and second tubulars for use in lining a borehole, the method comprising: coupling said first tubular to a top drive using a suspension unit, wherein the tubular engages the rotor of a motor supported by the suspension unit; engaging a lower end of said first tubular with an upper end of said second tubular; rotating said first tubular using the motor so as to screw the tubulars together; and tightening the connection between the tubulars by rotating the first tubular using the top drive.

In one embodiment, the method can comprise adjusting the suspension unit prior to tightening the connection using the top drive so as to bring the first tubular into alignment with the top drive.

For a better understanding of the present invention and in order to show how the same may be carried into effect reference will now be made, by way of example, to the accompanying drawings, in which:

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Figure 1 is a front perspective view of an apparatus in accordance with the present invention; and

Figure 2 is a rear perspective view of the apparatus of Figure 1 in use.

Referring to Figure 1 there is shown an apparatus which is generally identified by reference numeral 1.

The apparatus 1 comprises a connecting tubular 2, a suspension unit 3 and a hydraulic motor 4 and 4'. The hydraulic motor 4,4' has a stator 5 and a rotor 6 and is driven by a supply of pressurised hydraulic fluid (the fluid supply lines are not illustrated in the Figures). The suspension unit 3 suspends the hydraulic motor 4,4' from the connecting tubular 2.

The present invention also provides a method of facilitating making of a connection between an upper tubular and a lower tubular, comprising:

- engaging the upper tubular with a tubular engagement tool of a top drive having a suspension unit;
- engaging a lower end of the upper tubular with an upper end of the lower tubular;
- rotating the upper tubular via the tubular engagement tool, thereby threading the tubulars to form the connection;
- torquing the connection via the tubular engagement tool; and
- compensating for movement of the upper tubular with the suspension unit during the threading.

The present invention also provides a method of facilitating making of a connection between an upper tubular and a lower tubular, comprising:

- engaging the upper tubular with a gripping assembly having at least one radially displaceable element for gripping the upper tubular, wherein the gripping assembly is connected to a top drive having a suspension unit;
- compensating for weight of the upper tubular to accommodate movement of the upper tubular while engaged by the gripping assembly;
- engaging a lower end of the upper tubular with an upper end of the lower tubular to form the connection therebetween; and
- delivering torque to the upper tubular via the gripping assembly.

The present invention also provides a method of facilitating making of a connection between an upper tubular and a lower tubular, comprising:

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providing a make-up unit having a top drive, a suspension unit and a tubular engagement tool;
engaging the upper tubular with the tubular engagement tool;
engaging a lower end of the upper tubular with an upper end of the lower tubular;
rotating the upper tubular with the top drive via the tubular engagement tool, thereby threading the tubulars to form the connection;
torquing the connection with the top drive via the tubular engagement tool; and
compensating for movement of the upper tubular with the suspension unit during the threading.

The present invention also provides a method of facilitating making of a connection between an upper tubular and a lower tubular, comprising:

engaging the upper tubular with a tubular engagement tool attached to a suspension unit;
engaging a lower end of the upper tubular with an upper end of the lower tubular;
rotating the upper tubular via the tubular engagement tool, thereby threading the tubulars to form the connection;
torquing the connection via the tubular engagement tool; and
compensating for movement of the upper tubular with the suspension unit during the threading.

The present invention also provides a method of facilitating making of a connection between an upper tubular and a lower tubular, comprising:

engaging the upper tubular with a gripping assembly having at least one radially displaceable element for gripping the upper tubular, wherein the gripping assembly is connected to a suspension unit;
compensating for weight of the upper tubular to accommodate movement of the upper tubular while engaged by the gripping assembly;
engaging a lower end of the upper tubular with an upper end of the lower tubular to form the connection therebetween; and
delivering torque to the upper tubular via the gripping assembly.

The present invention also provides an apparatus for making a connection between an upper tubular and a lower tubular, comprising:

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a tubular engagement tool for gripping the upper tubular, wherein the tubular engagement tool includes at least one gripping element displaceable in a radial direction for engagement with a wall of the upper tubular in an engaged position; and

a suspension unit connected to the tubular engagement tool, the suspension unit having a motor for rotating the tubular engagement tool and a compensation portion, wherein, with the tubular engagement tool in the engaged position, the upper tubular is rotatable by the motor and is, relative to the lower tubular, movable along with the tubular engagement tool by operation of the compensation portion to compensate for movement of the upper tubular during making of the connection to the lower tubular.

The suspension unit 3 comprises a plate 7 which is fixed to the connecting tubular 2 by a collar 8. The plate 7 has two projections 9 and 10 which have holes 11 and 12 for accommodating axles 13 and 14, which are rotationally disposed therein. The axles 13 and 14 are integral with a rigid body 15. A slider 16 is arranged on runners 17 and (not shown) on the rigid body 15. Arms 18 and 19 are connected at one end to the slider 16 via spherical bearings 20 and at the other end to each side of the stator 5 via spherical bearings 21 and 21'. The arms 18 and 19 are provided with lugs 22 and 22' to which one end of a piston and cylinder 23, 24 is attached and are movable thereabout. The other end of each piston and cylinder 23, 24 is attached to lugs 25, 26 respectively and is movable thereabout. A mud pipe 27 is provided between the plate 7 and the stator 5 for carrying mud to the inside of a tubular therebelow. The mud pipe 27 comprises curved outer surfaces at both ends (not shown) which are located in corresponding recesses in cylindrical sections 28, 29, thus allowing a ball and socket type movement between the plate 7 and the stator 5.

Referring to Figure 2, the apparatus 1 is suspended from a top drive (not shown) via connecting shaft 2. A tool 30 for engaging with a tubular is suspended from beneath the rotor 6 of the hydraulic motor 4. Such a tool may be arranged to be inserted into the upper end of the tubular, with gripping elements of the tool being radially displaceable for engagement with the inner wall of the tubular so as to secure the tubular to the tool.

In use, a tubular (not shown) to be connected to a tubular string held in a spider (not shown) is located over the tool 30. The tool 30 grips the tubular. The apparatus 1 and the tubular are lowered by moving the top drive so that the tubular is in close proximity with the tubular string held in the spider. However, due to amongst other things manufacturing tolerances in the tubulars, the tubular often does not align

perfectly with the tubular held in the spider. The suspension unit 3 allows minor vertical and horizontal movements to be made by using alignment pistons 31 and 32 for horizontal movements, and piston and cylinders 23 and 24 for vertical movements. The alignment piston 31 acts between the rigid body 15 and the plate 7. The alignment
5 piston 32 acts between the slider 16 and the arm 19. The alignment pistons 31 and 32 and pistons and cylinders 23, 25 are actuated by hydraulic or pneumatic means and controlled from a remote control device.

The piston and cylinders 23, 24 are hydraulically operable. It is envisaged however, that the piston and cylinders 23, 24 may be of the pneumatic compensating
10 type, i.e. their internal pressure may be adjusted to compensate for the weight of the tubular so that movement of the tubular may be conducted with minimal force. This can conveniently be achieved by introducing pneumatic fluid into the piston and cylinder 23, 24 and adjusting the pressure therein.

Once the tubulars are aligned, the hydraulic motor 4 and 4' rotate the tubular via
15 gearing in the stator 5 thereby making up the severed connection. During connection the compensating piston and cylinders 23, 24 expand to accommodate the movement of the upper tubular. The alignment pistons 31 and 32 can then be used to move the top of the tubular into alignment with the top drive. If necessary, final torquing can be conducted by the top drive at this stage, via rotation of the pipe 27, and the main
20 elevator can also be swung onto and connected to the tubular prior to releasing the slips in the spider and lowering the casing string. It will be appreciated that the suspension unit 3 effectively provides an adapter for connecting a top drive to the tubular engaging tool 30.

The embodiments of the invention in which an exclusive property or privilege is claimed are defined as follows:

1. A method of facilitating making of a connection between an upper tubular and a lower tubular, comprising:

engaging the upper tubular with a tubular engagement tool of a top drive having a suspension unit;

engaging a lower end of the upper tubular with an upper end of the lower tubular;

rotating the upper tubular via the tubular engagement tool, thereby threading the tubulars to form the connection;

torquing the connection via the tubular engagement tool; and

compensating for movement of the upper tubular with the suspension unit during the threading.

2. The method of claim 1, further comprising adjusting the suspension unit to move the upper tubular in at least two planes.

3. The method of claim 1 or 2, wherein compensating for movement of the upper tubular comprises pneumatically compensating via at least one piston and cylinder arrangement.

4. A method of facilitating making of a connection between an upper tubular and a lower tubular, comprising:

engaging the upper tubular with a gripping assembly having at least one radially displaceable element for gripping the upper tubular, wherein the gripping assembly is connected to a top drive having a suspension unit;

compensating for weight of the upper tubular to accommodate movement of the upper tubular while engaged by the gripping assembly;

engaging a lower end of the upper tubular with an upper end of the lower tubular to form the connection therebetween; and
delivering torque to the upper tubular via the gripping assembly.

5. The method of claim 4, wherein engaging the lower end of the upper tubular with the upper end of the lower tubular includes rotating the upper tubular, thereby threading the tubulars together.

6. The method of claim 4 or 5, further comprising compensating for movement of the upper tubular with the suspension unit during the threading.

7. The method of claim 4, 5 or 6, further comprising adjusting the suspension unit to move the upper tubular in at least two planes.

8. The method of any one of claims 4 to 7, wherein compensating for weight of the upper tubular comprises compensating via at least one piston and cylinder arrangement.

9. The method of any one of claims 4 to 8, wherein compensating for weight of the upper tubular is pneumatic.

10. A method of facilitating making of a connection between an upper tubular and a lower tubular, comprising:

providing a make-up unit having a top drive, a suspension unit and a tubular engagement tool;

engaging the upper tubular with the tubular engagement tool;

engaging a lower end of the upper tubular with an upper end of the lower tubular;

rotating the upper tubular with the top drive via the tubular engagement tool, thereby threading the tubulars to form the connection;

torquing the connection with the top drive via the tubular engagement tool; and

compensating for movement of the upper tubular with the suspension unit during the threading.

11. The method of claim 10, further comprising adjusting the suspension unit to move the upper tubular in at least two planes.

12. The method of claim 10 or 11, wherein compensating for movement of the upper tubular comprises pneumatically compensating via at least one piston and cylinder arrangement.

13. The method of claim 10 or 11, wherein compensating for movement of the upper tubular comprises compensating via at least one piston and cylinder arrangement.

14. The method of any one of claims 10 to 13, wherein the tubular engagement tool includes at least one gripping element displaceable in a radial direction for engagement with a wall of the upper tubular during engaging the upper tubular.

15. A method of facilitating making of a connection between an upper tubular and a lower tubular, comprising:

engaging the upper tubular with a tubular engagement tool attached to a suspension unit;
engaging a lower end of the upper tubular with an upper end of the lower tubular;
rotating the upper tubular via the tubular engagement tool, thereby threading the tubulars to form the connection;
torquing the connection via the tubular engagement tool; and
compensating for movement of the upper tubular with the suspension unit during the threading.

16. The method of claim 15, wherein the upper tubular is rotated using a motor mounted on the suspension unit.

17. The method of claim 15 or 16, further comprising rotating the upper tubular using a top drive.
18. The method of claim 15, 16 or 17, further comprising adjusting the suspension unit to move the upper tubular in at least two planes.
19. The method of any one of claims 15 to 18, wherein compensating for movement of the upper tubular comprises pneumatically compensating via at least one piston and cylinder arrangement.
20. The method of any one of claims 15 to 18, wherein compensating for movement of the upper tubular comprises compensating via at least one piston and cylinder arrangement.
21. The method of any one of claims 15 to 20, wherein the tubular engagement tool includes at least one gripping element displaceable in a radial direction for engagement with a wall of the upper tubular during engaging the upper tubular.
22. A method of facilitating making of a connection between an upper tubular and a lower tubular, comprising:
- engaging the upper tubular with a gripping assembly having at least one radially displaceable element for gripping the upper tubular, wherein the gripping assembly is connected to a suspension unit;
 - compensating for weight of the upper tubular to accommodate movement of the upper tubular while engaged by the gripping assembly;
 - engaging a lower end of the upper tubular with an upper end of the lower tubular to form the connection therebetween; and
 - delivering torque to the upper tubular via the gripping assembly.

23. The method of claim 22, wherein the torque is generated from a motor mounted to the suspension unit.

24. The method of claim 22 or 23, wherein engaging the lower end of the upper tubular with the upper end of the lower tubular includes rotating the upper tubular, thereby threading the tubulars together.

25. The method of claim 22, 23 or 24, further comprising compensating for movement of the upper tubular with the suspension unit during the threading.

26. The method of any one of claims 22 to 25, further comprising adjusting the suspension unit to move the upper tubular in at least two planes.

27. The method of any one of claims 22 to 26, wherein compensating for weight of the upper tubular comprises compensating via at least one piston and cylinder arrangement.

28. The method of any one of claims 22 to 26, wherein compensating for weight of the upper tubular is pneumatic.

29. An apparatus for making a connection between an upper tubular and a lower tubular, comprising:

a tubular engagement tool for gripping the upper tubular, wherein the tubular engagement tool includes at least one gripping element displaceable in a radial direction for engagement with a wall of the upper tubular in an engaged position; and

a suspension unit connected to the tubular engagement tool, the suspension unit having a motor for rotating the tubular engagement tool and a compensation portion, wherein, with the tubular engagement tool in the engaged position, the upper tubular is rotatable by the

motor and is, relative to the lower tubular, movable along with the tubular engagement tool by operation of the compensation portion to compensate for movement of the upper tubular during making of the connection to the lower tubular.

30. The apparatus of claim 29, further comprising a top drive connected to the suspension unit.

31. The apparatus of claim 30, wherein the top drive is capable of rotating the tubular engagement tool.

32. The apparatus of claim 29, 30 or 31, wherein the suspension unit is adapted to move the tubular engagement tool in the axial direction to compensate for movement of the upper tubular during make up.

33. The apparatus of any one of claims 29 to 32, wherein the suspension unit is adapted to move the upper tubular in at least two planes.

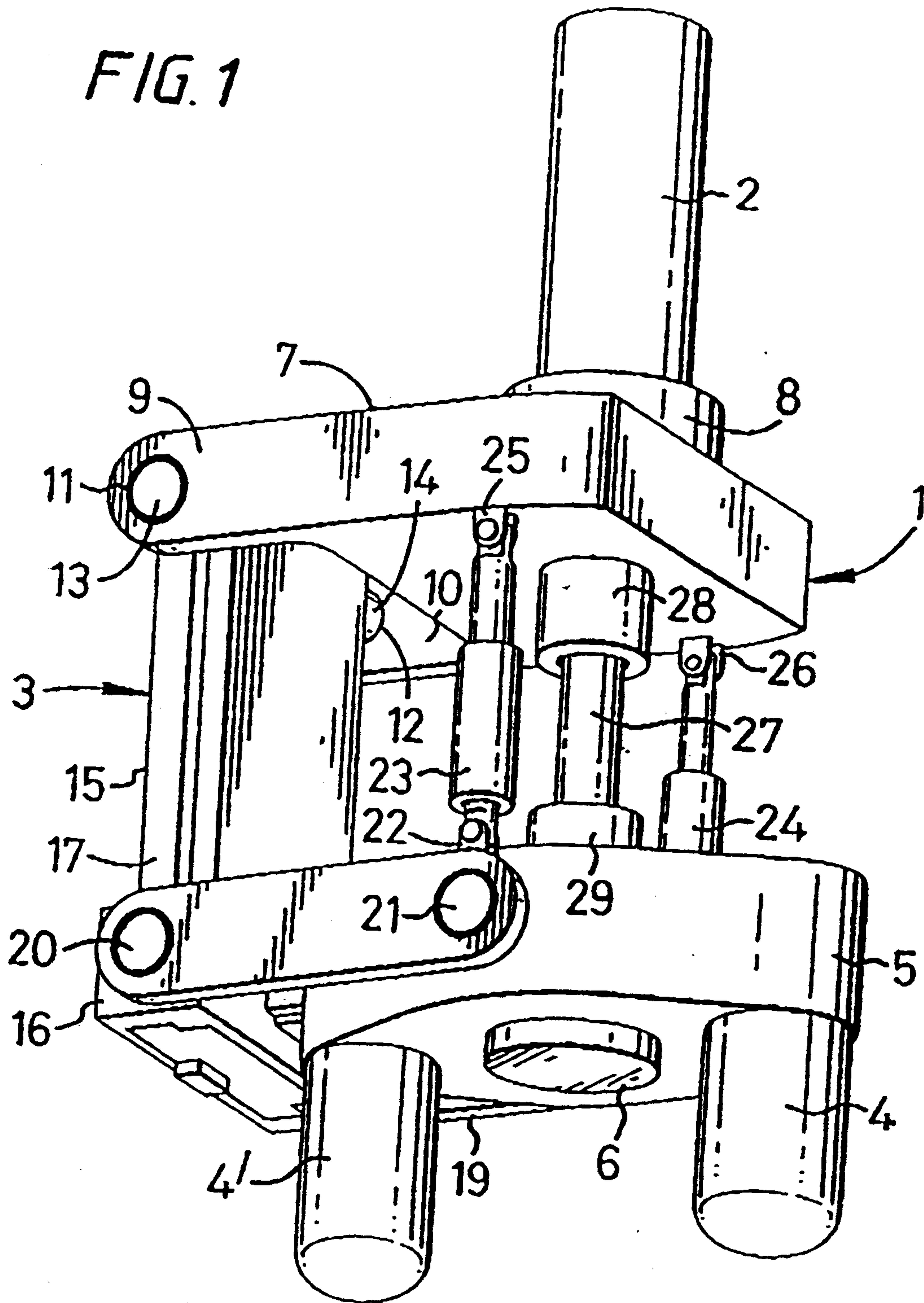
34. The apparatus of any one of claims 29 to 33, wherein the compensation portion comprises at least one piston and cylinder arrangement.

35. The apparatus of any one of claims 29 to 34, further comprising a mud pipe for carrying mud to the tubulars.

36. The apparatus of any one of claims 29 to 35, wherein the at least one gripping element is displaceable for engagement with an inner wall of the upper tubular in the engaged position.

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FIG. 1



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FIG. 2

