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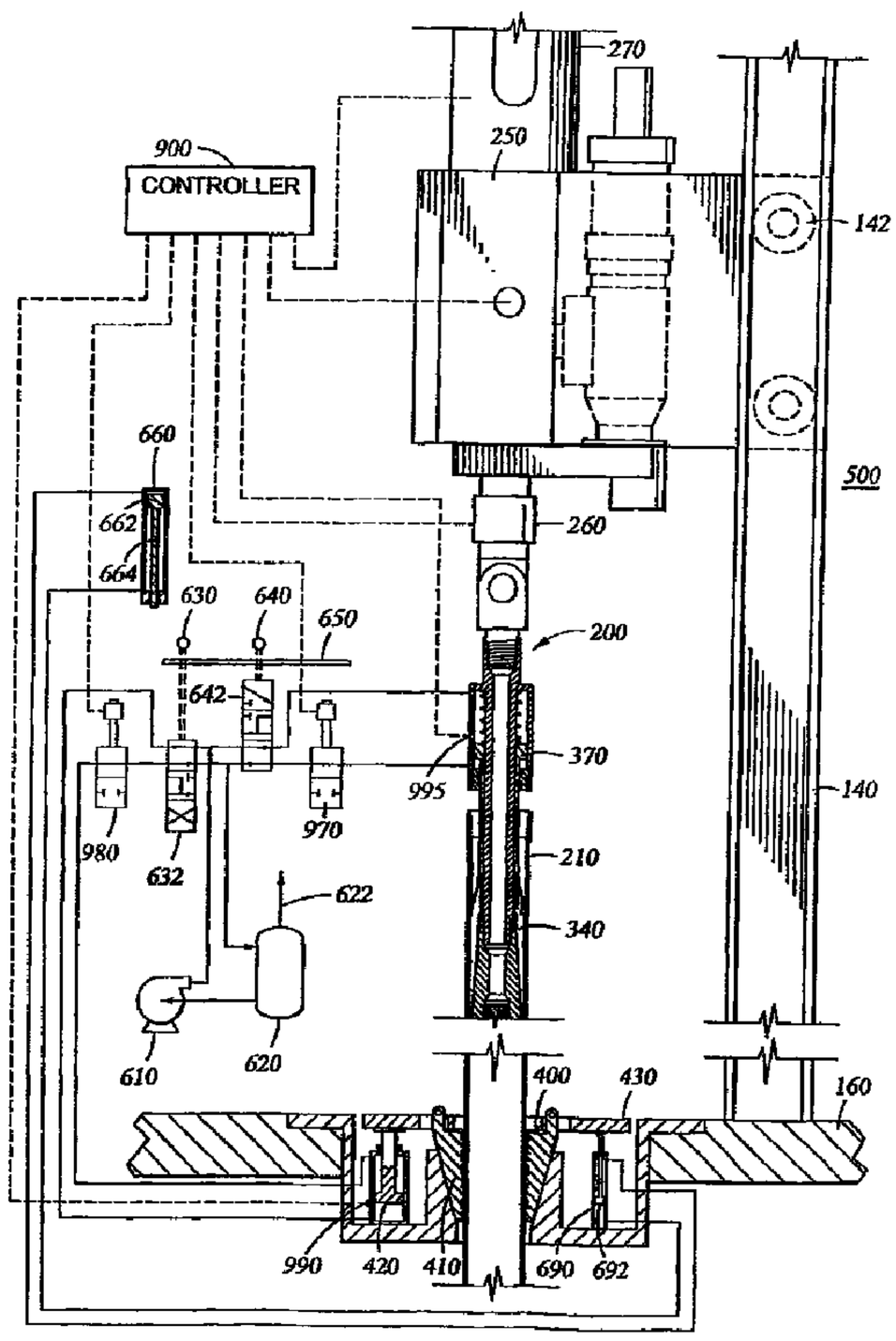
(54) **Titre : APPAREIL ET PROCEDES DE VERROUILLAGE DESTINES A LA FORMATION DE TUBES**
(54) **Title: APPARATUS AND METHODS FOR TUBULAR MAKEUP INTERLOCK**



(57) **Abrégé/Abstract:**
The present invention provides for an apparatus and methods to prevent an operator from inadvertently dropping a string (210) into a wellbore (180) during assembling and disassembling of tubulars. Additionally, the apparatus and methods can be used to for running in casing, running in wellbore components or for a drill string.

Abstract

The present invention provides for an apparatus and methods to prevent an operator from inadvertently dropping a string (210) into a wellbore (180) during assembling and disassembling of tubulars. Additionally, the apparatus and methods can be used to for running in casing, running in wellbore components or for a drill string.

APPARATUS AND METHODS FOR TUBULAR MAKEUP INTERLOCK

This is a divisional application of Canadian Patent Application Serial No. 2 446 687 filed on May 8, 2002.

The present invention relates to an apparatus and methods for facilitating the connection of tubulars.

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 and completion of oil or gas wells, a drilling rig is constructed on the earth's surface to facilitate the insertion and removal of tubular strings into a wellbore. The drilling rig includes a platform and power tools such as an elevator and a spider to engage, assemble, and lower the tubulars into the wellbore. The elevator is suspended above the platform by a draw works that can raise or lower the elevator in relation to the floor of the rig. The spider is mounted in the platform floor. The elevator and spider both have slips that are capable of engaging and releasing a tubular, and are designed to work in tandem. Generally, the spider holds a tubular or tubular string that extends into the wellbore from the platform. The elevator engages a new tubular and aligns it over the tubular being held by the spider. A power tong and a spinner are then used to thread the upper and lower tubulars together. Once the tubulars are joined, the spider disengages the tubular string and the elevator lowers the tubular string through the spider until the elevator and spider are at a predetermined distance from each other. The spider then re-engages the tubular string and the elevator disengages the string and repeats the process. This sequence applies to assembling tubulars for the purpose of drilling, running casing or running wellbore components into the well. The sequence can be reversed to disassemble the tubular string.

During the drilling of a wellbore, a drill string is made up and is then necessarily rotated in order to drill. Historically, a drilling platform includes a rotary table and a gear to

turn the table. In operation, the drill string is lowered by an elevator into the rotary table and held in place by a spider. A Kelly is then threaded to the string and the rotary table is rotated, causing the Kelly and the drill string to rotate. After thirty feet (9 m) or so of drilling, the Kelly and a section of the string are lifted out of the wellbore, and additional drill string is added.

The process of drilling with a Kelly is expensive due to the amount of time required to remove the Kelly, add drill string, reengage the Kelly, and rotate the drill string. In order to address these problems, top drives were developed.

Figure 1A is a side view of an upper portion of a drilling rig 100 having a top drive 200 and an elevator 120. An upper end of a stack of tubulars 130 is shown on the rig 100. The figure shows the elevator 120 engaged with a tubular 130. The tubular 130 is placed in position below the top drive 200 by the elevator 120 in order for the top drive with its gripping means to engage the tubular.

Figure 1B is a side view of a drilling rig 100 having a top drive 200, an elevator 120, and a spider 400. The rig 100 is built at the surface 170 of the well. The rig 100 includes a travelling block 110 that is suspended by wires 150 from draw works 105 and holds the top drive 200. The top drive 200 has a gripping means for engaging the inner wall of tubular 130 and a motor 240 to rotate the tubular 130. The motor 240 rotates and threads the tubular 130 into the tubular string 210 extending into the wellbore 180. The motor 240 can also rotate a drill string having a drill bit at an end, or for any other purposes requiring rotational movement of a tubular or a tubular string. Additionally, the top drive 200 is shown with elevator 120 and a railing system 140 coupled thereto. The railing system 140 prevents the top drive 200 from rotational movement during rotation of the tubular string 210, but allows for vertical movement of the top drive under the travelling block 110.

In Figure 1B, the top drive 200 is shown engaged to tubular 130. The tubular 130 is positioned above the tubular string 210 located therebelow. With the tubular 130 positioned over the tubular string 210, the top drive 200 can lower and thread the tubular into the tubular string. Additionally, the spider 400, disposed in the platform 160, is shown engaged around a tubular string 210 that extends into wellbore 180.

Figure 2 illustrates a side view of a top drive engaged to a tubular, which has been lowered through a spider. As depicted in the Figure, the elevator 120 and the top drive 200 are connected to the travelling block 110 via a compensator 270. The compensator 270 functions similar to a spring to compensate for vertical movement of the top drive

200 during threading of the tubular 130 to the tubular string 210. In addition to its motor 240, the top drive includes a counter 250 to measure rotation of the tubular 130 during the time tubular 130 is threaded to tubular string 210. The top drive 200 also includes a torque sub 260 to measure the amount of torque placed on the threaded connection between the tubular 130 and the tubular string 210. The counter 250 and the torque sub 260 transmit data about the threaded joint to a controller via data lines (not shown). The controller is preprogrammed with acceptable values for rotation and torque for a particular joint. The controller compares the rotation and the torque data to the stored acceptable values.

Figure 2 also illustrates a spider 400 disposed in the platform 160. The spider 400 comprises a slip assembly 440, including a set of slips 410, and piston 420. The slips 410 are wedge-shaped and are constructed and arranged to slidably move along a slopped inner wall of the slip assembly 440. The slips 410 are raised or lowered by piston 420. When the slips 410 are in the lowered position, they close around the outer surface of the tubular string 210. The weight of the tubular string 210 and the resulting friction between the tubular string 210 and the slips 410, forces the slips downward and inward, thereby tightening the grip on the tubular string. When the slips 410 are in the raised position as shown, the slips are opened and the tubular string 210 is free to move axially in relation to the slips.

Figure 3 is cross-sectional view of a top drive 200 and a tubular 130. The top drive 200 includes a gripping means having a cylindrical body 300, a wedge lock assembly 350, and slips 340 with teeth (not shown). The wedge lock assembly 350 and the slips 340 are disposed around the outer surface of the cylindrical body 300. The slips are constructed and arranged to mechanically grip the inside of the tubular 130. The slips 340 are threaded to piston 370 located in a hydraulic cylinder 310. The piston is actuated by pressurized hydraulic fluid injected through fluid ports 320, 330. Additionally, springs 360 are located in the hydraulic cylinder 310 and are shown in a compressed state. When the piston 370 is actuated, the springs decompress and assist the piston in moving the slips 340. The wedge lock assembly 350 is constructed and arranged to force the slips against the inner wall of the tubular 130 and moves with the cylindrical body 300.

In operation, the slips 340, and the wedge lock assembly 350 of top drive 200 are lowered inside tubular 130. Once the slips 340 are in the desired position within the tubular 130, pressurized fluid is injected into the piston through fluid port 320. The fluid actuates the piston 370, which forces the slips 340 towards the wedge lock assembly 350. The wedge lock assembly 350 functions to bias the slips 340 outwardly as the slips are slidably forced along the outer surface of the assembly, thereby forcing the slips to engage the inner wall of the tubular 130.

Figure 4 illustrates a cross-sectional view of a top drive 200 engaged to a tubular 130. The figure shows slips 340 engaged with the inner wall of the tubular 130 and a spring 360 in the decompressed state. In the event of a hydraulic fluid failure, the springs 360 can bias the piston 370 to keep the slips 340 in the engaged position, thereby providing an additional safety feature to prevent inadvertent release of the tubular string 210. Once the slips 340 are engaged with the tubular 130, the top drive 200 can be raised along with the cylindrical body 300. By raising the body 300, the wedge lock assembly 350 will further bias the slips 340. With the tubular 130 engaged by the top drive 200, the top drive can be relocated to align and thread the tubular with tubular string 210.

In another embodiment (not shown), a top drive 200 includes a gripping means for engaging a tubular on the outer surface. For example, the slips can be arranged to grip on the outer surface of the tubular, preferably gripping under the collar 380 of the tubular 130. In operation, the top drive is positioned over the desired tubular. The slips are then lowered by the top drive to engage the collar 380 of the tubular 130. Once the slips are positioned beneath the collar 380, the piston is actuated to cause the slips to grip the outer surface of the tubular 130. Sensors may be placed in the slips to ensure that proper engagement of the tubular.

Figure 5 is a flow chart illustrating a typical operation of a string or casing assembly using a top drive and a spider. The flow chart relates to the operation of an apparatus generally illustrated in Figure 1B. At a first step 500, a tubular string 210 is retained in a closed spider 400 and is thereby prevented from moving in a downward direction. At step 510, top drive 200 is moved to engage a tubular 130 from a stack with the aid of an

elevator 120. The tubular 130 may be a single tubular or could typically be made up of two or three tubulars threaded together to form a stack. Engagement of the tubular by the top drive includes grasping the tubular and engaging the inner surface thereof. At step 520, the top drive 200 moves the tubular 130 into position above the tubular string 210. At step 530, the top drive 200 threads the tubular 130 to tubular string 210. At step 540, the spider 400 is opened and disengages the tubular string 210. At step 550, the top drive 200 lowers the tubular string 210, including tubular 130 through the opened spider 400. At step 560 and the spider 400 is closed around the tubular string 210. At step 570 the top drive 200 disengages the tubular string and can proceed to add another tubular 130 to the tubular string 210 as in step 510. The above-described steps may be utilized in running drill string in a drilling operation or in running casing to reinforce the wellbore or for assembling strings to place wellbore components in the wellbore. The steps may also be reversed in order to disassemble the casing or tubular string.

Although the top drive is a good alternative to the Kelly and rotary table, the possibility of inadvertently dropping a tubular string into the wellbore exists. As noted above, a top drive and spider must work in tandem, that is, at least one of them must engage the tubular string at any given time during tubular assembly. Typically, an operator located on the platform controls the top drive and the spider with manually operated levers that control fluid power to the slips that cause the top drive and spider to retain a tubular string. At any given time, an operator can inadvertently drop the tubular string by moving the wrong lever. Conventional interlocking systems have been developed and used with elevator/spider systems to address this problem, but there remains a need for a workable interlock system usable with a top drive/spider system such as the one described herein.

There is a need therefore, for an interlock system for use with a top drive and spider to prevent inadvertent release of a tubular string. There is a further need for an interlock system to prevent the inadvertent dropping of a tubular or tubular string into a wellbore. There is also a need for an interlock system that prevents a spider or a top drive from disengaging a tubular string until the other component has engaged the tubular.

In accordance with one aspect of the present invention there is provided an apparatus for use with tubulars, comprising a first device for gripping and joining the tubulars; a second device for gripping the tubulars; and an interlock system to ensure that a tubular string is gripped by at least the first or second device.

According to an aspect of the invention there is provided an apparatus for use with tubulars, the apparatus comprising:

a first device for gripping and joining the tubulars;

a second device for gripping the tubulars; and

an interlock system to ensure that a tubular string is gripped by at least the first or second device.

According to another aspect of the invention there is provided an apparatus for assembling and disassembling tubulars, the apparatus comprising:

a first member having a motor for rotating and joining tubulars at a joint and forming a tubular string therefrom, and a cylindrical body having a first set of slips and a wedge lock assembly disposed on the cylindrical body, the first set of slips being coupled to a piston that is coupled to a resilient member;

a second member having a piston coupled to a second set of slips; and

an interlock system.

Furthermore, the first set of slips can be engageable with an outer surface of the tubulars.

According to a further aspect of the invention there is provided a method for use with assembling and disassembling tubulars, the method comprising:

joining a first tubular engaged by a top drive to a second tubular engaged by a spider, thereby forming a joint therebetween;

collecting data related to the formation of the joint;

comparing the data to pre-programmed values using a controller;

collecting data from the top drive and the spider via sensors to determine if they are engaging the tubulars;

opening the spider when predetermined conditions are met lowering the tubular string through the spider;

engaging the tubular string with the spider; and

disengaging the tubular string with the top drive when predetermined conditions are met.

According to a further aspect of the invention there is provided a method for use with assembling and disassembling tubulars, the method comprising:

joining a first tubular engaged by a first apparatus to a second tubular engaged by a second apparatus thereby forming a tubular string;

opening the second apparatus thereby disengaging the string;

lowering the tubular string through the second apparatus;

engaging the second apparatus to the string; and

disengaging the first apparatus from the string, wherein an interlock system is provided to ensure that at least the first apparatus or the second apparatus is engaging the tubular string.

Furthermore, the first set of slips can be engageable with an outer surface of the tubular.

According to a further aspect of the invention there is provided a method for use for an apparatus with tubular, the method comprising:

closing a first member around a first tubular;

engaging a second member to a second tubular;

moving the second tubular to a well center;

threading the second tubular to the first tubular to form a joint and thereby a tubular string;

sending data from the second member to a controller;

opening the first member;

lowering the tubular string through the first member;

closing the first member around the tubular string; and

disengaging the second member from the tubular string.

Furthermore, engaging a second member to a second tubular includes engaging an outer surface of the tubular.

The present invention generally provides an apparatus and methods to prevent inadvertent release of a tubular or tubular string. In one aspect, the apparatus and methods disclosed herein ensure that either the top drive or the spider is engaged to the tubular before the other component is disengaged from the tubular. The interlock system is utilized with a spider and a top drive during assembly of a tubular string.

According to an aspect of the invention there is provided an apparatus for use with tubulars, the apparatus comprising:

a spider having a set of slips for gripping the tubulars;

a top drive disposable above the spider for gripping the tubulars; and

an interlock system to ensure that a tubular string is gripped by one of the top drive and the spider, wherein the interlock system prevents the top drive from disengaging the tubular string, unless the spider is engaged around the tubular string.

According to another aspect of the invention there is provided an apparatus for use with tubulars, the apparatus comprising:

a spider having a set of slips for gripping the tubulars;

a top drive disposable above the spider for gripping the tubulars; and

an interlock system to ensure that a tubular string is gripped by one of the top drive and the spider, wherein the interlock system prevents the spider from disengaging the tubular string, unless the top drive is engaged to the tubular string.

According to a further aspect of the invention there is provided an apparatus for use with tubulars, the apparatus comprising:

a spider having a set of slips for gripping the tubulars;

a top drive disposable above the spider for gripping the tubulars; and

an interlock system to ensure that a tubular string is gripped by one of the top drive and the spider, wherein the interlock system includes a controller.

According to a further aspect of the invention there is provided an apparatus for assembling and disassembly tubulars, the apparatus comprising:

a first member having a motor for rotating and joining tubulars at a joint and forming a tubular string therefrom, and a cylindrical body having a first set of slips and a wedge lock assembly disposed on the cylindrical body, the first set of slips is coupled to a piston that is coupled to a resilient member;

a second member having a piston coupled to a second set of slips; and

an interlock system.

According to a further aspect of the invention there is provided a method for use with assembling and dissembling a tubular string formed by a first tubular and a second tubular, the method comprising:

engaging a first apparatus to the first tubular;

engaging a second apparatus to the second tubular;

joining the first tubular to the second tubular thereby forming the tubular string;

providing an interlock system to ensure that at least the first apparatus or the second apparatus is engaging the tubular string;

opening the second apparatus to disengage the second apparatus from the second tubular;

lowering the tubular string;

engaging the second apparatus to the tubular string; and

disengaging the first apparatus from the first tubular, wherein the first apparatus includes a motor for joining the tubulars and at least a first set of slips, and the second apparatus has at least a second set of slips.

According to a further aspect of the invention there is provided an apparatus for use with a tubular string formed by connecting a first tubular and a second tubular, the apparatus comprising:

a first device for gripping and rotating the first tubular;

a second device for gripping the second tubular; and

an interlock system operatively connected to the first and second devices to ensure that the tubular string is gripped by at least one of the first and second devices.

According to a further aspect of the invention there is provided a method for assembling and disassembling tubulars, the method comprising:

joining a first tubular engaged by a top drive to a second tubular engaged by a spider, thereby forming a joint therebetween;

collecting data related to the formation of the joint;

comparing the data to preprogrammed values using a controller;

collecting data from the top drive and the spider via sensors to determine if they are engaging the tubulars;

opening the spider when predetermined conditions are met;

lowering the tubular string through the spider;

engaging the tubular string with the spider; and

disengaging the tubular string with the top drive when predetermined conditions are met.

According to a further aspect of the invention there is provided a method of connecting tubulars, comprising:

closing a gripping member around a first tubular;

engaging a second gripping member of a top drive to a second tubular;

moving the second tubular to a well center;

threading the second tubular to the first tubular to form a joint and thereby a tubular string;

transmitting data from the second gripping member to a controller;

ensuring the second gripping member is engaged with the tubular string;

opening the first gripping member;

lowering the tubular string through the first gripping member;

closing the first gripping member around the tubular string; and

disengaging the second gripping member from the tubular string.

According to a further aspect of the invention there is provided a method of connecting tubulars, comprising:

closing a first member around a first tubular;

engaging a second member to a second tubular;

moving the second tubular to a well center;

threading the second tubular to the first tubular to form a joint and thereby a tubular string;

sending data from the second member to a controller, the second member having a counter that relays data relating to tubular rotations making up the joint;

opening the first member;

lowering the tubular string through the first member;

closing the first member around the tubular string; and

disengaging the second member from the tubular string.

According to a further aspect of the invention there is provided a method of connecting tubulars, comprising:

closing a first member around a first tubular;

engaging a second member to a second tubular;

moving the second tubular to a well center;

threading the second tubular to the first tubular to form a joint and thereby a tubular string;

sending data from the second member to a controller, wherein the controller is preprogrammed with acceptable values of the joint;

opening the first member;

lowering the tubular string through the first member;

closing the first member around the tubular string; and

disengaging the second member from the tubular string.

According to a further aspect of the invention there is provided a method of connecting tubulars, comprising:

closing a first member around a first tubular;

engaging a second member to a second tubular, wherein second member comprises a compensator;

moving the second tubular to a well center;

threading the second tubular to the first tubular to form a joint and thereby a tubular string;

sending data from the compensator to a controller to indicate that the second member is engaged with the tubular string;

opening the first member;

lowering the tubular string through the first member;

closing the first member around the tubular string; and

disengaging the second member from the tubular string.

According to a further aspect of the invention there is provided a system for handling a tubular, the system comprising:

a top drive;

a first gripping member operatively coupled to the top drive;

a second gripping member; and

an interlock system connected to the first gripping member and the second gripping member, the interlock system adapted to ensure that at least one of the first gripping member and the second gripping member is connected to the tubular.

According to a further aspect of the invention there is provided a system for handling a tubular, the system comprising:

a top drive;

a first gripping member operatively coupled to the top drive;

a second gripping member;

an interlock system for ensuring that at least one of the first gripping member and the second gripping member is connected to the tubular; and

a stretch sensor.

According to a further aspect of the invention there is provided a system for handling a tubular, the system comprising:

a top drive;

a first gripping member operatively coupled to the top drive;

a second gripping member;

an interlock system for ensuring that at least one of the first gripping member and the second gripping member is connected to the tubular; and

a counter to measure rotation of the tubular.

According to an aspect of the present invention there is provided an apparatus for use with a tubular string formed by connecting a first tubular and a second tubular, the apparatus comprising:

a first device for gripping and rotating the first tubular;

a second device for gripping the second tubular; and

an interlock system operatively connected to the first and second devices to ensure that the tubular string is gripped by at least one of the first and second devices;

wherein the first device comprises a top drive and the second device is a spider having a set of slips therein for engaging the tubulars.

According to another aspect of the present invention there is provided a method of connecting casing sections by using a top drive, comprising:

closing a first member around a first casing section;

gripping and supporting a weight of a second casing section with the top drive;

rotating the second casing section with the top drive to join the second casing section to the first casing section to form a casing string having a joint;

sending data from the top drive to a controller, wherein the controller is preprogrammed with an acceptable rotation or torque value of the joint;

stopping rotation of the second casing section based on the acceptable rotation or torque value of the joint;

supporting a weight of the casing string with the top drive; and

opening the first member.

According to a further aspect of the present invention there is provided a method of connecting casing sections, comprising:

closing a first member around a first casing;

engaging a second casing with a second member, wherein the second member comprises a top drive comprising at least one adapter for gripping a casing;

moving the second casing to a well center;

threading the second casing to the first casing to form a casing string having a joint;

sending data from the second member to a controller, wherein the controller is preprogrammed with an acceptable rotation or torque value of the joint;

opening the first member;

lowering the casing string through the first member;

closing the first member around the casing string; and

disengaging the second member from the casing string.

According to a further aspect of the present invention there is provided a method of connecting casing sections, comprising:

closing a spider around a first casing;

engaging a second casing with a top drive having a casing gripping apparatus connected thereto;

moving the second casing to a well center;

threading the second casing to the first casing to form a joint and a casing string;

sending data from the top drive to a processing unit, wherein the processing unit is preprogrammed with at least one acceptable torque value of the joint or at least one acceptable rotation value of the joing;

opening the spider;

lowering the casing string through the spider;

closing the spider around the casing string; and

disengaging the top drive from the casing string.

According to a further aspect of the present invention there is provided a method of connecting tubulars, the method comprising:

gripping a first tubular using a first device comprising a top drive;

closing a second device around a second tubular;

rotating the first tubular with the first device to join the first tubular to the second tubular to form a joint and a tubular string;

sending data from the first device to a controller, wherein the controller is preprogrammed with an acceptable torque or rotation value of the joint; and

stopping rotation of the first tubular based on a comparison between the sent data and the acceptable torque or rotation value of the joint.

According to a further aspect of the present invention there is provided an apparatus for connecting tubulars, the apparatus comprising:

a first device for gripping a first tubular, the first device comprising a top drive;

a second device arranged to close around a second tubular;

means for rotating the first tubular with the first device to join the first tubular to the second tubular for forming a joint and a tubular string;

means for sending data from the first device to a controller, wherein the controller is preprogrammed with an acceptable torque or rotation value of the joint; and

means for stopping rotation of the first tubular based on a comparison between the sent data and the acceptable torque or rotation value of the joint.

Aspects of the present invention are provided by the following clauses.

Clauses

1. An apparatus for use with tubulars, comprising:

a first device for gripping and joining the tubulars;

a second device for gripping the tubulars; and

an interlock system to ensure that a tubular string is gripped by at least the first or second device.

2. An apparatus according to clause 1, wherein the first device comprises a top drive disposable on a rig above the second device.

3. An apparatus according to clause 2, wherein the top drive comprises:

a body having a slip assembly disposed on a surface;

the slip assembly engageable on a surface on a first end of a tubular;

a motor to provide rotational movement to the tubulars; and

a compensator disposed on the top drive thereby allowing incremental axial movement of the tubular.

4. An apparatus according to clause 2 or 3, wherein the second device is a spider having a set of slips therein for engaging the tubulars.

5. An apparatus according to clause 4, wherein the interlock system prevents the top drive from disengaging the tubular string, unless the spider is engaged around the tubular string.

6. An apparatus according to clause 4 or 5, wherein the interlock system prevents the spider form disengaging the tubular string, unless the top drive is engaged to the tubular string.

7. An apparatus according to clause 4, 5 or 6, wherein the interlock system further comprises a controller.

8. An apparatus according to clause 7, wherein the controller collects data relating to a joint formed between the tubulars.

9. An apparatus according to clause 8, wherein data is generated by a torque sub disposed adjacent the top drive.

10. An apparatus according to clause 8 or 9, wherein data is generated by a revolution counter.

11. An apparatus according to clause 8, 9, or 10, wherein the data relates to torque generated in the joint.

12. An apparatus according to clause 8, 9, 10 or 11, wherein the data further relates to the number of tubular rotations making up the joint.

13. An apparatus according to any one of clauses 8 to 12, wherein the controller compares the data to pre-stored values defining an acceptable joint.

14. An apparatus according to any one of clauses 8 to 13, wherein data is generated from the compensator, the data related to the axial movement of the compensator during make up of the joint.

15. An apparatus according to any of clauses 8 to 14, wherein the interlock system further includes at least one valve to enable and lock out controls for the top drive and the spider, the valve controllable by the controller based upon the data.

16. An apparatus according to any of clauses 4 to 15, wherein the interlock system further comprises:

a physical barrier to control the movement of manual controls controlling the top drive and the spider to engage and release the tubular string; and

a sensor assembly in communication with the spider and a locking assembly, the sensor assembly arranged to sense the engagement of the spider and relay the information to the locking assembly, which is arranged to control the movement of the physical barrier.

17. An apparatus for assembling and disassembly tubulars, comprising:

a first member having a motor for rotating and joining tubulars at a joint and forming a tubular string therefrom, and a cylindrical body having a first set of slips and a wedge lock assembly disposed on the cylindrical body, the first set of slips being coupled to a piston that is coupled to a resilient member;

a second member having a piston coupled to a second set of slips; and

an interlock system.

18. An apparatus according to clause 17, wherein the first set of slips is engageable with an inner surface of the tubulars.

19. An apparatus according to clause 17, wherein the first set of slips is engageable with an outer surface of the tubulars.

20. An apparatus according to clause 17, 18 or 19, wherein a first member sensor is coupled to the first member and a second member sensor is coupled to the second member.

21. An apparatus according to any of clauses 17 to 20, wherein the first member further comprises:

a counter providing data relating to the tubular rotations making up the joint;

a torque sub providing data relating to the amount of torque placed during joining of the tubulars; and

a compensator coupling the first member to a rig and providing data regarding whether the first member is engaging the tubular string.

22. An apparatus according to any of clauses 17 to 21, wherein the first member is a top drive and is couplable to a railing system mounted on a rig.

23. An apparatus according to any of clauses 17 to 22, wherein the second member is couplable to a platform of a rig.

24. An apparatus according to any of clauses 17 to 23, wherein the second member is a spider.

25. An apparatus according to any of clauses 17 to 24, wherein the interlock system further comprises:

a sensor assembly in communication with the second set of slips;

a locking assembly in communication with the sensor assembly;

a control plate having a first member lever controlling a first member valve, a second member lever controlling a second member valve, the movement of the control plate is controlled by the locking assembly; and

a controller in communication with the first and second member sensors, the torque sub, the counter, a first and second member solenoid valves.

26. An apparatus according to clause 25, wherein the controller is also in communication with the compensator.

27. A method for use with assembling and disassembling tubulars, comprising:

joining a first tubular engaged by a top drive to a second tubular engaged by a spider, thereby forming a joint therebetween;

collecting data related to the formation of the joint;

comparing the data to pre-programmed values using a controller;

collecting data from the top drive and the spider via sensors to determine if they are engaging the tubulars;

opening the spider when predetermined conditions are met;

lowering the tubular string through the spider;

engaging the tubular string with the spider; and

disengaging the tubular string with the top drive when predetermined conditions are met.

28. A method according to clause 27, wherein collecting data related to the formation of the joint further comprises data relating to torque applied.

29. A method according to clause 27 or 28, wherein collecting data related to the formation of the joint further comprises data relating to revolutions completed.

30. A method according to clause 27, 28 or 29, wherein collecting data related to the formation of the joint further comprises data relating axial movement.

31. A method according to any of clauses 27 to 30, wherein collecting data related to the formation of the joint further comprises data relating to torque and revolutions.

32. A method for use with assembling and disassembling tubulars comprising:

joining a first tubular engaged by a first apparatus to a second tubular engaged by a second apparatus thereby forming tubular string;

providing an interlock system to ensure that at least the first apparatus or the second apparatus is engaging the tubular string;

opening the second apparatus thereby disengaging the string;

lowering the tubular string through the second apparatus;

engaging the second apparatus to the string; and

disengaging the first apparatus from the string.

33. A method according to clause 32, wherein the first apparatus further comprises a motor for joining the tubulars and at least a first set of slips, and the second apparatus has at least a second set of slips.

34. A method according to clause 32 or 33, wherein the first set of slips are engageable with an inner surface of the tubular.

35. A method according to clause 32, 33 or 34, wherein the first set of slips are engageable with an outer surface of the tubular.

36. A method according to any of clauses 32 to 35, wherein the interlock system is arranged to prevent the first set of slips from disengaging the tubular string, unless the second set of slips is closed around the tubular string.

37. A method according to any of clauses 32 to 36, wherein the interlock system is arranged to prevent the second set of slips from opening or disengaging the tubular string, unless the first set of slips are engaged to the tubular string.

38. A method according to any of clauses 32 to 37, wherein the first apparatus is a top drive and the second apparatus is a spider.

39. A method for use for an apparatus with tubular comprising:

closing a first member around a first tubular;

engaging a second member to a second tubular;

moving the second tubular to a well center;

threading the second tubular to the first tubular to form a joint and thereby a tubular string;

sending data from the second member to a controller;

opening the first member;

lowering the tubular string through the first member;

closing the first member around the tubular string; and

disengaging the second member from the tubular string.

40. A method according to clause 39, wherein closing a first member around a first tubular further comprises locking the first member in the closed position, and sending a signal to the controller that the first member is in the closed position.

41. A method according to clause 39 or 40, wherein the second member includes a counter that relays data relating to tubular rotations making up the joint.

42. A method according to clause 39, 40 or 41, wherein the second member includes a torque sub that relays data relating to torque generated in the tubular joint.

43. A method according to any of clauses 39 to 42, wherein engaging a second member to a second tubular is engaging an inner surface of the tubular.

44. A method according to any of clauses 39 to 42, wherein engaging a second member to a second tubular is engaging an outer surface of the tubular.

45. A method according to any of clauses 39 to 44, wherein engaging a second member to a second tubular further comprises sending a signal to the controller that the second member is engaged to the second tubular.

46. A method according to any of clauses 39 to 45, wherein the controller is preprogrammed with an acceptable values of a related joint.

47. A method according to any of clauses 39 to 46, wherein sending data from the second member to a controller, further comprises of sending data from the counter and the torque sub.

48. A method according to any of clauses 39 to 47, wherein sending data from the second member to a controller, further comprises, comparing the data with the acceptable values of the joint.

49. A method according to any of clauses 39 to 48, wherein if the data is within acceptable values then controller sends a signal to the second member to lock in the engaged position, and sends another signal to the first member to unlock.

50. A method according to clause 48 or 49, wherein if the data is not within acceptable parameters then the first member remains locked and a signal is sent to an operator to rethread the joint.

51. A method according to any of clauses 39 to 50, wherein closing the first member around the tubular string includes sending the signal from the first member to the controller.

52. A method according to clause 50, wherein if the signal from the first member is received by the controller, the controller then sends the signal to the second member to unlock.

53. A method according to any of clauses 39 to 52, wherein disengaging the second member from the tubular string includes sending the signal from the controller to the first member to lock.

54. A method according to any of clauses 39 to 53, wherein the second member further comprises a compensator.

55. A method according to any of clauses 39 to 54, wherein sending data from the second member to a controller includes sending data from the compensator to indicate that the second member is engaged to the tubular string.

56. A method according to any of clauses 39 to 55, wherein the first member is a spider and the second member is a top drive.

57. An apparatus for use with a top drive, comprising:

a mechanism connected to a lower end of the top drive, wherein the mechanism comprises a pivotable portion which is pivotable towards and away from the top drive; and

gripping means connected to a lower end of the pivotable portion and pivotable by the pivotable mechanism, wherein the gripping means is arranged to grippingly engage a casing string.

58. An apparatus for use with a top drive, comprising:

a tubular gripping means attached to a structure connected to the top drive, the structure comprising a pivotable portion which is pivotable with respect to the top drive, the apparatus being arranged to move a tubular from a first position in which the tubular is not aligned with the top drive to a second position below the top drive in which it is aligned with the top drive.

59. The apparatus of clause 58, wherein the structure comprises said pivotable portion and a further portion, the pivotable portion being pivotable with respect to the further portion.

60. The apparatus of clause 59, wherein the further portion is operatively connected to the top drive and the pivotable portion is operatively connected to the tubular gripping means.

61. The apparatus of any of clauses 58 to 60, wherein the apparatus is arranged to move the tubular to the center of a well.

62. A method for gripping a tubular, comprising:

providing a top drive and a tubular gripping means pivotally connected by a pivotable structure;

pivoting the pivotable structure to bias the tubular gripping means toward the tubular;

grippingly engaging the tubular with the tubular gripping means so that the tubular and the tubular gripping means are rotationally and axially fixed relative to one another.

63. The method of clause 62, further comprising pivoting the pivotable structure to move the tubular from a first position in which the tubular is not aligned with the top drive to a second position below the top drive in which it is aligned with the top drive.

64. The method of clause 63, wherein moving the tubular from the first position to the second position comprises moving the tubular to the center of a well.

Some preferred embodiments of the invention will now be described by way of example only and with reference to the accompanying drawings, in which:

Figure 1A is a side view of a drilling rig having a top drive and an elevator;

Figure 1B is a side view of a drilling rig having a top drive, an elevator, and a spider;

Figure 2 illustrates a side view of a top drive engaged to a tubular, which has been lowered through a spider;

Figure 3 is cross-sectional view of a top drive and a tubular;

Figure 4 illustrates a cross-sectional view of the top drive of Figure 3 engaged to a tubular;

Figure 5 is a flow chart of a typical operation of tubular string or casing assembly using a top drive and a spider;

Figure 6 shows a flow chart using an interlock system for a spider and a top drive;

Figure 7 illustrates the mechanics of the interlock system in use with a spider, a top drive and a controller; and

Figure 8 illustrates a control plate for a spider lever and a top drive lever.

Embodiments of the present invention relate to an interlock system for use with a top drive and a spider during assembly of a string of tubulars. Certain embodiments also refer to an interlock system for a top drive and a spider for use in assembling or disassembling tubulars. The invention may be utilized to assemble tubulars for different purposes including drill strings, strings of liner and casing and run-in strings for wellbore components.

Figure 6 is a flow chart illustrating the use of an interlock system of the present invention with a spider and a top drive and Figure 7 illustrates the mechanics of the interlock system in use with a spider, a top drive and a controller. At step 500, a tubular string 210 is retained in a closed spider 400 and prevented from moving in a downward direction. The spider includes a spider piston sensor located at a spider piston 420 to sense when the spider 400 is open or closed around the tubular string 210. The sensor data 502 is relayed to a controller 900.

A controller includes a programmable central processing unit that is operable with a memory, a mass storage device, an input control unit, and a display unit. Additionally, the controller includes well-known support circuits such as power supplies, clocks, cache, input/output circuits and the like. The controller is capable of receiving data from sensors and other devices and capable of controlling devices connected to it.

One of the functions of the controller 900 is to prevent opening of the spider. Preferably, the spider 400 is locked in the closed position by a solenoid valve 980 (Figure 7) that is placed in the control line between the manually operated spider control lever 630 (Figure 7) and the source of fluid power operating the spider. Specifically, the spider solenoid valve 980 controls the flow of fluid to the spider piston 420. The solenoid valve 980 is operated by the controller 900 and the controller is programmed to

keep the valve closed until certain conditions are met. While valve 980 is electrically powered in the embodiment described herein, the valve could be fluidly or pneumatically powered so long as it is controllable by the controller 900. Typically, the

valve 980 is closed and the spider 400 is locked until a tubular is successfully joined to the string and held by the top drive.

At step 510, the top drive 200 is moved to engage a pre-assembled tubular 130 from a stack with the aid of an elevator 120. A top drive sensor 995 (Fig. 7) is placed near a top drive piston 370 to sense when the top drive 200 is disengaged, or in this case engaged around the tubular 130. The sensor data 512 is relayed to the controller 900. At step 520, the top drive 200 moves the tubular 130 into position and alignment above the tubular string 210. At step 530, the top drive 200 rotationally engages the tubular 130 to tubular string 210, creating a threaded joint therebetween. Torque data 532 from a torque sub 260 and rotation data 534 from a counter 250 are sent to the controller 900.

The controller 900 is preprogrammed with acceptable values for rotation and torque for a particular connection. The controller 900 compares the rotation data 534 and the torque data 532 from the actual connections and determines if they are within the accepted values. If not, then the spider 400 remains locked and closed, and the tubular 130 can be rethreaded or some other remedial action can take place by sending a signal to an operator. If the values are acceptable, the controller 900 locks the top drive 200 in the engaged position via a top drive solenoid valve 970 (Fig. 7) that prevents manual control of the top drive 200. At step 540, the controller 900 unlocks the spider 400 via the spider solenoid valve, and allows fluid to power the piston 420 to open the spider 400 and disengage it from the tubular string 210. At step 550, the top drive 200 lowers the tubular string 210, including tubular 130 through the opened spider 400. At step 560 and the spider 400 is closed around the tubular string 210. The spider sensor 990 (Fig. 7) signals the controller 900 that the spider 400 is closed. If no signal is received, then the top drive 200 stays locked and engaged to tubular string 210. If a signal is received confirming that the spider is closed, the controller locks the spider 400 in the closed position, and unlocks the top drive 200. At step 570 the top drive 200 can disengage the tubular string 210 and proceed to add another tubular 130. In this manner, at least the top drive or the spider is engaging the tubular string at all times.

Alternatively, or in addition to the foregoing, a compensator 270 (shown in Figure 2) may be utilized to gather additional information about the joint formed between the

tubular and the tubular string. The compensator 270, in addition to allowing incremental movement of the top drive 200 during threading together of the tubulars, may be used to ensure that a threaded joint has been made and that the tubulars are mechanically connected together. For example, after a joint has been made between the tubular and the tubular string, the top drive may be raised or pulled up. If a joint has been formed between the tubular and the string, the compensator will "stoke out" completely, due the weight of the tubular string therebelow. If however, a joint has not been formed between the tubular and the string due to some malfunction of the top drive or misalignment between a tubular and a tubular string therebelow, the compensator will stroke out only a partial amount due to the relatively little weight applied thereto by the single tubular or tubular stack. A stretch sensor located adjacent the compensator, can sense the stretching of the compensator 270 and can relay the data to a controller 900. Once the controller 900 processes the data and confirms that the top drive is engaged to a complete tubular string, the top drive 200 is locked in the engaged position, and the next step 540 can proceed. If no signal is received, then the spider 400 remains locked and a signal maybe transmitted by the controller to an operator. During this "stretching" step, the spider 400 is not required to be unlocked and opened. The spider 400 and the slips 410 are constructed and arranged to prevent downward movement of the string but allow the tubular string 210 to be lifted up and moved axially in a vertical direction even though the spider is closed. When closed, the spider 400 will not allow the tubular string 210 to fall through its slips 410 due to friction and the shaped of the teeth on the spider slips.

The interlock system 500 is illustrated in Figure 7 with the spider 400, the top drive 200, and the controller 900 including various control, signal, hydraulic, and sensor lines. The top drive 200 is shown engaged to a tubular string 210 and is coupled to a railing system 140. The railing system includes wheels 142 allowing the top drive to move axially. The spider 400 is shown disposed in the platform 160 and in the closed position around the tubular string 210. The spider 400 and the top drive 200 may be pneumatically actuated, however the spider and top drive discussed herein are hydraulically activated. Hydraulic fluid is supplied to a spider piston 420 via a spider control valve 632. The spider control valve 632 is a three-way valve and is operated by a spider lever 630.

Also shown in Figure 7 is a sensor assembly 690 with a piston 692 coupled to spider slips 410 to detect when the spider 400 is open or closed. The sensor assembly 690 is in communication with a locking assembly 660, which along with a control plate 650 prevents the movement of the spider and top drive lever. The locking assembly 660 includes a piston 662 having a rod 664 at a first end. The rod 564 when extended, blocks the movement of the control plate 550 when the plate is in a first position. When the spider 400 is in the open position, the sensor assembly 690 communicates to the locking assembly 660 to move the rod 664 to block the control plate's 650 movement. When the spider 400 is in the closed position as shown, the rod 664 is retracted allowing the control plate 650 to move freely from the first to a second position. Additionally, the sensor assembly 660 can also be used with the top drive 200 as well in the same fashion. Similarly, hydraulic fluid is supplied to a top drive piston 370 via a top drive control valve 642 and hydraulic lines. The top drive control valve 642 is also a three-way valve and is operated by a top drive lever 640. A pump 610 is used to circulate fluid to the respective pistons 370, 420. A reservoir 620 is used to re-circulate hydraulic fluid and receive excess fluid. Excess gas in the reservoir 620 is vented 622.

Further shown in Figure 7, controller 900 collects data from a top drive sensor 995 regarding the engagement of the top drive to the tubular string 210. Data regarding the position of the spider 400 is also provided to controller 900 from a spider sensor 990. The controller 900 controls fluid power to the top drive 200 and spider 400 via solenoid valves 970, 980, respectively.

In Figure 7, the top drive 200 is engaged to tubular string 210 while the spider 400 is in the closed position around the same tubular string 210. At this point, steps 500, 510, 520, and 530 of Figure 6 have occurred. Additionally, the controller 900 has determined through the data received from counter 250 and torque sub 260 that an acceptable threaded joint has been made between tubular 130 and tubular string 210. In the alternative or in addition to the foregoing, a compensator 270 can also provide data to the controller 900 that a threaded joint has been made and that the tubular 130 and the tubular string 210 are mechanically connected together via a stretch sensor (not shown). The controller 900 then sends a signal to a solenoid valve 970 to lock and keep a top

drive piston 370 in the engaged position within the tubular string 210. Moving to step 540 (figure 6), the controller 900 can unlock the previously locked spider 400, by sending a signal to a solenoid valve 980. The spider 400 must be unlocked and opened in order for the top drive 200 to lower the tubular string 210 through the spider 400 and into a wellbore. An operator (not shown) can actuate a spider lever 630 that controls a spider valve 632, to allow the spider 400 to open and disengage the tubular string 210. When the spider lever 630 is actuated, the spider valve allows fluid to be flow to spider piston 420 causing spider slips 410 to open. With the spider 400 opened, a sensor assembly 690 in communication with a locking assembly 660 will cause a rod 664 to block the movement of a control plate 650. Because the plate 650 will be blocked in the rightmost position, the top drive lever 640 is held in the locked position and will be unable to move to the open position.

As illustrated in Figure 7, the interlock system when used with the top drive and the spider prevents the operator from inadvertently dropping the tubular string into the wellbore. As disclosed herein, the tubular string at all times is either engaged by the top drive or the spider. Additionally, the controller prevents operation of the top drive under certain, even if the top drive control lever is actuated. Further, the interlock system provides a control plate to control the physical movement of levers between an open and closed, thereby preventing the operator from inadvertently actuating the wrong lever.

Figure 8 illustrates a control plate for a spider lever and a top drive lever that can be used with the interlock system of the present invention. The control plate 650 is generally rectangular in shape and is provided with a series of slots 656 to control the movement of the spider lever 630, and the top drive lever 640. Typically, the control plate 650 is slideably mounted within a box 652. The slots 656 define the various positions in which the levers 630, 640 may be moved at various stages of the tubular assembly or disassembly. The levers 630, 640 can be moved in three positions: (1) a neutral position located in the center; (2) a closed position located at the top and causes the slips to close; and (3) an open position located at the bottom, which causes the slips to open. The control plate 650 can be moved from a first rightmost position to a second leftmost position with a knob 654. However, both levers 630, 640 must be in the closed

position before the control plate is moved from one position to another. The control plate 650 is shown in the first rightmost position with a rod 664 extending from a locking assembly 660 to block the movement of the control plate. In operation, in the first rightmost position of the control plate 650, the spider lever 630 can be moved between the open and close positions, while the top drive lever 640 is kept in the closed position. In the second leftmost position, the top drive lever 640 can be moved between the open and close positions, while the spider lever 630 is kept in the closed position. A safety lock 658 is provided to allow the top drive or spider levers 630, 640 to open and override the control plate 650 when needed.

The interlock system may be any interlock system that allows a set of slips to disengage only when another set of slips is engaged to the tubular. The interlock system may be mechanically, electrically, hydraulically, pneumatically actuated systems. The spider may be any spider that functions to hold a tubular or a tubular string at the surface of the wellbore. A top drive may be any system that can grab a tubular by the inner or outer surface and can rotate the tubular. The top drive can also be hydraulically or pneumatically activated.

While the foregoing is directed to the preferred embodiment of the present invention, other and further embodiments of the invention may be devised without departing from the basic scope thereof, and the scope thereof is determined by the claims that follow.

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

1. A method of connecting casing sections by using a top drive, comprising:
closing a first member around a first casing section;
gripping and supporting a weight of a second casing section with the top drive;
rotating the second casing section with the top drive to join the second casing section to the first casing section to form a casing string having a joint;
sending data from the top drive to a controller, wherein the controller is preprogrammed with an acceptable rotation or torque value of the joint;
stopping rotation of the second casing section based on the acceptable rotation or torque value of the joint;
supporting a weight of the casing string with the top drive; and
opening the first member.

2. The method of claim 1, wherein the acceptable rotation or torque value of the joint is an acceptable rotation value of the joint.

3. The method of claim 2, further comprising comparing at least a portion of the data with the acceptable rotation value using the controller.

4. The method of claim 3, further comprising initiating remedial action using the controller.

5. The method of claim 2, further comprising:
preprogramming the controller with an acceptable axial load value of the joint; and
comparing at least a portion of the data with the acceptable axial value using the controller.

6. The method of 1, wherein the acceptable rotation or torque value of the joint is an acceptable torque value of the joint.

7. The method of claim 6, further comprising:

lowering the casing string through the first member.

8. The method of claim 7, further comprising:

closing the first member around the casing string.

9. The method of claim 8, further comprising:

disengaging the top drive from the casing string.

10. The method of claim 6, wherein the controller is further preprogrammed with an acceptable rotation value.

11. The method of claim 6, wherein the acceptable torque value is a value limit.

12. The method of claim 6, wherein the first member comprises a spider.

13. The method of claim 6, wherein sending comprises transmitting.

14. The method of claim 6, wherein the data is indicative of a torque value of the joint.

15. The method of claim 6, wherein the top drive comprises at least one adapter for gripping a casing.

16. The method of claim 15, wherein the adapter comprises an elevator.

17. The method of claim 15, wherein the adapter comprises a spear.

18. The method of claim 5, wherein the adapter comprises a torque head.

19. The method of claim 15, wherein the adapter comprises movable slips.

20. The method of claim 15, wherein the adapter comprises an elevator and a gripping member having movable slips.

21. The method of claim 6, wherein the top drive comprises a torque sub.

22. The method of claim 6, wherein the top drive comprises a rotation counter.

23. The method of claim 6, wherein the gripping and supporting comprises gripping and supporting with movable slips.

24. The method of claim 6, wherein the controller includes a data storage device.

25. The method of claim 6, wherein the controller is configured to control at least one device connected to it.

26. The method of claim 6, wherein the controller includes a display unit.

27. The method of claim 6, wherein the controller includes a clock, a cache, an input control unit and an input/output circuit.

28. The method of claim 6, further comprising comparing at least a portion of the data with the acceptable torque value using the controller.

29. The method of claim 28, further comprising initiating remedial action using the controller.

30. The method of claim 29, wherein the initiating comprises sending a signal to an operator.

31. The method of claim 6, further comprising:

preprogramming the controller with an acceptable axial load value of the joint; and

comparing at least a portion of the data with the acceptable axial value using the controller.

32. A method of connecting casing sections, comprising:

closing a first member around a first casing;

engaging a second casing with a second member, wherein the second member comprises a top drive comprising at least one adapter for gripping a casing;

moving the second casing to a well center;

threading the second casing to the first casing to form a casing string having a joint;

sending data from the second member to a controller, wherein the controller is preprogrammed with an acceptable rotation or torque value of the joint;

opening the first member;

lowering the casing string through the first member;

closing the first member around the casing string; and

disengaging the second member from the casing string.

33. The method of claim 32, wherein said acceptable rotation or torque value of the joint comprises an acceptable rotation value of the joint.

34. The method of claim 33, further comprising comparing at least a portion of the data with the acceptable rotation value using the controller.

35. The method of claim 34, further comprising:

preprogramming the controller with an acceptable axial load value of the joint; and

comparing at least a portion of the data with the acceptable axial value using the controller.

36. The method of claim 33, wherein the first member comprises a spider for retaining the casing string.

37. The method of claim 32, wherein said acceptable rotation or torque value of the joint comprises an acceptable torque value of the joint.

38. The method of claim 32, wherein the controller preprogrammed with said acceptable rotation value of the joint and said acceptable torque value of said joint

39. The method of claim 38, wherein the acceptable torque and rotation values are value limits.

40. The method of claim 32 or 37, wherein the first member comprises a spider.

41. The method of claim 32 or 37, wherein sending comprises transmitting.

42. The method of claim 32 or 37, wherein the data is indicative of at least one value of the joint.

43. The method of claim 42, wherein the at least one value is torque.

44. The method of claim 32 or 37, wherein the top drive comprises a torque sub.

45. The method of claim 32 or 37, wherein the adapter comprises an elevator.

46. The method of claim 32 or 37, wherein the adapter comprises a spear.

47. The method of claim 32 or 37, wherein the adapter comprises a torque head.

48. The method of claim 32 or 37, wherein the adapter comprises movable slips.

49. The method of claim 32 or 37, wherein the adapter comprises an elevator and a gripping member having movable slips.

50. The method of claim 32 or 37, wherein the top drive comprises a rotation counter.

51. The method of claim 32 or 37, wherein engaging comprises gripping with movable slips.

52. The method of claim 32 or 37, wherein the controller includes a data storage device.

53. The method of claim 32 or 37, wherein the controller is configured to control at least one device connected to it.

54. The method of claim 32 or 37, wherein the controller includes a display unit.

55. The method of claim 32 or 37, wherein the controller includes a clock, a cache, an input control unit and an input/output circuit.

56. The method of claim 32 or 37, further comprising comparing at least a portion of the data with the acceptable torque value using the controller.

57. The method of claim 56, further comprising initiating remedial action using the controller.

58. The method of claim 57, wherein the initiating comprises sending a signal to an operator.

59. A method of connecting casing sections, comprising:

closing a spider around a first casing;

engaging a second casing with a top drive having a casing gripping apparatus connected thereto;

moving the second casing to a well center;

threading the second casing to the first casing to form a joint and a casing string;

sending data from the top drive to a processing unit, wherein the processing unit is preprogrammed with at least one acceptable torque value of the joint or at least one acceptable rotation value of the joing;

opening the spider;

lowering the casing string through the spider;

closing the spider around the casing string; and

disengaging the top drive from the casing string.

60. The method of claim 59, wherein the top drive further comprises an elevator operatively coupled thereto.

61. The method of claim 60, wherein moving the second casing comprises:
moving with the second casing using the elevator.

62. The method of claim 59, further comprising raising the top drive and thereby raising the casing string.

63. The method of claim 59, further comprising ensuring that a threaded connection has been made.

64. A method of connecting tubulars, the method comprising:
gripping a first tubular using a first device comprising a top drive;
closing a second device around a second tubular;
rotating the first tubular with the first device to join the first tubular to the second tubular to form a joint and a tubular string;
sending data from the first device to a controller, wherein the controller is preprogrammed with an acceptable torque or rotation value of the joint; and
stopping rotation of the first tubular based on a comparison between the sent data and the acceptable torque or rotation value of the joint.

65. Apparatus for connecting tubulars, the apparatus comprising:
a first device for gripping a first tubular, the first device comprising a top drive;
a second device arranged to close around a second tubular;
means for rotating the first tubular with the first device to join the first tubular to the second tubular for forming a joint and a tubular string;
means for sending data from the first device to a controller, wherein the controller is preprogrammed with an acceptable torque or rotation value of the joint; and
means for stopping rotation of the first tubular based on a comparison between the sent data and the acceptable torque or rotation value of the joint.

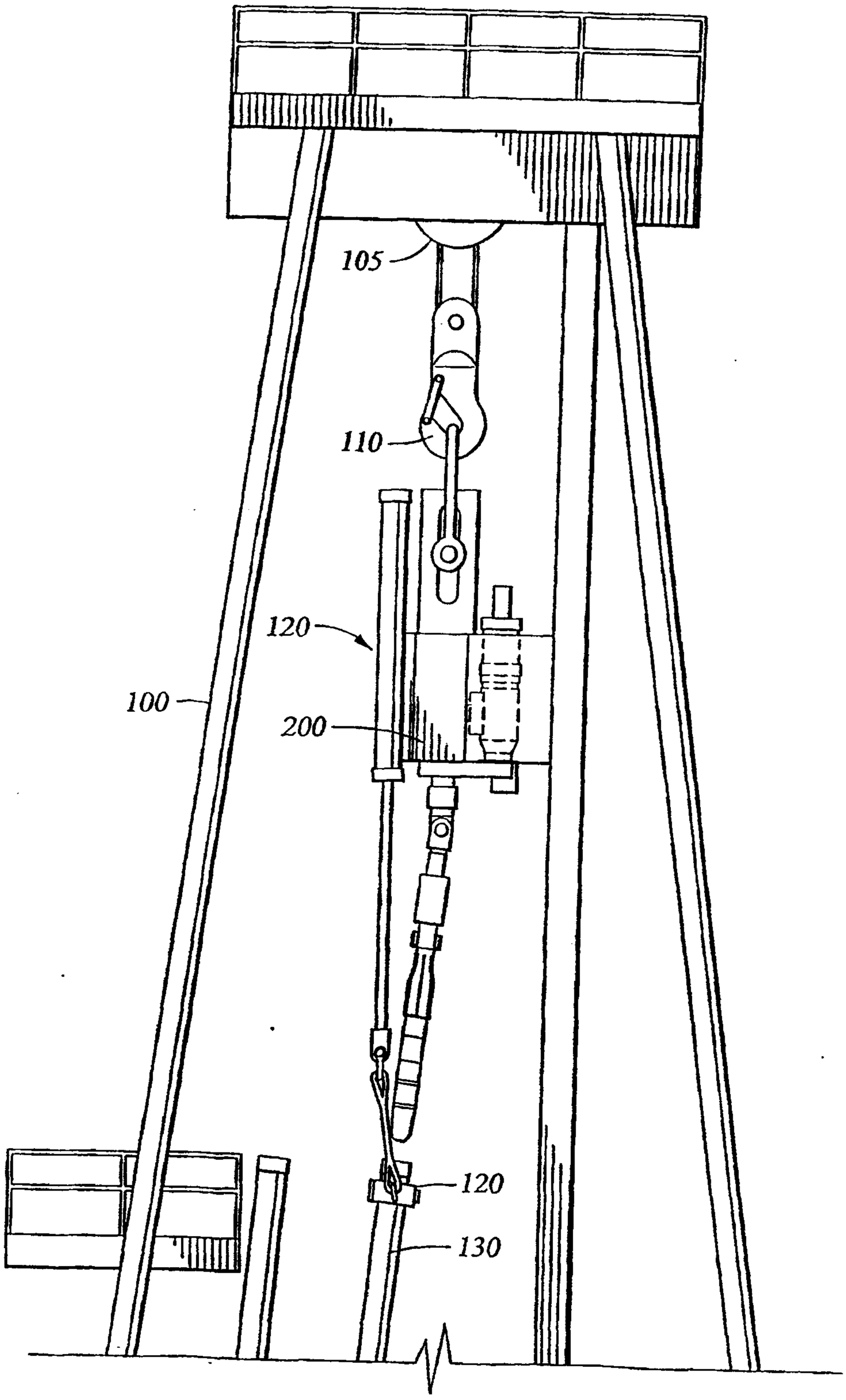
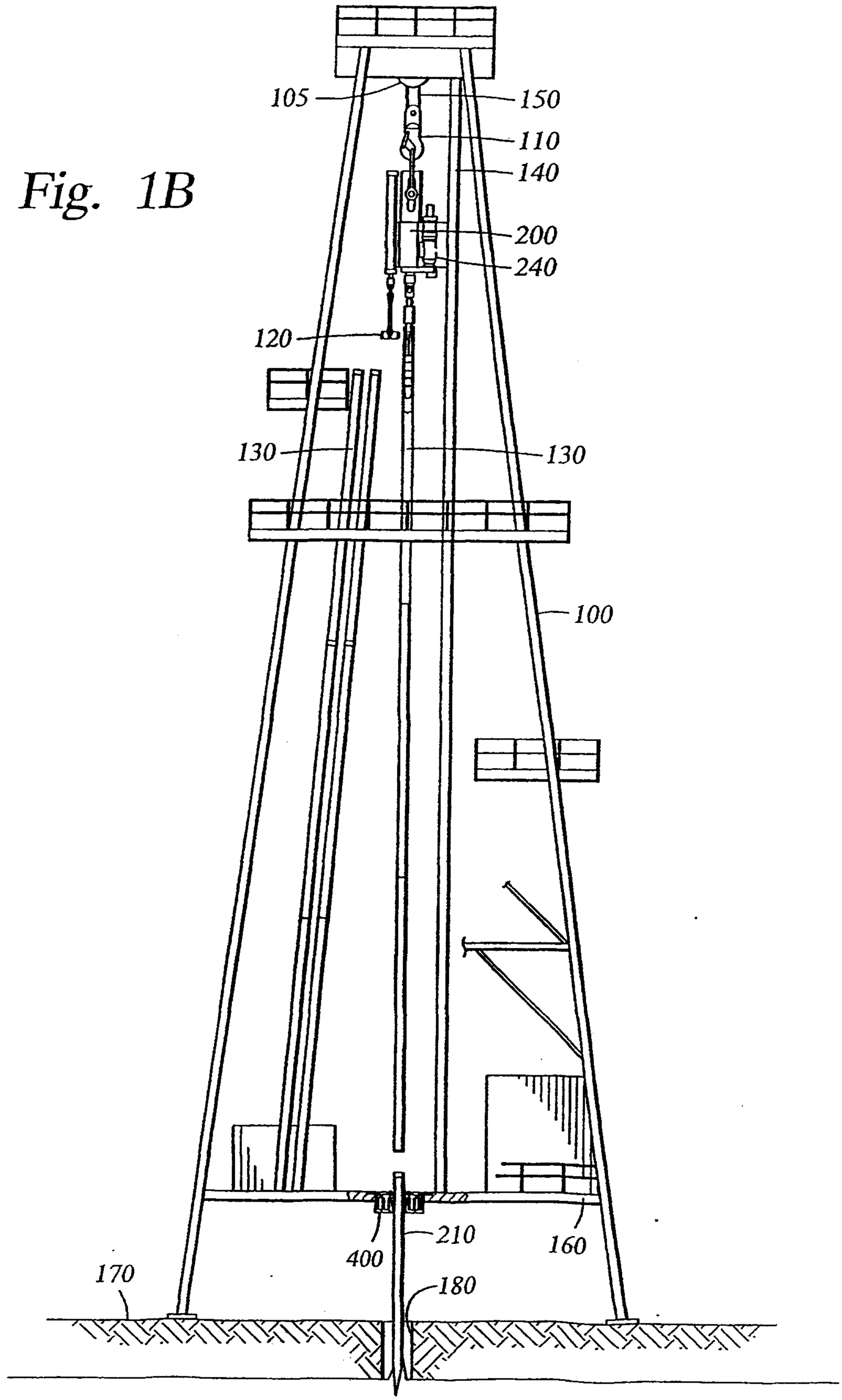


Fig. 1A

Fig. 1B



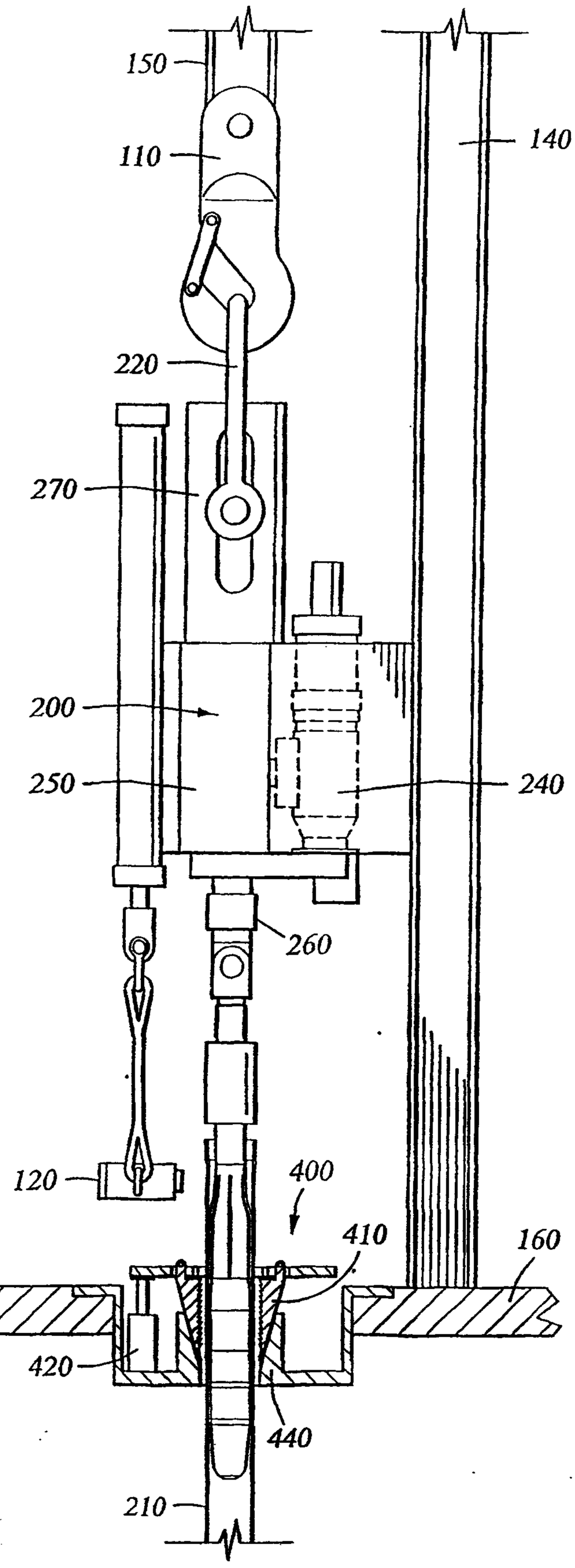
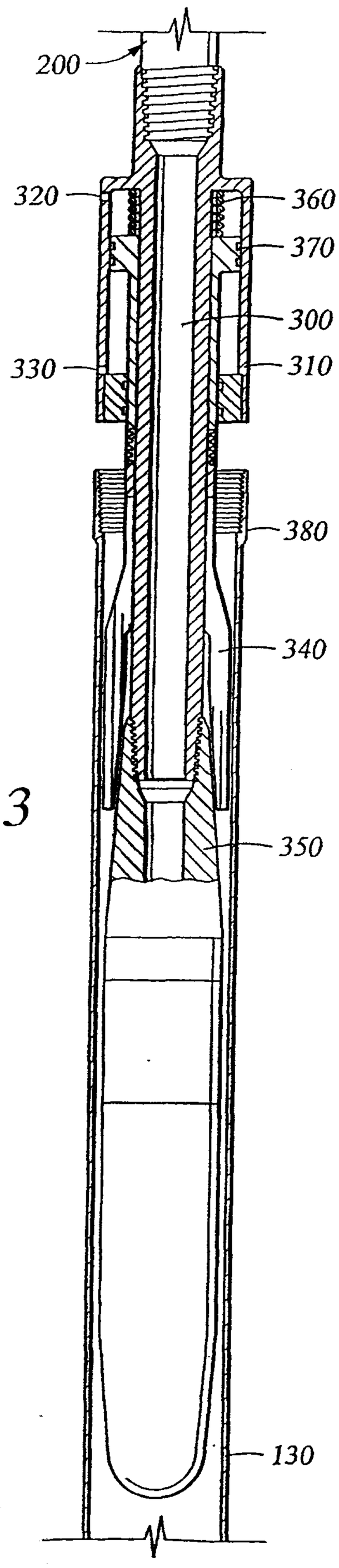


Fig. 2


200
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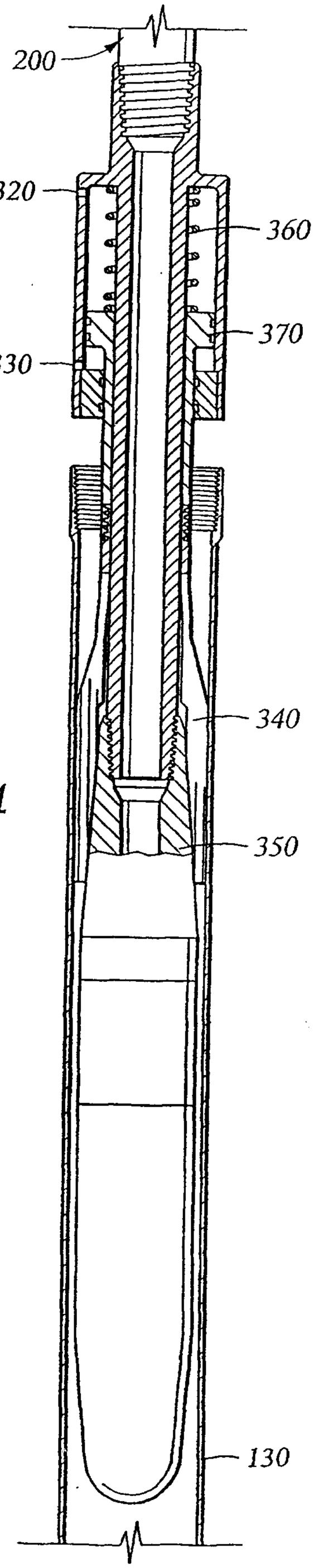
310
380
340
350
130

Fig. 3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360
370
330
340
350
130

Fig. 4

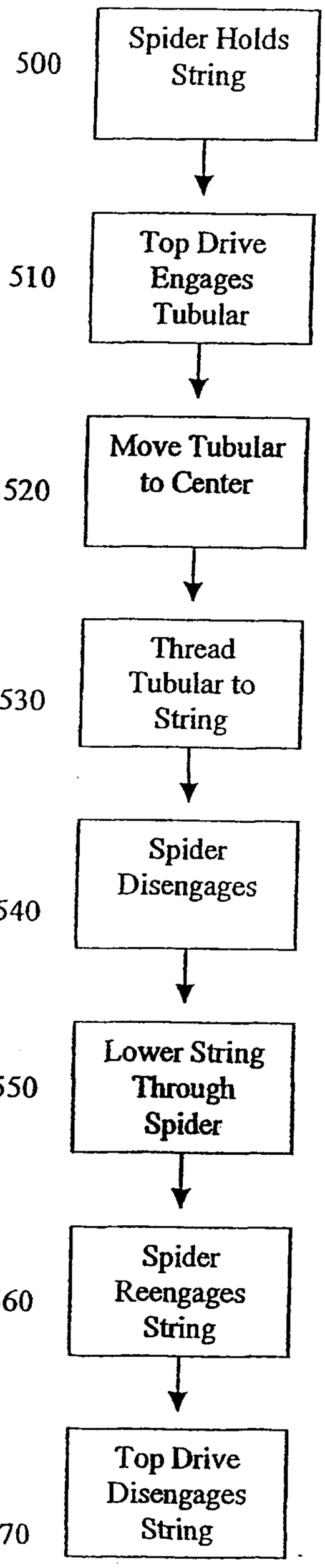

Fig. 5

(PRIOR ART)

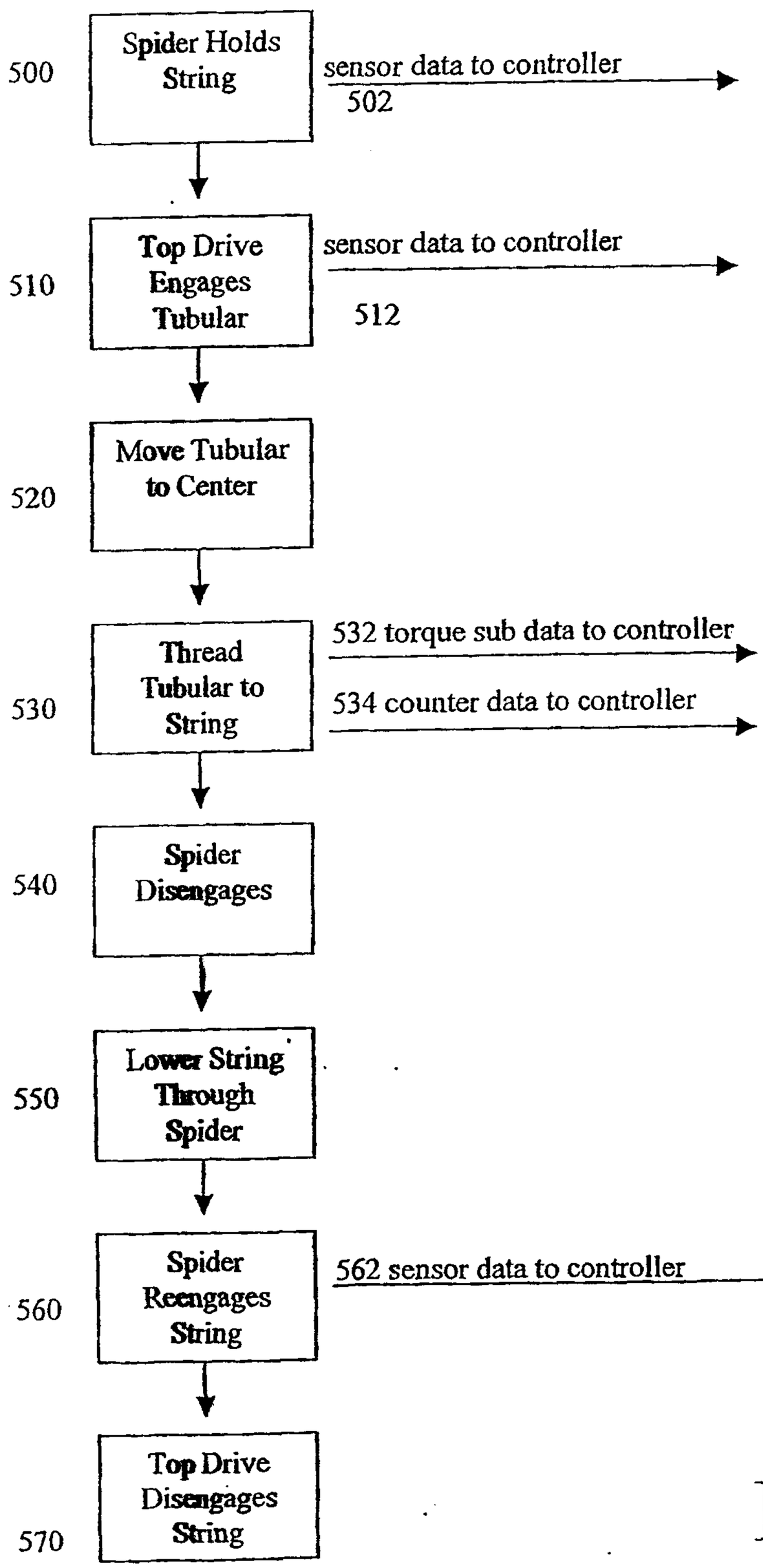
500
Spider Holds String
sensor data to controller
502
510
Top Drive Engages Tubular
sensor data to controller
512
520
Move Tubular to Center
530
Thread Tubular to String
532 torque sub data to controller
534 counter data to controller
540
Spider Disengages
550
Lower String Through Spider
560
Spider Reengages String
562 sensor data to controller
570
Top Drive Disengages String

Fig. 6

Fig. 7

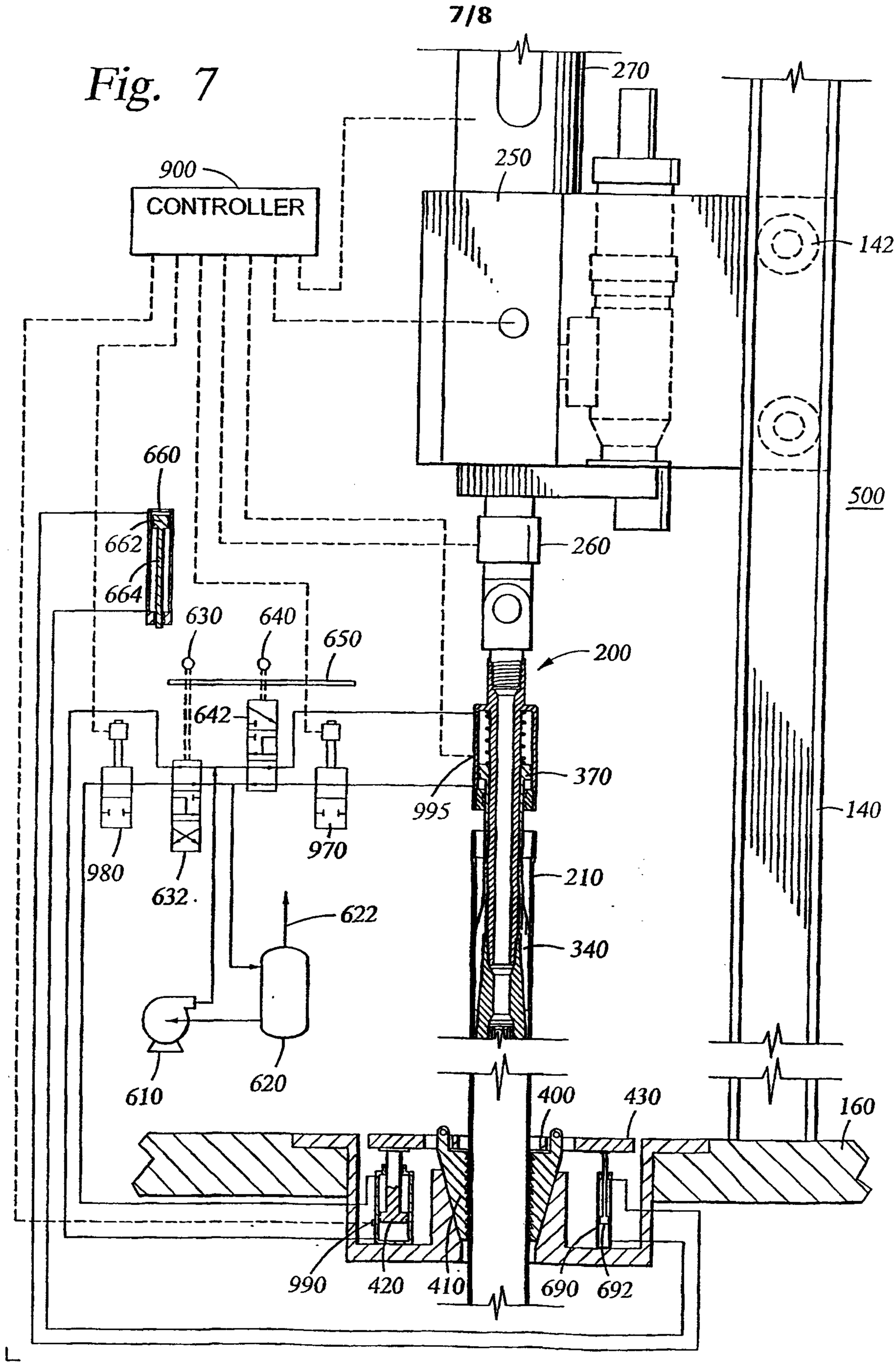
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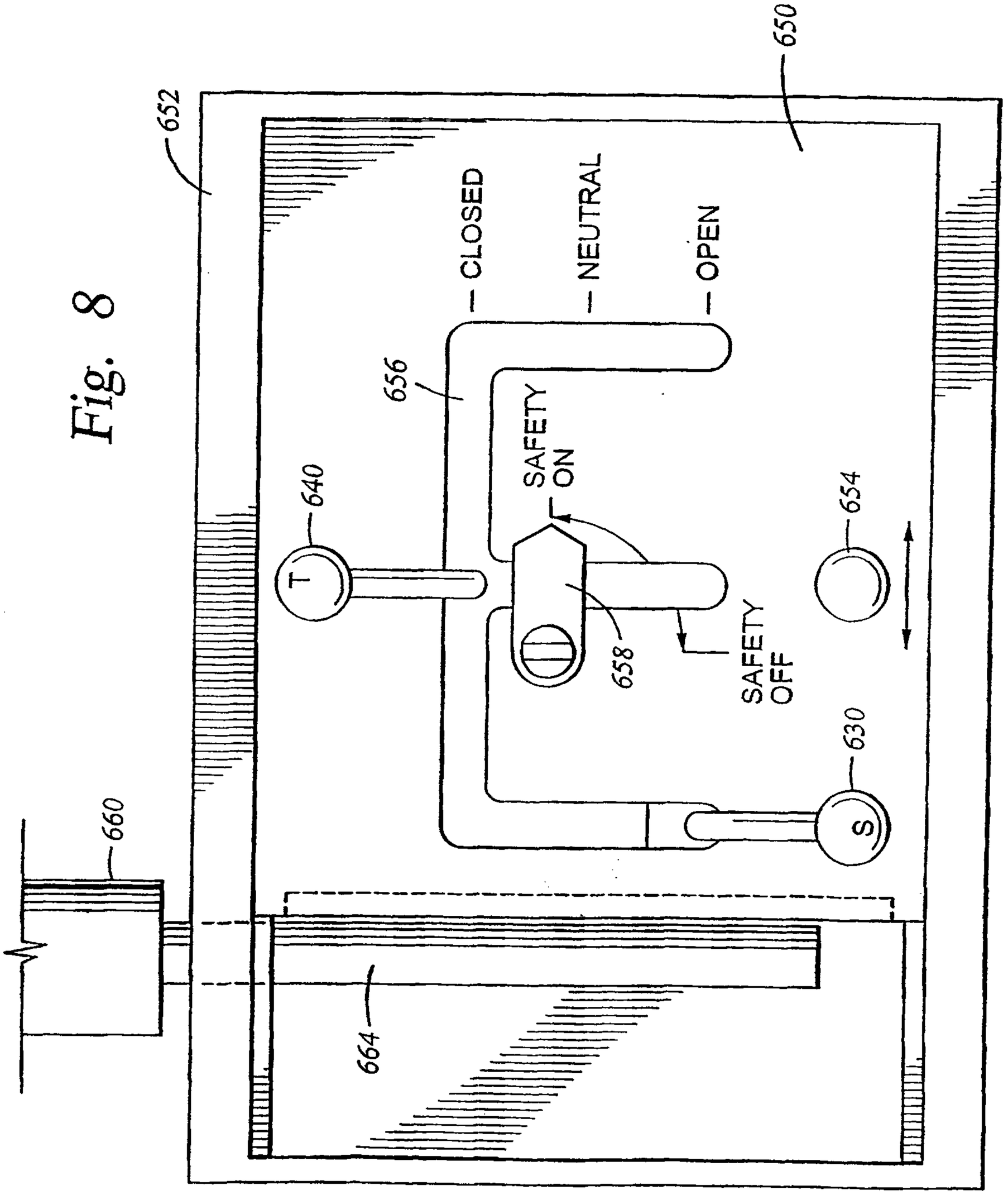
Fig. 8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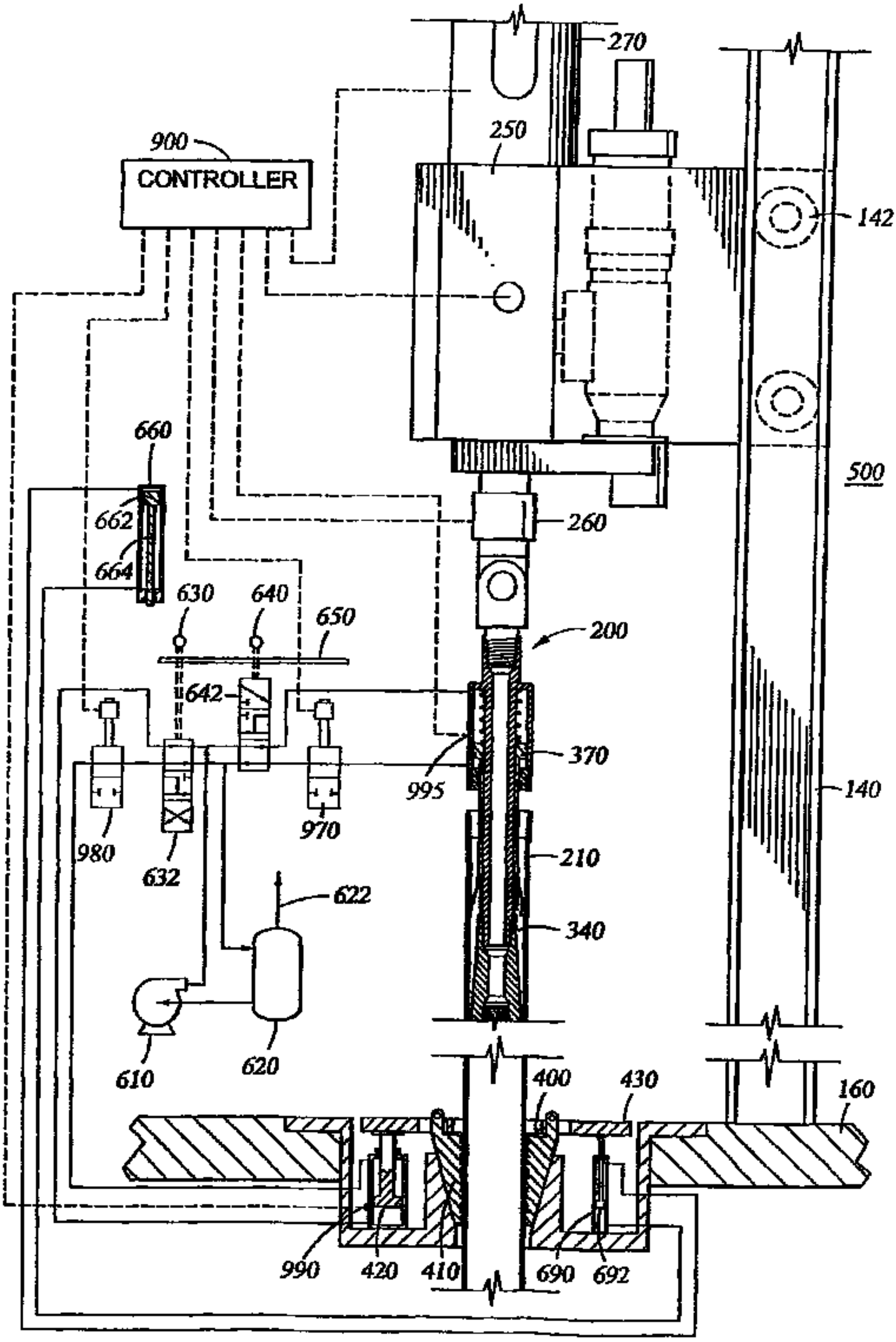
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