METHOD AND APPARATUS FOR DRILLING UNDERWATER WELLS

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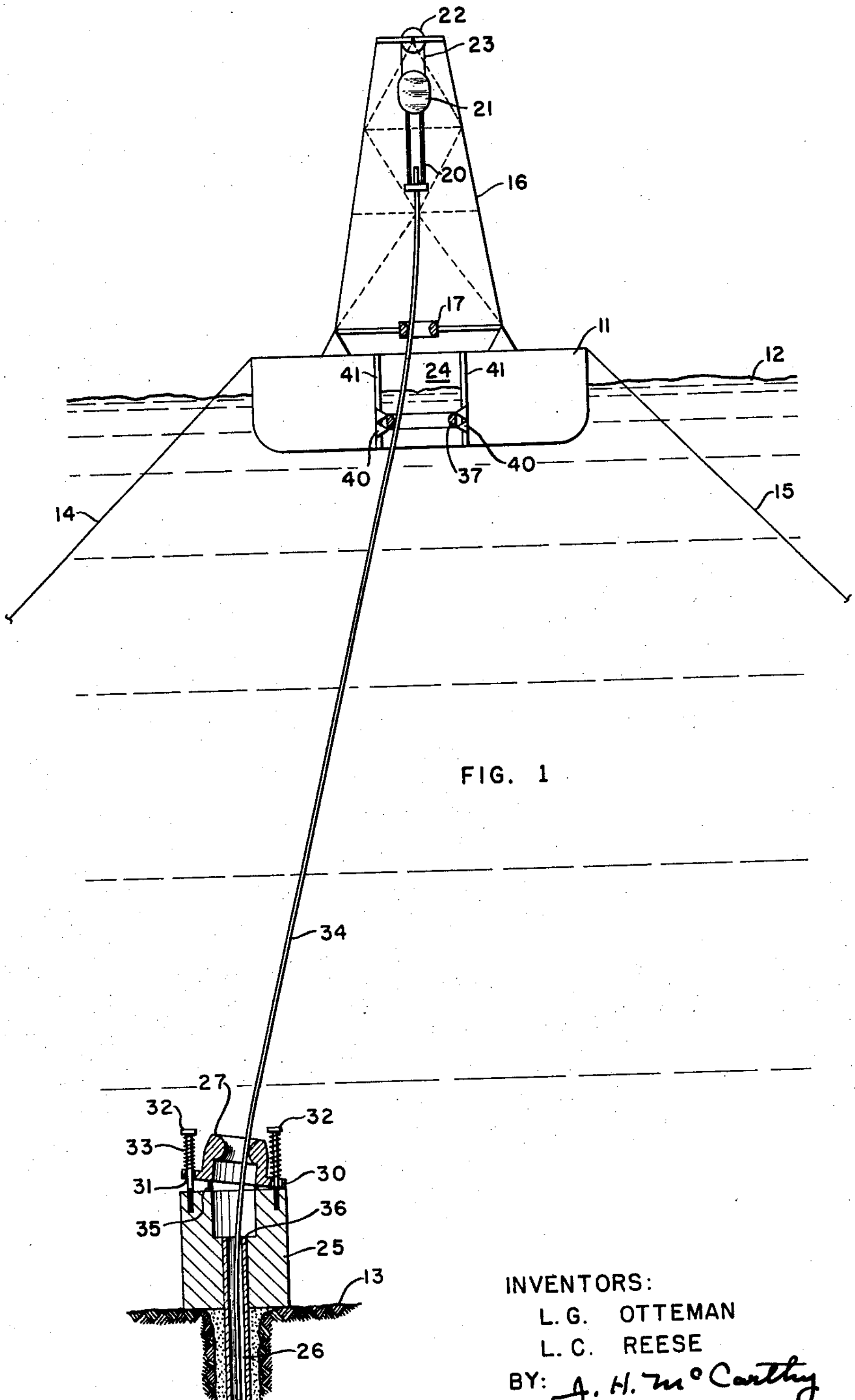

FIG. 1

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METHOD AND APPARATUS FOR DRILLING UNDERWATER WELLS

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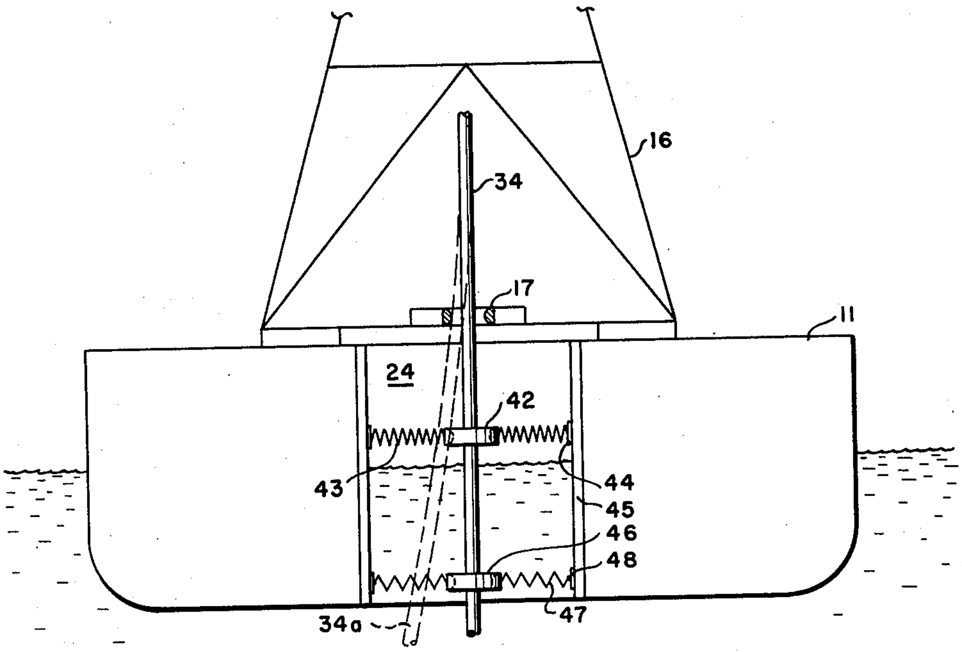

FIG. 2

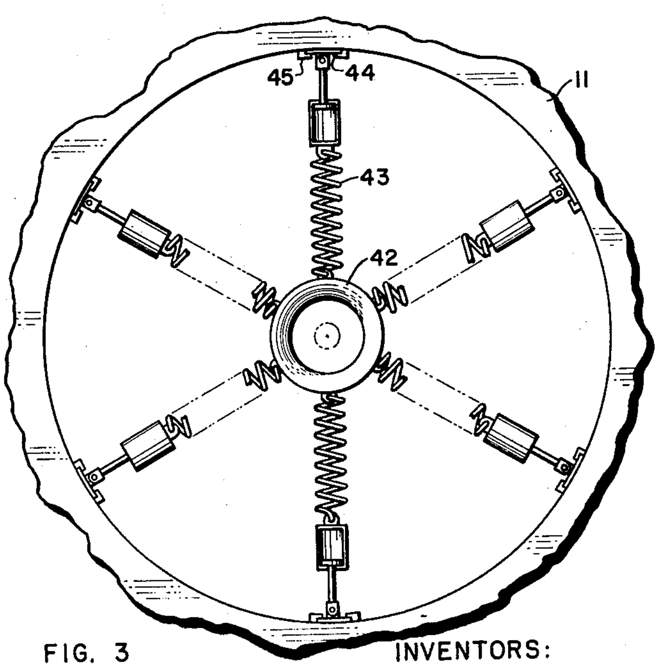

FIG. 3

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METHOD AND APPARATUS FOR DRILLING UNDERWATER WELLS

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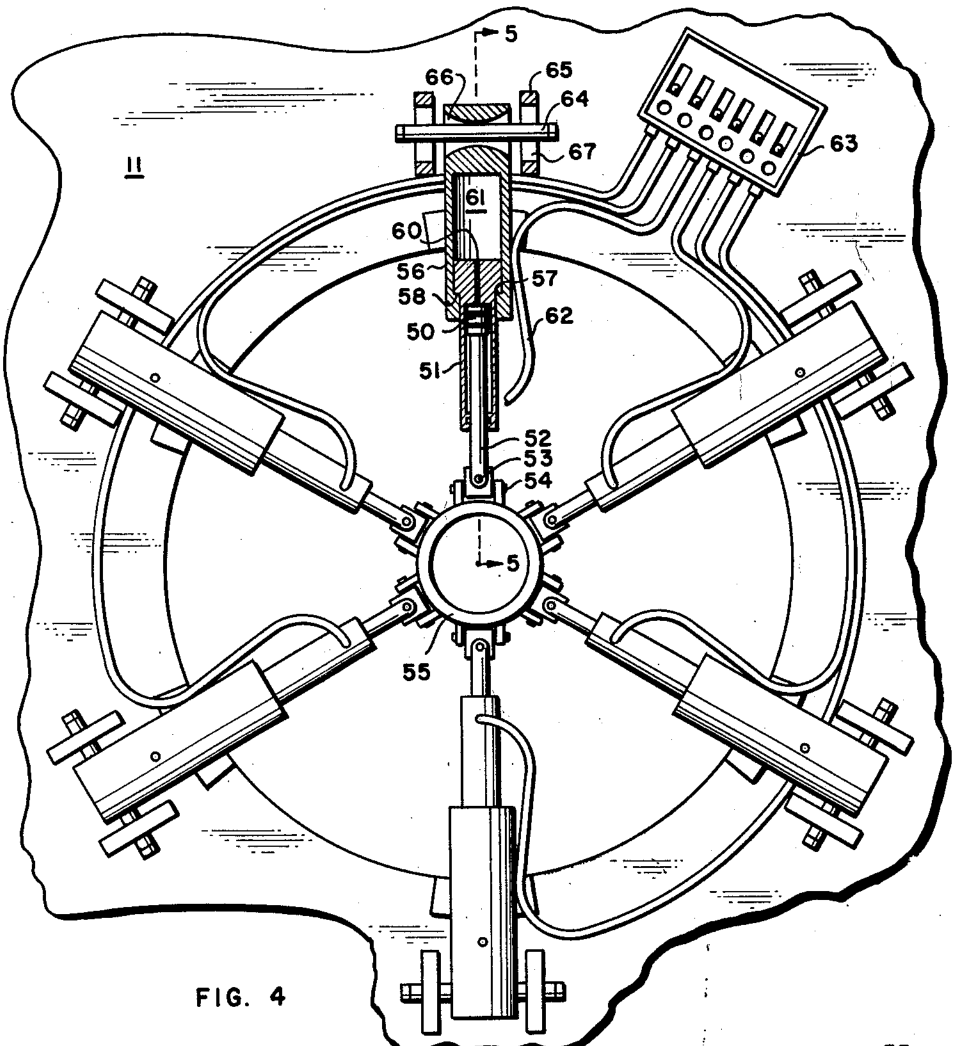

FIG. 4

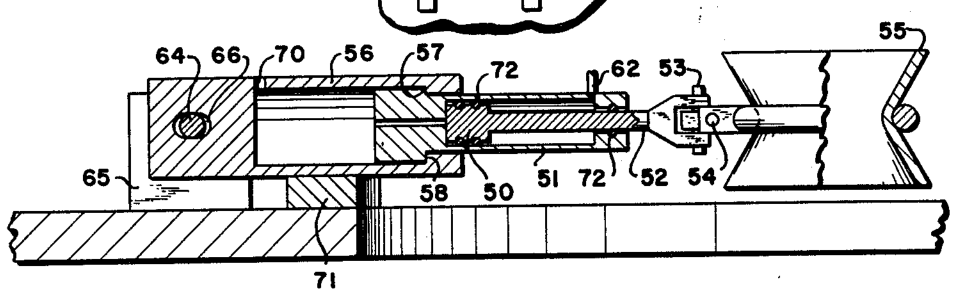

FIG. 5

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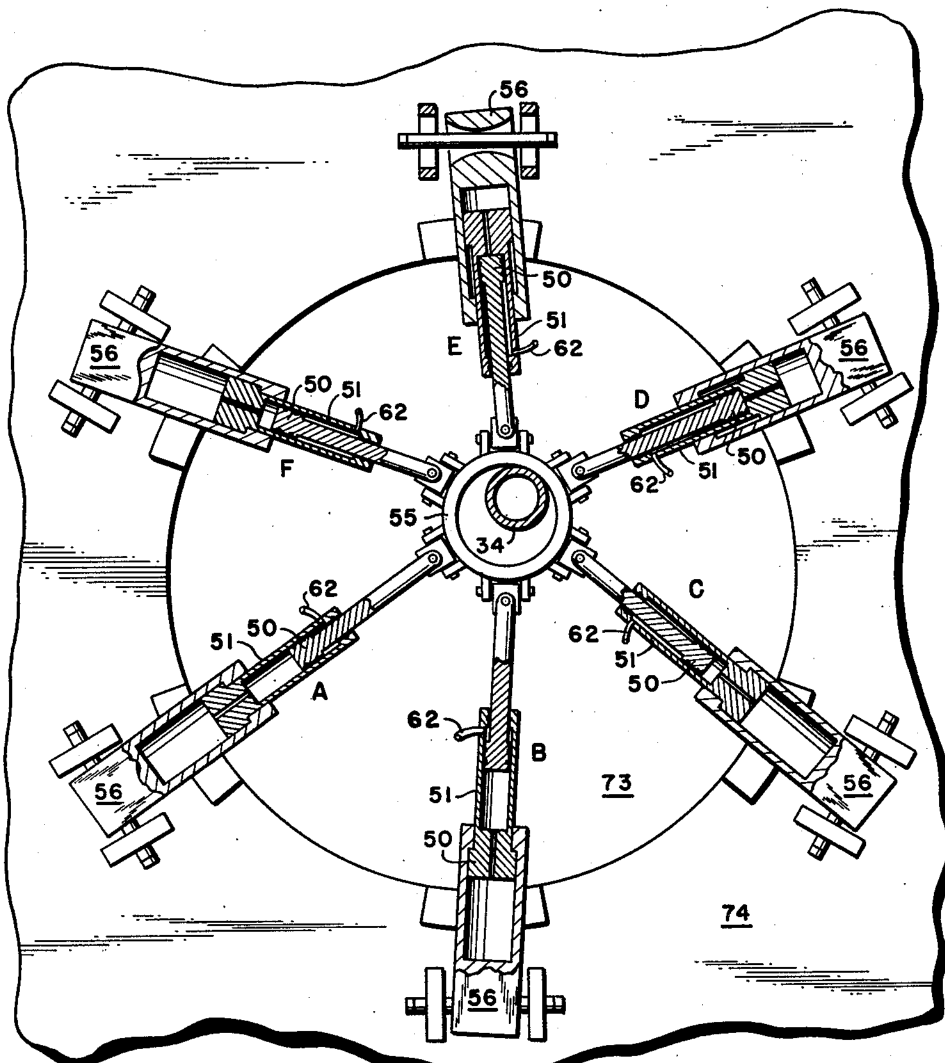

FIG. 6

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METHOD AND APPARATUS FOR DRILLING UNDERWATER WELLS

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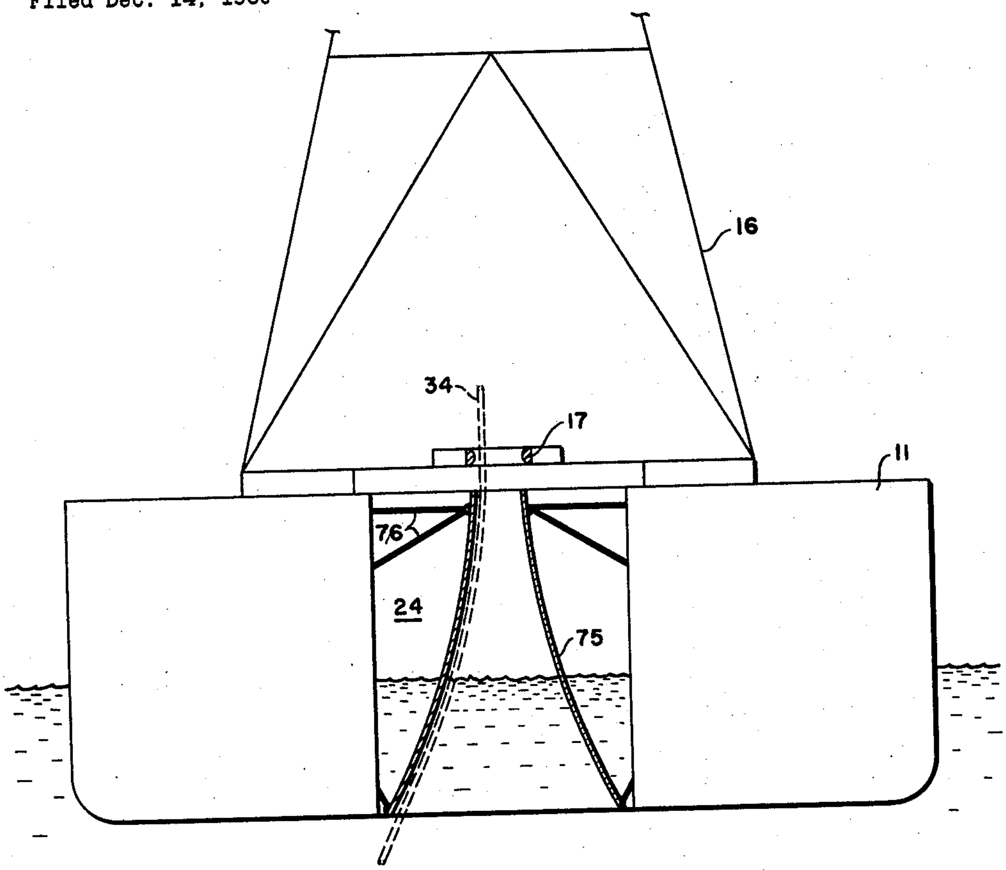

FIG. 7

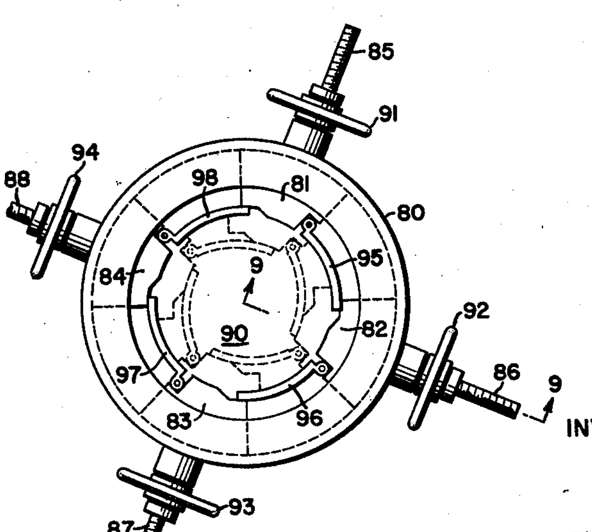

FIG. 8

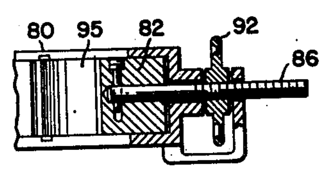

FIG. 9

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METHOD AND APPARATUS FOR DRILLING UNDERWATER WELLS

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Filed Dec. 14, 1960, Ser. No. 75,790
17 Claims. (Cl. 175—7)

This invention relates to the drilling of oil and gas wells and pertains more particularly to a method and apparatus for drilling wells at offshore locations where the drilling operations are carried out from a floating base positioned on the surface of the water and the well being drilled is provided with a wellhead assembly positioned below the surface of the water.

Heretofore most offshore wells have been drilled either from stationary platforms anchored to the ocean floor or from movable barges temporarily positioned on the ocean floor. Regardless of the manner in which the wells were drilled, most wells were completed in a manner such that the outermost tubular member of the well extends upwardly from the ocean floor to above the surface of the water where a wellhead or Christmas tree was mounted thereon for controlling the production of the well. Drilling offshore wells by either of these methods was carried out in much the same manner that wells are drilled on land. Thus, the string of drill pipe that was suspended from the derrick passed through the rotary table in the floor of the derrick and thence downwardly into the wellhead assembly which was positioned just below the operating floor of the derrick or the drill barge, well above the surface of the water. At most, there was only a few feet of drill pipe between the rotary table and the top of the conductor pipe or wellhead assembly on which blowout preventers were usually mounted.

A recent development in the art of drilling wells offshore has been a method for drilling and completing wells from a floating drilling base which was employed to suspend a string of drill pipe therefrom, with the drill pipe extending down through the water to a wellhead or conductor pipe positioned below the surface of the body of water. Generally, the wellhead assembly was positioned on the ocean floor and anchored thereto by cementing a conductor pipe into the ocean floor. With the floating drilling base anchored over the wellhead assembly positioned on the ocean floor, well drilling operations could be carried on on water depths of from 100 to 1500 feet or more. A method of drilling and completing an underwater well on the ocean floor in this manner is described in copending application, Serial No. 830,538, filed July 30, 1959, to Haeber et al.

Since it is impossible to anchor a floating drilling unit or barge to the ocean floor so that the barge maintains a fixed position at all times directly over a wellhead assembly positioned on the ocean floor, strings of tubular goods employed in drilling the well from the floating drilling unit are subjected to unusual bending conditions due to the movement of the drilling unit. Movement of a floating drilling unit on the surface of the ocean is caused by wind and wave forces and may take the form of a roll and/or horizontal movement from a position directly over the well being drilled. If the bending forces to which a string of pipe is subjected are too severe, the pipe will be damaged. To prevent damage of a pipe string, for example a string of drill pipe, drilling operations have to be suspended whenever conditions of the sea are such that the drilling unit's movement exceeds the allowable working range or bending limits of the pipe string.

It is therefore an object of this invention to provide a method and apparatus for increasing the working range of a floating well drilling unit subjected to wave and other forces tending to cause the unit roll on the surface of a body of water or to move horizonally from a position directly over an underwater well.

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A further object of the present invention is to provide a method and apparatus for properly distributing the bending forces induced in a string of drill pipe extending from a floating drilling barge into a wellhead positioned beneath the surface of a body of water when the barge moves from a position directly over the wellhead.

These and other objects of this invention will be understood from the following description taken with reference to the drawing, wherein:

FIGURE 1 is a diagrammatic view illustrating a floating drilling unit or barge anchored to the ocean floor over a drilling location with a string of drill pipe extending from the barge into a wellhead assembly positioned on the ocean floor;

FIGURE 2 is a diagrammatic view of the hull of a floating drilling barge provided with a force-displacement type horizontal pipe supports within the drilling slot of the barge in accordance with the present invention;

FIGURE 3 is a plan view taken along line 3—3 of FIGURE 2 showing the force-displacement type horizontal pipe support in enlarged detail;

FIGURE 4 is a plan view of a force-displacement type horizontal pipe support provided with hydraulically-operated pistons for centering a string of pipe or applying pressure to any side thereof;

FIGURE 5 is a view taken in cross-sectional detail of one of the piston elements of the pipe support of FIGURE 4;

FIGURE 6 is a diagrammatic plan view taken in cross-sectional detail of the piston-operated pipe support device of FIGURE 4 with a pipe in the centering ring thereof which has been moved to one side; and

FIGURE 7 is a schematic view of a floating drilling unit provided with a cone-shaped pipe support means in accordance with the present invention.

FIGURE 8 is a plan view of one form of a ring element having an internally variable diameter.

FIGURE 9 is a cross-sectional view taken along the line 9—9 of FIGURE 8.

Referring to FIGURE 1 of the drawing, a drilling barge 11, of any suitable floating type is illustrated as floating on the surface of a body of water 12 and substantially fixedly positioned over a preselected drilling location, as by being anchored to the ocean floor 13 by suitable anchors (not shown) at the ends of anchor lines 14 and 15. Equipment of this type may be used when carrying out well drilling operations in water varying from about 100 feet to 1500 feet or more in depth. The drilling barge is equipped with a suitable derrick 16 as well as other auxiliary equipment needed during drilling, such for example as a rotary table 17, elevators 20, traveling block 21, crown block 22 and fall lines 23. The derrick 16 on the drilling barge is positioned over a drilling slot or well 24 which extends vertically through the barge in a conventional manner. When using the equipment of the present invention, the slot 24 of the barge may be either centrally located or extend in from one edge. Additionally, well drilling operations may be carried out over the side of a barge without using the slot, if desired.

A wellhead assembly 25 is schematically shown as being positioned on the ocean floor 13 and being fixedly anchored thereto by a conductor pipe or well casing 26 which extends into the ocean floor 13 and is preferably cemented therein. While an underwater wellhead assembly of this type as described in the copending application Serial No. 830,538, filed July 20, 1959, to Haeber et al., is generally provided with a series of guide columns for guiding equipment into place on top of the wellhead assembly, and with a series of guide lines extending from the wellhead assembly on the ocean floor to the drilling barge floating on the surface of the water, since these elements do not form a part of the present invention they will not be further described here.

The top of the wellhead assembly **25** is provided with a tiltable collar or bushing **27** suitably connected for slight tilting movement in any direction around the top of the wellhead assembly, for example, the tiltable collar **27** may be provided with a lower flange **30** having a series of large diameter holes **31** therethrough with bolts **32** extending through each of the holes **31**. A compression spring **33** is mounted above the flange **30** to exert pressure against the flange when it is being tilted. In FIGURE 1, a string of drill pipe **34** is shown as extending down through the tiltable collar **27** and into the wellhead assembly **25**. In drilling underwater wells of this type it is general to have a conductor pipe of larger diameter than the drill pipe **34** extend in a fluidtight manner from the top of the wellhead assembly **25** or the tiltable collar **27** to a point just below the rotary table **17** on the barge **11**. In the event that a conductor pipe (not shown) of this type is employed, a fluidtight seal, for example a bellows **35** would be installed between the bottom of the tiltable collar **27** and the top of the wellhead assembly **25**. Thus it may be seen that the tiltable collar **27** forms a horizontal pipe support device so that down at the ocean floor a pipe string **34** would bear against the tiltable collar **27** and also against the top edge **36** of the conductor pipe **26**, as illustrated in FIGURE 1. The distance between the top edge **36** of the conductor pipe **26** and the pipe contacting face of a tiltable collar **27** is generally in the order of five feet or more.

The simplest form of a horizontal pipe support adapted to be secured to the barge **11** is that of a ring **37** located directly below the rotary table **17**. For ease in explanation and descriptive purposes the term pipe string will be employed, it being understood that the principles discussed hereinbelow apply to any tubular goods that may be used in well operations such as casing, tubing, drill pipe, drill tubing, etc., and that the equipment described herein may be used on any type of tubular goods. Also, the principles to be discussed hereinbelow apply to a pipe string being run in or pulled out of a well, while rotating or not rotating as the case may be.

If desired, the horizontal pipe support ring **37** may be fixedly secured to the vessel **11** within the slot **24** thereof, as by welding, bolting, etc., or it may be fixedly secured to carriages **40** which are adapted to be run up and down and positioned at any point on vertical tracks **41**. The ring **37** has an internal diameter somewhat greater than the internal diameter of the rotary table **17**. A ring shaped to the horizontal pipe support **37** is employed so that the support **37** functions when the floating drilling unit **11** moves in any direction off the center line of the wellhead assembly **25**.

In the operation of the equipment of FIGURE 1, the pipe string **34** is suspended by the elevators **20** and passes down through the rotary table **17**, the horizontal support ring **37**, into the water and down the well. The drilling barge **11** is originally anchored so that a vertical line passes through the rotary table **17**, the support ring **37** and the wellhead assembly **25** on the ocean floor. As wind and wave forces move the drilling barge **11** horizontally off this center line through the well, the pipe string **34** first comes into contact with the rotary table **17**. A force is developed between the pipe string **34** and the rotary table **17** so that a bending of the pipe string **34** takes place opposite the rotary table, that is, where the two are in contact. As the amount of horizontal movement of the drilling barge **11** increases, the force between the rotary table **17** and the pipe string **34** increases with a resultant increased bending in the section of the pipe string **34** opposite and for some distance above and below the rotary table. Generally, the bending is at a maximum at the point of contact between the rotary table **17** and the pipe string **34** and decreases to an insignificant magnitude about 20 feet or so from the point of contact. Continued movement of the drilling barge **11** in the same direction horizontally causes the pipe string **34** to come in contact with the horizontal support ring **37** and a force is developed between the pipe string **34** and the support ring **37** with bending being induced in this section of the pipe opposite the support ring **37** as well as in the section of pipe opposite the rotary table **17**. With continued movement of the vessel **11** in the same direction, the force between the horizontal support ring **37** and the pipe string **34** causes bending in the pipe string at a point opposite the ring to increase, while the force between the rotary table **17** and the pipe string **34** as well as the bending in the pipe string at a point opposite the rotary table remains fairly uniform.

If the bending in the pipe string **34** opposite the rotary table **17** was near the maximum working limit of the pipe string at the time the pipe string contacted the lower point of support and thereafter remains nearly constant, then any additional horizontal movement of the vessel will merely induce an amount of bending in the section of pipe opposite the support ring **37** without endangering the pipe at the point opposite the rotary table **17**. The method and apparatus of the present invention provides for additional horizontal support for a drill pipe in order to reduce the maximum curvature or bending of the pipe by distributing the bending over more length of the pipe. With conventional floating drilling units, the drill pipe is supported vertically with either slips set in the rotary table or by the elevators on the traveling block. In either case, as the drilling barge **11** moves horizontally and/or rolls, a horizontal force develops between the pipe and the rotary table. Bending results in the section of pipe opposite the rotary table. The magnitude of the bending is a function of the magnitude of the movements of the drilling vessel **11**. If the vessel's movement exceeds certain limits, the magnitude of the bending will cause damage to the pipe. Thus, by providing a horizontal pipe support in addition to the rotary table, the magnitude of the bending in the section of pipe opposite the rotary table can be reduced by inducing bending in the section of pipe opposite the other horizontal pipe supports. Instead of using a multiple number of horizontal supports, a multiplicity of supports could be interconnected to form a continuous horizontal pipe support member in the form of a cone, as will be described with regard to FIGURE 7.

If the equipment of the present invention is properly designed, the magnitude of the bending induced in a pipe string can be reduced by, say, 30 percent or more for a given amount of vessel movement. The range of the vessel movement would therefore be increased by a proportional amount and would result in significant reduction in the amount of drilling time lost on a barge when it is necessary to shut down operations because waves are causing the barge to roll too much or the barge has moved too far off the center of the well. When equipment with a balanced design is employed, the magnitude of the bending in the section of the pipe opposite the rotary table and in the section of pipe opposite a second horizontal pipe support ring would be nearly equal at the limiting amount of vessel movement.

Movement of the drilling barge **11** off the center of the well also induces bending in the section of the pipe string **34** opposite the first fixed horizontal support below the barge **11**. This first fixed horizontal support is generally the top of the wellhead assembly or the top edge **36** of the conductor pipe **26**. Additional support can be supplied to the pipe string **34** by providing the tiltable collar **27** which would operate on the pipe string **34** to cause bending therein in the same manner as the horizontal support ring **37** operates near the top of the pipe string.

In the apparatus shown in FIGURE 1, four points of contact have been provided for inducing bending in the pipe string, that is, at the rotary table **17**, the ring **37**, the tiltable collar **27** and the top edge **36** of the conductor pipe **26**. The dimensions of the internal diameter of the support ring **37** are very important. In the example given hereinbelow, the pipe string **34** was assumed to make contact with the ring **37** at the time the bending in the section of the pipe string opposite the rotary table **17** had reached a predetermined magnitude. In employing the method of the present invention it is necessary to know both the magnitude of the bending in the pipe string **34** at a point opposite the rotary table **17**, and also the relative position of the pipe string **34** at the level of the second point of contact which is the horizontal support ring **37**. This information depends on several factors such as, size of pipe, type of drilling equipment on the drilling unit, design and characteristics of the drilling vessel especially with regard to the relative relationship of roll and horizontal displacement, load on the hook or elevators **20**, properties of the pipe material, and distance between the support ring **37** and the rotary table **17**. By application of engineering principles it is possible to determine the proper internal diameter for the support ring **37** for any combination of the above factors.

The desired internal diameter of the support ring **37** will vary as any of the above factors vary. Either various size rings can be used or a ring of variable internal diameter can be employed. Thus, under some conditions the support ring **37** of FIGURE 1 could be removed with a ring of smaller diameter being substituted therefor. Alternatively, instead of changing the ring to one of a different size, the same results can be accomplished by changing the vertical distance between the horizontal supports, i.e., the rotary table **17** and the ring **37**. Thus, the point at which the ring **37** contacts the pipe string **34** can be changed at any time by moving the carriage **40** up or down track **41** to change the position of the ring.

Referring to FIGURES 2 and 3 of the drawing, a drilling vessel **11** is illustrated as being provided with a force-displacement type horizontal pipe support or contact element in the form of a ring **42** centrally positioned in the slot **24** of the drilling barge **11** by means of a plurality of radially-extending springs **43**. The springs **43** are anchored to the vessel **11** by means of any suitable connectors such as bolts, but are preferably mounted for sliding vertical movement within the slot **24** so that the distance between the ring **42** and the rotary table **17** may be varied depending upon the drilling conditions and equipment that are used. One suitable device for connecting the springs to the walls of the slot may take the form of a sliding plate element **44** anchored to the outermost end of each spring **43** while being slidably positioned for vertical movement within a keyway or track **45**. All springs are preferably attached to a slip-rod connection which is in the extended position when the center ring, **42**, is in the center of the well, **24**. As the center ring is moved horizontally the spring arrangements opposite the direction of movement will be in tension, extending the spring, while the spring arrangement at 180° will be inactive because of the slip-rod connection. As an alternative, the spring-arrangements could be designed so that the spring provides force when in compression instead of when in tension. If desired, a second horizontally-displaceable pipe support ring **46** may be similarly mounted in spaced relationship with the ring **42**. The lower pipe support ring **46** is centrally positioned within the well **24** of the barge **11** by means of radially-extending springs **47** which are secured at their outer ends to sliding plate elements **48** mounted within the keyway or track **45**. If desired, the plate elements **44** and **48** may be fixedly secured to the walls of the slot **24** of the drilling barge **11**, as by bolts.

Preferably, the springs **47** of the lowermost horizontal pipe support ring **46** are weaker than the springs **43** of the pipe support ring **42** positioned thereabove if the diameters of the pipe support rings **42** and **46** are the same or nearly the same. The internal diameter of the lowermost support ring **46** must be made larger than the internal diameter of the support ring **42** above it in order to get benefit of both support rings **42** and **46** while using springs **43** and **47** of the same strength. When using rings **42** and **46** of suitable dimension and spacing so that the design of the pipe support equipment is balanced with regard to the drilling equipment being used during drilling operations, the bending of the pipe string **34** opposite each of the supports **17**, **42** and **46** on the vessel will be nearly equal at the maximum allowable vessel movement which may be in the form of horizontal over the vertical lines through a well and/or roll of the drilling vessel. The drill pipe **34*a*** illustrates one possible position of the pipe string when the vessel **11** has moved horizontally to one side of the line through the axis of a well at which time the vessel is said to be "off the well."

When using the arrangement of one or more spring-loaded pipe support rings **42** and/or **46**, as illustrated in FIGURES 2 and 3 of the drawing, there is not the necessity of varying the internal diameter of a ring as often as it would be necessary with the use of a rigidly mounted pipe support ring **37** as described with regard to FIGURE 1. The ring **37** employed in FIGURE 1 may vary in diameter from 3 inches to 30 inches or more in internal diameter depending on pipe size being used and drilling conditions. Preferably, the ring **37** is located at least 5 feet below the rotary table **17** and preferably 10 feet or more. The internal diameter of the pipe support ring **37** is a function of its distance from the rotary table **17**. With the ring **37** mounted for vertical movement, as illustrated in FIGURE 1, the ring could be lowered as the well was drilled deeper rather than to go to the trouble of substituting a smaller diameter ring. The optimum internal diameter of the ring varies with the weight suspended from the elevators **20**. Changes in the diameters and/or spacing of the support rings are made with the aim of achieving a bending stress at the rotary table **17** and at each of the support rings **37** or **42** and **46** which is substantially equal.

Rather than employing a series of radially-extending springs to position a centralizing pipe support ring as described with regard to FIGURES 2 and 3, the springs may be replaced by a series of hydraulic or pneumatic pistons or suitable mechanical devices. One form of a pneumatically-operated device is illustrated in FIGURES 4, 5 and 6 which employs a series of pistons **50** which are mounted within piston sleeves **51** for extension therefrom. The end of a piston rod **52** is connected by suitable swivels **53** and **54** to a pipe centralizer or pipe support ring **55**. Preferably, each piston **50** and sleeve **51** arrangement is provided with a telescoping joint formed by a body member **56** in which the opposite end of the piston sleeve **51** can telescope, its extended movement being limited by contact between a shoulder **57** formed on the outer surface of the piston sleeve **51** which contacts a shoulder **58** formed on the inner wall of the body member **56**. A bleed port **60** is provided to chamber **61**. A pressure-fluid conduit **62** which is connected to a suitable automatic controller or control panel **63** provides means for admitting air pressure into the piston sleeve **51**.

The rear end of the body member **56** is pivotally mounted in any suitable manner to the drilling vessel **11**. For example, a swivel pin **64** may extend horizontally through the rear end of the body member **56** and through a pair of support blocks **65** which are secured to the drilling vessel **11**. A horizontal slot **66** which extends through the body member **56** is contoured in a manner so as to provide movement of the body member

56 in a horizontal plane from side-to-side. In a like manner, wide swivel slots 67 are preferably provided in the support blocks 65 to permit further horizontal movement from side-to-side of the body member 56 and the piston arm 50—51. As shown in FIGURE 5, the body member 56 is provided with a bleed port 70 while shock absorbers 71 are preferably positioned below the body member 56. Suitable O-ring seals 72 are provided on the piston and around the shaft 52.

In FIGURE 6, the relative positions of the six pistons, described with regard to FIGURE 5, are shown while the pipe support ring 55 is exerting a force against the drill pipe 34 which is in an off-center position within the well 73 of the drilling vessel 74. Air is being supplied through the conduit 62 to all pistons A through F, either selectively or equally, through their respective supply conduits. In this particular example, because of the direction of movement of the pipe support ring 55, pistons E and D exert a negligible force against the pipe support ring 55, whereas pistons F, A, B and C exert a force equal to the air pressure of the air supply in conduit 62 times the effective cross-sectional area of piston 50. This force being in the same direction as the longitudinal axis of the piston 50. The resulting force between the pipe 34 and the pipe support ring 55 being equal to the vectorial sum of the forces exerted by pistons F, A, B and C. Since the pistons E and D can move no further into their piston sleeves, their telescoping piston sleeves 51 have moved into their body members 56. Any number of pistons, two or more, can be used. The force-displacement characteristics of the air pressure requirements in respect to the hook load or the load supported by the elevators 20 (FIGURE 1) can be readily computed. For a given size of drill pipe 34, as the hook load increased in uniform increments, the necessary air pressure starts from a low value, rises to a rounded off peak, and then decreases.

Another form of a pipe supporting apparatus for a drilling vessel is illustrated in FIGURE 7 wherein the pipe-supporting member comprises a continuous guide shoe 75 which has a radius of curvature which is designed to control the bending stresses of a pipe string 34 extending therethrough. The internal diameter of the guide shoe 75 at the top, if it is spaced relatively close to the rotary table 17, is equal to or slightly larger than the opening through the rotary table 17. The diameter of the opening at the bottom of the guide shoe 75 would depend on many factors such as the height of the guide shoe, the drilling equipment to be used and the drilling conditions to be encountered. The guide shoe 75 will be fixedly secured within the well 24 of the vessel by suitable braces 76.

As mentioned hereinabove a ring of variable internal diameter can be employed. One simple form is shown in FIGURES 8 and 9 wherein a ring housing member 80 is provided with a plurality of radially movable blocks 81, 82, 83 and 84 mounted at the ends of adjusting screws 85, 86, 87 and 88. The position of the blocks 81, 82, 83 and 84 relative to the vertical bore 90 through the housing ring is controlled by adjusting wheels 91, 92, 93 and 94. The blades are provided with hinged overlapping pipe retainer members 95, 96, 97 and 98 for closing the spaces between the blocks and forming an internal ring to contact a vertical pipe (not shown).

We claim as our invention:

1. In a method of drilling a well from a floating vessel at an offshore location and through a wellhead assembly positioned beneath the surface of a body of water, said method comprising positioning a floating drilling base over an underwater wellhead, suspending a string of drilling pipe from said drilling base so that the lower end of said drilling pipe string extends through said wellhead during drilling operations, supporting said pipe string against horizontal movement near the upper end thereof at a point adjacent the drilling base and at a point where

the pipe string passes through the wellhead, and supporting said pipe string against horizontal movement at least at a third point intermediate the support points on said drilling base and said wellhead, said supporting action taking place against said pipe string to induce bending thereof at said intermediate support point when the axis of the pipe string at a point adjacent said drilling base on the surface of the body of water is displaced from a coaxial position with the axis of said wellhead.

2. In a method of drilling a well from a floating vessel at an offshore location and through a wellhead assembly positioned beneath the surface of a body of water, said method comprising positioning and anchoring a floating drilling base over an underwater wellhead, suspending a string of drilling pipe from said drilling base so that the lower end of said drilling pipe string extends through said wellhead during drilling operations, supporting said pipe string against horizontal movement near the upper end thereof at a point adjacent the drilling base and at a point where the pipe string passes through the wellhead, and supporting said pipe string against horizontal movement at least at a third point intermediate the support points on said drilling base and said wellhead, said supporting action taking place against said pipe string to induce bending thereof at said intermediate support point when said drilling base has moved horizontally on the surface of the body of water from a position directly over said wellhead to a position one side thereof.

3. In a method of drilling a well from a floating vessel at an offshore location and through a wellhead assembly positioned beneath the surface of a body of water, said method comprising positioning a floating drilling base over an underwater wellhead, suspending a string of drilling pipe from said drilling base so that the lower end of said drilling pipe string extends through said wellhead during drilling operations, and supporting said pipe string against horizontal movement near the upper end thereof at least at two spaced points adjacent the drilling base and at least at two spaced points where the pipe string passes through the wellhead, said supporting action taking place against said pipe string to induce bending thereof at each of said support points when said drilling base has moved horizontally on the surface of the body of water from a position directly over said wellhead to a position one side thereof.

4. In a method of drilling a well from a floating vessel at an offshore location and through a wellhead assembly positioned beneath the surface of a body of water, said method comprising positioning and anchoring a floating drilling base over an underwater wellhead, suspending a string of drilling pipe from said drilling base so that the lower end of said drilling pipe string extends through said wellhead during drilling operations, supporting said pipe string against horizontal movement near the upper end thereof at a point adjacent the drilling base and at a point where the pipe string passes through the wellhead, supporting said pipe string against horizontal movement at least at a third point intermediate the support points on said drilling base and said wellhead, said supporting action taking place against said pipe string to induce bending thereof at said intermediate support point when said drilling base has moved horizontally on the surface of the body of water from a position directly over said wellhead to a position one side thereof, and rotating said horizontally-supported pipe string to drill a well.

5. Apparatus for providing horizontal support to a non-vertical section of drill pipe extending from a floating drilling base on the surface of a body of water and through a wellhead assembly positioned below the surface of said body of water, said apparatus comprising a wellhead assembly positioned below a body of water, and anchored to the floor of said body of water, a floating drilling base on the surface of the body of water normally positioned over said wellhead assembly, a rotary table mounted on said floating drilling base, a drill pipe string sus-

pended by said floating drilling base within the rotary table thereof and extending downwardly through said water and said wellhead assembly, and at least one horizontal annular pipe support means operatively secured to said drilling base and arranged around said drill pipe string in normally spaced relationship thereto for contact therewith at a point below the rotary table on said drilling base, said pipe support means having an effective diameter greater than the pipe string suspended therein to permit limited lateral movement of said pipe string at any time in any direction.

6. The apparatus of claim 5 wherein the horizontal pipe support means is in the form of a rigid horizontal support ring.

7. The apparatus of claim 6 including means for removably securing said rigid support ring to said floating drilling base in spaced relationship with and below said rotary table, the opening through said support ring being larger than the opening through said rotary table.

8. The apparatus of claim 6 wherein the diameter of said rigid support ring is adjustable in size.

9. The apparatus of claim 6 including track means mounted on said drilling base and means secured to said rigid support ring and movably positionable on said track means for altering the vertical spacing between said rigid support ring and the rotary table on said drilling base.

10. The apparatus of claim 7 including a second rigid support ring of a diameter larger than said other support ring and secured to said drilling base in spaced relationship with said other support ring and coaxial therewith.

11. The apparatus of claim 6 including force-displacement means securing said rigid support ring to said drilling base and coaxial with the rotary table thereof.

12. The apparatus of claim 11 wherein the force-displacement means comprises a plurality of spring means connected on one end to the support ring and extending outwardly therefrom and being connected at the other end to the drilling base.

13. The apparatus of claim 11 wherein the force-displacement means comprises a plurality of pressure-actuated extendible piston means connected on one end to the support ring and extending outwardly therefrom and being connected at the other end to the drilling base.

14. Apparatus for providing horizontal support to a non-vertical section of drill pipe extending from a floating drilling base on the surface of a body of water and through a wellhead assembly positioned below the surface of said body of water, said apparatus comprising a wellhead assembly positioned below a body of water, conductor pipe means secured to the bottom of said wellhead assembly and extending downwardly into the floor of said body of water for anchoring said wellhead assembly thereto, a floating drilling base on the surface of the body of water normally positioned and anchored over said wellhead assembly, a rotary table mounted on said floating drilling base, a drill pipe string suspended by said floating drilling base within the rotary table thereof and extending downwardly through said water and said wellhead assembly, at least one horizontal pipe support ring means arranged around and adapted to contact said pipe string at a point intermediate the wellhead assembly and the rotary table on said drilling base when said drilling base moves to one side of the axis of said wellhead assembly, said pipe support ring means being adjustable in diameter, and positioning means operatively connected to said support ring means for varying the vertical position thereof relative to said rotary table.

15. A floating drilling base adapted to be positioned on the surface of a body of water for drilling wells through a wellhead assembly positioned beneath the surface of said body of water and anchored to the floor thereof, said drilling base comprising a floating vessel having a drilling slot therein, a rotary table having an opening therethrough and being mounted on said drilling vessel over the drilling slot thereof, a derrick mounted on said vessel over said rotary table and adapted to suspend a string of drill pipe which extends through said rotary table, and at least one horizontal pipe support ring means of adjustable diameter secured to said vessel and coaxially arranged beneath said rotary table opening and spaced therefrom for surrounding a pipe string extending vertically therethrough.

16. A floating drilling base adapted to be positioned on the surface of a body of water for drilling wells through a wellhead assembly positioned beneath the surface of said body of water and anchored to the floor thereof, said drilling base comprising a floating vessel having a drilling slot therein, a rotary table having an opening therethrough and being mounted on said drilling vessel over the drilling slot thereof, a derrick mounted on said vessel over said rotary table and adapted to suspend a string of drill pipe which extends through said rotary table, at least one horizontal pipe support ring means normally coaxially arranged beneath said rotary table and spaced therefrom for surrounding a pipe string extending vertically therethrough, connector means movably securing said ring means to said vessel, and centering means connected between said support ring means and said drilling base for applying force to maintain said support ring means in vertical axial alignment with said rotary table.

17. A floating drilling base adapted to be positioned on the surface of a body of water for drilling wells through a wellhead assembly positioned beneath the surface of said body of water and anchored to the floor thereof, said drilling base comprising a floating vessel having a drilling slot therein, a rotary table having an opening therethrough and being mounted on said drilling vessel over the drilling slot thereof, a derrick mounted on said vessel over said rotary table and adapted to suspend a string of drill pipe which extends through said rotary table, at least one horizontal pipe support ring means of a diameter larger than the rotary table opening and coaxially arranged beneath said rotary table and spaced therefrom for surrounding a pipe string extending vertically therethrough, connector means movably securing said ring means to said vessel, and positioning means for moving said support ring means vertically to alter the position thereof with respect to said rotary table.

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