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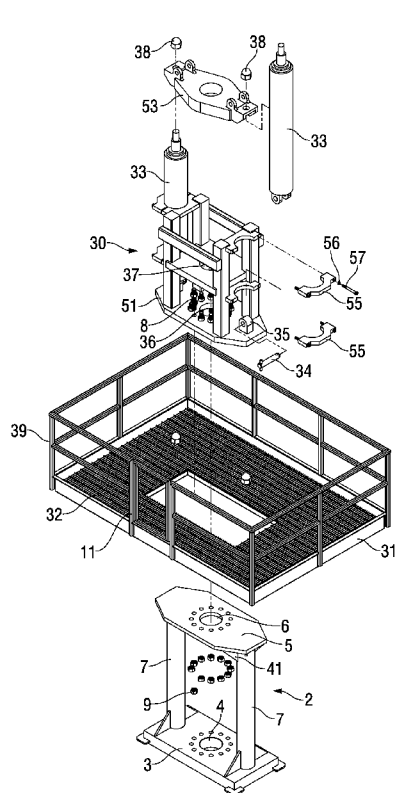
(54) **Title:** TELESCOPING SNUBBING UNIT FRAME

FIG. 3

(57) **Abstract:** This application describes a snubbing frame unit having a pair of telescoping hydraulic cylinders for moving a jack head towards and away from the snubbing base slips to snub a pipe through the snubbing unit. The hydraulic cylinders are parallel dual-acting three stage hydraulic cylinder rods and are spaced from an opening designed to be above a wellbore. In an embodiment, each cylinder has two bidirectional ports for quickly moving hydraulic fluid into and out of the cylinders. The telescoping three stage cylinders allows the snubbing frame to handle heavier pipe and higher pressures while facilitating quicker insertion with lighter pipes and lower pressure. The compact design allows the equipment to be easily transportable while providing sufficient space for equipment connected to the wellbore including blow out preventers. An attachable gin lift device allows pipe handling and insertion of pipe without the need for a mast assembly.

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**TELESCOPING SNUBBING UNIT FRAME
SPECIFICATION**

CROSS REFERENCE TO RELATED APPLICATIONS

[0001] The present application is a Patent Cooperation Treaty (PCT) patent application that claims priority to United States Patent Application Serial Number 62/286,966, entitled “Telescoping Snubbing Unit Frame,” filed on January 26, 2016, which is incorporated in its entirety by reference

FIELD

[0002] The present invention pertains to snubbing units and a method for using a snubbing unit, and in particular, but without limitation, to a telescoping snubbing unit frame and a method for inserting and removing tubulars in a wellbore.

BACKGROUND

[0003] In hydrocarbon exploration and development, including oil and gas well operations, single tubulars or long strings of tubular members, are inserted into and removed from wellbores at various points. When tubular members are inserted into a well, a single tubular member is typically attached to the top of a tubular string and the string is then lowered into the well. Conversely, when tubular members are removed from a well, a single tubular member is typically removed from the top of a tubular string and the string is then raised from the well. Depending on the depth of a well, a string of tubular members may be thousands of feet long and multiple tubular members may require attachment or removal from the string to complete an operation.

[0004] In the oil and gas industry, snubbing is the action of inserting or running tubular members into a well, or retrieving tubular members from a well under pressure. Snubbing may

be performed using a device called a snubbing jack or a snubbing unit. Snubbing units are known in the oil and gas industry for facilitating access to a well under pressure during various well operations, such as, for example, well completion operations. Specifically, a snubbing unit manipulates various tubular members, such as pipe, tubing, and bottom hole assemblies (BHA) in and out of a well, whereby the snubbing unit provides sufficient vertical force to the tubular string to overcome wellbore pressure. The vertical movement is typically generated by the movement of the travelling slip holding the tubular.

[0005] A snubbing unit typically employs lower stationary slip assemblies and upper traveling slip assemblies, oriented in opposite directions, to grip and controllably move tubular members into and out of the well through a wellhead. The snubbing unit can move the tubular string despite the possibility of either heavy tubular loads (pipe heavy conditions), which urge the tubular string to fall down into the well, or pressure-generated loads on the tubular string (pipe light conditions), which urge the tubular string to move upwards out of the well. In an open position, a slip assembly is disengaged from the tubular member to allow the tubular string to move freely relative to the slip assembly. In a closed position, the slip assembly engages a tubular member and supports the weight of the tubular string, or prevents ejection of the tubular string due to wellbore pressure. Therefore, during operations, the stationary slip assembly maintains the tubular string stationary while the traveling slip assembly travels vertically to lift or lower the tubular string.

[0006] When a snubbing unit is controlling the weight of the tubular string, it is advantageous to have a strong frame that can handle heavy weight loads and high wellbore pressure when inserting tubulars into the wellbore. For example, if the wellbore contains high pressure, it is advantageous to have a snubbing unit capable of holding heavier joints of pipe and

capable of forcing the heavier joints downhole. If the snubbing unit cannot sufficiently handle the weight of the tubular string or wellbore pressure acting on the tubular, the tubular string will either be ejected out of the well due to wellbore pressure or dropped down into the well. Additionally, there is the potential for injury and damage resulting from flying objects and the uncontrolled release of well fluids. Therefore, there is a need for a snubbing apparatus and method that can handle heavier tubulars and higher wellbore pressures during operations.

[0007] The ability to handle heavy loads typically requires heavier and larger snubbing unit frames to support the weight of the heavy tubulars used in higher pressures. In addition, the stroke length of the extending frame may need to be increased to hold larger tubulars and/or provide more force. The additional weight requirement of snubbing unit frames capable of supporting heavier tubulars causes difficulties in transporting. For example, the heavier snubbing units frames require heavier transport and stronger cranes for installation. Furthermore, the increased size makes it more difficult to install a mast above the snubbing equipment and wellbore equipment beneath the snubbing frame. Accordingly, there is a need for a lighter, more compact snubbing unit.

[0008] While the larger stroke length may be necessary for heavier and longer pipe joints, the larger stroke takes significantly longer to install each joint of pipe. For lighter or smaller tubulars, or operations with less pressure, a longer stroke length is unnecessary and slows down the time to insert or snub each joint. Accordingly, there is a need to provide multiple stroke lengths based on the type of joint and wellbore conditions.

[0009] Another issue with hydraulic snubbing units is the amount of time it takes to move hydraulic fluids into hydraulic cylinder[s] significantly slows the process. Additional hydraulic fluid is needed for the heavier loads and pressures, so additional hydraulic fluid means additional

time to flow the hydraulic fluid necessary to snub each pipe joint. Accordingly, there is a need to quickly move hydraulic fluid into and out of the snubbing unit.

[00010] The larger snubbing units historically required a mast to insert the joints of pipe into the snubbing units because of the height of the units. A mast assembly is expensive and takes time to transport and install. Accordingly, there is a need for a snubbing unit that does not require a mast.

[00011] Embodiments of the present invention, discussed below, satisfy these needs.

SUMMARY

[00012] In one embodiment, the present disclosure is directed to a snubbing frame. The snubbing frame comprises a bottom plate supporting a load weight of the snubbing frame, wherein the bottom plate comprises a bottom plate opening and a top plate, wherein the top plate comprises a top plate opening. The snubbing unit comprises at least two columns connecting the bottom plate with the top plate and at least two hydraulically actuated multi-stage telescoping cylinders. Each hydraulically actuated multi-stage telescoping cylinder comprises a first end and a second end, wherein each of the first ends are connected to the top plate, and wherein each of the second ends is connected to a jack head.

[00013] In a second embodiment, the present disclosure is further directed to a method of using a snubbing unit. The method comprises several steps. First, a snubbing unit as described above is constructed comprising a bottom plate with a bottom plate opening supporting the load weight of the snubbing unit and a top plate with a top plate opening. The snubbing unit further comprises at least two columns connecting the bottom plate with the top plate, and at least two hydraulically actuated multi-stage telescoping cylinders connected to the top plate on a first end

and a jack head on a second end. A travelling slip is mounted on the jack head, and a stationary slip is mounted on the top plate. The travelling slip in conjunction with the stationary slip are both used to move a tubular and/or tubular string through the bottom plate opening into a well.

[00014] In a third embodiment, the present disclosure is further directed to a snubbing unit system for moving pipe into or out of a wellbore. The system comprises a bottom plate supporting the load weight of a snubbing frame, wherein the bottom plate has a bottom plate opening over the wellbore. Above the bottom plate is a top plate, wherein the top plate has a top plate opening and a stationary slip attached to the top plate and at least two columns connecting the bottom plate with the top plate. Above the top plate are at least two hydraulically actuated multi-stage telescoping cylinders comprising a first end and a second end, wherein the first end is connected to the top plate and the second end is connected to a jack head. A travelling slip is attached to the jack head. The system further comprises a control unit for controlling the at least two hydraulically actuated multi-stage telescoping cylinders.

[00015] The foregoing is intended to give a general idea of the invention, and is not intended to fully define nor limit the invention. The invention will be more fully understood and better appreciated by reference to the following description and drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

[00016] In the detailed description of various embodiments usable within the scope of the present disclosure, presented below, reference is made to the accompanying drawings, in which:

[00017] FIG. 1 depicts an elevational front view of a snubbing unit.

[00018] FIG. 2 depicts a corresponding elevational front view of the snubbing unit of FIG. 1 in an extended position.

[00019] FIG. 3 depicts an exploded perspective view of a snubbing unit frame with a work opening floor structure.

[00020] FIG. 4 depicts a perspective view of the snubbing frame base.

[00021] FIG. 5 depicts the connected perspective view of the snubbing unit frame shown in FIG. 2.

[00022] FIG. 6A depicts a side elevational view of the snubbing frame unit of FIG. 3, with the jack head fully contracted.

[00023] FIG. 6B depicts a side elevational view of the snubbing frame unit of FIG. 3, with the jack head partially extended using the first stage of the telescoping cylinders.

[00024] FIG. 6C depicts a side elevational view of the snubbing frame unit of FIG. 3, with the jack head partially extended using the first and second stages stage of the telescoping cylinders.

[00025] FIG. 6D depicts a side elevational view of the snubbing frame unit of FIG. 3, with the jack head fully extended using the first, second, and third stages of the telescoping cylinders.

[00026] FIG. 7 depicts a perspective view of the telescoping cylinders with multiple hydraulic fluid ports and hydraulic lines.

[00027] FIG. 8A depicts a perspective view of the snubbing frame unit of Fig. 3 with a gin pole.

[00028] FIG. 8B depicts a front elevational view of the snubbing frame unit of Fig. 3 with a gin pole.

[00029] FIG. 8C depicts a side elevational view of the snubbing frame unit of Fig. 3 with a gin pole.

[00030] FIG. 9 depicts a side elevational view of the uppermost part of the gin pole showing a sling cable and pulley system for raising and lowering the gin pole.

[00031] FIG 10 depicts an exploded perspective view of a gin pole tube head used with a cable and pulley system for raising and lowering the gin pole.

[00032] FIG 11 depicts a front elevational view of a snubbing unit attached to a blow out preventer above a wellhead.

[00033] One or more embodiments are described below with reference to the listed Figures.

DETAILED DESCRIPTION OF THE EMBODIMENTS

[00034] Before describing selected embodiments of the present disclosure in detail, it is to be understood that the present invention is not limited to the particular embodiments described herein. The disclosure and description herein is illustrative and explanatory of one or more presently preferred embodiments and variations thereof, and it will be appreciated by those skilled in the art that various changes in the design, organization, means of operation, structures and location, methodology, and use of mechanical equivalents may be made without departing from the spirit of the invention.

[00035] As well, it should be understood that the drawings are intended to illustrate and plainly disclose presently preferred embodiments to one of skill in the art, but are not intended to be manufacturing level drawings or renditions of final products and may include simplified conceptual views to facilitate understanding or explanation. As well, the relative size and arrangement of the components may differ from that shown and still operate within the spirit of the invention.

[00036] Moreover, it will be understood that various directions such as “upper”, “lower”,

“bottom”, “top”, “left”, “right”, “first”, “second” and so forth are made only with respect to explanation in conjunction with the drawings, and that components may be oriented differently, for instance, during transportation and manufacturing as well as operation. Because many varying and different embodiments may be made within the scope of the concepts herein taught, and because many modifications may be made in the embodiments described herein, it is to be understood that the details herein are to be interpreted as illustrative and non-limiting.

[00037] Referring firstly to FIGS. 1 and 2 of the accompanying drawings, there is shown a prior art pipe snubbing unit, indicated generally by reference numeral 10, for snubbing a vertical pipe 12 into or from an underground well or wellbore (29). The snubbing unit 10 has stationary snubbing slips or pipe grippers 14, provided with an underlying blowout preventer (BOP) 16, travelling snubbing slips or pipe grippers 18, and a pair of hydraulic jacks 20 for moving the travelling snubbing slips 18 vertically with respect to the stationary snubbing slips 14, as shown in FIG. 2.

[00038] The jacks 20 each comprise a hydraulic cylinder 22, from which extends a jack rod 24, the lowermost end of the hydraulic cylinder 22 being mounted on a middle plate 26, and the uppermost end of the jack rod 24 being connected to a travelling plate or jack head 28 on which the travelling snubbing slips 18 are mounted.

[00039] In operation of the snubbing unit 10, the jack rods 24 move the travelling snubbing slips 18 vertically up and down relative to the stationary snubbing slips 14, while the stationary snubbing slips 14 and the travelling snubbing slips 18 alternately grip the pipe 12. In this way, the pipe 12 is fed into or from the well by the snubbing slips 14 and 18 through a “hand-over-hand” operation of the slips, as shown in FIG. 1 and FIG. 2, with the jack rods 24 extended and retracted, respectively. The snubbing unit 10, as described above, and its operation are well

known in the art and, therefore, are not described herein in greater detail.

[00040] Turning now to FIG. 3, an embodiment of the snubbing unit 1, described herein, is directed to a new frame. This figure shows a snubbing unit base frame 2 to support the snubbing unit 1. FIG. 4 illustrates the base frame unit from FIG. 3, in more detail. The base cylinder frame 2 comprises a bottom plate 3 with a bottom plate opening 4, and a top plate 5 with a top plate opening 6. Two columns 7 which can be pipes or cylinders both support and connect the top plate 5 with the bottom plate 3. In one embodiment, the cylinder base frame provides sufficient space to house an annular BOP, shear BOP, pressure control equipment, wellhead, and combinations thereof.

[00041] Turning now to FIGS. 4 and 5, the top plate 5 of the base cylinder frame 2 is connected to an upper cylinder frame 30. Furthermore, the top plate 5 is supported with attached columns 7, as well as optional plate gusset 41 and eye gusset 42 providing additional structural support.

[00042] The top plate 5 of base cylinder frame 2 is connectable to the lower frame plate 51 of the upper cylinder frame 30. In FIG. 5, the lower frame plate 51 has a matching exterior contour and matching opening 36 with the top plate 5 of base cylinder frame 2. The combination of the plate 5 and the lower frame plate 51 can also be referred to as a middle plate. Bolts 8 along with nuts 9 can be used to connect the top plate 5 of base cylinder frame 2 to the lower frame plate 51 of the upper cylinder frame 30. Other suitable methods for connecting include, but are not limited to, welding, fasteners, riveting, or combinations thereof. An optional work floor structure 31 can be installed around base cylinder frame 2 to provide a work area that may include a grated non-slip floor 32, guard rails 33, and door 11.

[00043] The upper cylinder frame 30 comprises two dual-acting and multi-stage telescoping

cylinders 33 that are removeably attached to the lower frame plate 51 of the upper cylinder frame 30 and removeably attached to a jack head 53 with an opening 69 on the top. The dual-acting cylinders 33 allow hydraulic controls using hydraulic fluid to raise and lower the hydraulic cylinders 33. Multi-stage requires at least two-stages or sections in the cylinders 33 that can raise and lower with controlled hydraulic fluid.

[00044] An interior frame 54 is attached or welded to the lower frame plate 51 of the upper cylinder frame 30 to help support the multi-stage telescoping cylinders 33. The removable supports may include saddles 55 for securing the multi-stage telescoping cylinders 33 to the interior frame 54. The removable saddles 55 can be secured with a washer 56 and bolt 57 attached to a thread or other attachment means. In an embodiment, the interior frame 54 includes a plurality of corner legs 58 supporting a mid-plate 59. The mid-plate 59, shown in FIG. 5, is attached to the inside of legs 58 of the interior frame 54 with an opening 37. Additionally, a plurality of lateral supports 50 may be attached to the outside of the interior frame 54 to provide additional lateral support for the interior frame 54 supporting the two multi-stage telescoping cylinders 33. The legs 58 of the interior frame 54 provide additional support for the removable saddles 55 that clamp around the multi-stage telescoping cylinders 33. Accordingly, the interior frame 54 provides additional support, including lateral and load bearing support, to the telescoping cylinders 33 and snubbing unit 1.

[00045] As shown in FIG. 5, the jack head 53 opening 69, middle plate 59 opening 37, top plate 5 opening 36, and bottom plate 3 opening 4 are all aligned. Furthermore, the plurality of snubbing unit 1 openings (69, 37, 36 and 4) all have sufficient diameters to permit unobstructed movement of the tubulars, as discussed below.

[00046] The telescoping cylinders 33 can be removably attached to jack head 53 on the top

with a nut 38 and are removably attached to the lower frame plate 51 with a clevis pin 34 and corresponding clevis bracket 35. The bottom of the base cylinder frame 2 is designed to be bolted onto a wellbore or a Blow-Out-Preventer (BOP) attached to the wellbore, or other wellbore device.

[00047] The slips or slip assemblies (not shown) are attached to the snubbing unit 1, as described above. The slips can be added at the factory or attached at the wellbore site. The snubbing unit is typically less than 8 tons and can be less than 7 tons to facilitate transportation. The multi-stage cylinders allow the total stroke height to be less than 10 feet with the fully extended cylinders 33 typically less than 7 feet.

[00048] The design of the base cylinder frame 2 allows a significant amount of equipment to be placed above the bottom plate 3 and above the top plate 5 of the base cylinder frame 2. This equipment includes, but is not limited to: wellhead, pressure control equipment, spool injectors, BOP, and combinations thereof.

[00049] The removable cylinders 33 enable quick replacement of damaged equipment including cylinders and slips in the field. In the embodiments, described above, the removable cylinders 33 can be removed by removing the saddles 55, clevis pin 34 and nut 38. Likewise, a new cylinder is secured by adding the clevis pin 34, nut 38 and saddles 55.

[00050] FIG 6A, FIG 6B, FIG 6C, and FIG 6D illustrate side elevational view of the snubbing frame unit of FIG. 3, with the jack head 52 fully contracted, first stage 61 activated, first stage 61 and second stage 62 activated, and fully extended with the first stage 61, second stage 62, and third stage 63 activated, respectively. As shown in the figures, each stage progressively extends the jack head 52. The operator will selectively activate each stage as necessary, based on weight and pressure requirements, as described below.

[00051] Typically, each cylinder has a single port for connecting the cylinder to the hydraulic fluid lines. The use of a single port limits the flow rate of hydraulic fluid. Turning now to FIG. 7, an embodiment of the port system is illustrated which allows multiple hydraulic fluid flows bi-directionally in and out of each of the multi-stage telescoping cylinders 33. In the embodiment shown, there is a lower port 71 and upper port 72 in each multi-stage telescoping cylinder 33. The lower ports 71 and upper ports 72 are connected to hydraulic fluid lines 74 that are typically connected to a hydraulic reservoir pump system (not shown). The ports 71, 72 can further comprise high flow quick release connectors 73 that allow quick connection and release as well as high pressure and high flow rates of up to 130 gallons per minute and pressure of up to 3,000 pounds per square inch. In one embodiment, one port such as, the upper port 72 is used for injecting hydraulic fluid and one port such as, the lower port 71 is used for extracting hydraulic fluid. In alternative embodiments, the ports can be reversed or simultaneously operate together for either injections or extraction of hydraulic fluids.

Gin pole

[00052] In one embodiment, a gin pole can be used that can eliminate the need for a derrick or mast assembly. Turning now to FIGS. 8A-8C, FIG. 8A illustrates a gin pole assembly 80 with a snubbing unit 1 with elements similar to those described in FIGS. 3-7 and given the same reference numerals. FIG 8B and Fig 8C illustrates different views of the same gin pole assembly 80 shown in in FIG. 8A, with the same elements given the same reference numerals.

[00053] As shown in FIG. 8A the gin pole assembly 80 has a lower tube assembly 81 connected to the snubbing unit 1. In the embodiment shown, the lower tube assembly 81 is connected to the interior frame 54 with a connection box 82 comprising a pivot point 83,

multiple pins 78 and pin holes 79 and in alternative embodiments, multiple connections (not shown). The multiple pin holes with removable pins 78 can be used to selectively angle or orient the gin pole lower tube assembly 81. FIG. 8C illustrates how the placement of the removable pins 78 can create a slight vertical offset in the gin pole lower tube assembly 81. This selective vertical offset would be useful in directional wellbore operations.

[00054] A winch pivot arm 84 can be provided for moving and aligning tubulars and a tong crane 85 can be connected to a tong (not shown) to rotate and thread a tubular into another tubular or thread tubulars into a drill string. One or more additional tube assemblies can be attached or inserted inside the lower tube assembly. In the embodiment shown, a first additional tube assembly 86 and a second tube assembly (or top pole) 87 are retractably inserted into the lower tube assembly 81. In addition, tube heads 88 house pulley wheels 90. A crown assembly 89 which can house a plurality of pulley wheels 90 is attached to the second tube assembly, shown as the top pole 87.

[00055] The gin pole assembly 80 is connected to a series of pulley wheels 90 for raising and lowering the gin pole assembly 80 with a line, or sling cable 92, as shown in FIG. 9. The sling cable 92 can be connected to a telescoping winch (not shown) which will then raise and lower the gin pole assembly 80 by increasing or decreasing the length of sling cable 92 connected to the plurality of pulley wheels 90. The telescoping winch is typically hydraulically powered and controlled and can share the same hydraulic system and control as the snubbing unit 1 and/or slip assemblies. The plurality of pulley wheels 90 are engineered to quickly raise and lower the gin pole assembly 80, which is used to move tubulars in and out of the snubbing unit 1, as previously discussed.

[00056] The gin pole assembly 80 enables the snubbing unit 1 to handle all the pipe handling

requirements for most drilling operations with a total height of less than 42 feet. In addition, the entire snubbing system and pipe handling system can be transported with only one trailer.

[00057] FIG. 10 depicts an exploded perspective view of a gin pole tube head 88 with a pulley wheel 90 for raising and lowering the gin pole assembly 80 using the cable and pulley system shown in FIG. 9. The tube head 88 of FIG. 10 comprises four metallic plates 102 that are welded together to house a pulley wheel 90. The pulley wheel 90 is held on both sides by outer pulley brackets 101 wherein the two outer pulley brackets are connected and secured by threaded bolts 110 and caps or nuts 109. The center of the outer pulley brackets 101 and pulley wheel 90 are connected by a pulley pin cap 106 and pulley pin 107 held in place by a cap screw 111. The pulley pin 107 in the center allows the pulley wheel 90 to spin. A cable clevis eye 105 can be welded to the outside of the metallic plates. Flush plates 103 on the outside of the tube head 88 are secured to the inside to blocks 104 by threaded rods (or bolts) 112 and screw caps, nuts, and/or lock nuts 109 and additional bolts 119 and washers 114.

Method

[00058] Referring to FIGS. 6A-6D, an embodiment of a method of use of the snubbing unit 1 in a snubbing system is depicted. This method example demonstrates using the snubbing unit 1 and controlling slips or slips assemblies (not shown) of the snubbing unit 1 to insert or remove pipe or pipe strings. This example is offered by way of illustration and is not intended to limit the claimed invention in any manner.

[00059] One embodiment is a method of using the snubbing unit 1. This method can comprise the steps of:

[00060] a) obtaining a snubbing unit 1 comprising a bottom plate 3 with a bottom plate

opening 4 supporting the load weight of the snubbing unit 1, a top plate opening 6, at least two columns 7 connecting the bottom plate 3 with the top plate 5. The snubbing unit further comprises at least two hydraulically actuated multi-stage telescoping cylinders 33 connected to the top plate 5 on a first end and a jack head 53 on a second end, a travelling slip mounted on the jack head 53 and a stationary slip mounted on the top plate 5.

[00061] b) inserting a tubular member of a tubular string through the travelling slip and the stationary slip of the snubbing unit 1. Typically, the tubular member is initially inserted through the travelling slip on the jack head 53, secondly through the top plate opening 6 into the interior frame 54, thirdly through the stationary slip and bottom plate opening 4, and finally into the wellbore.

[00062] c) closing the stationary slip around the tubular member. The stationary slip grips the tubular and supports the weight of the tubular and/or the tubular string.

[00063] d) moving the travelling slip assembly to a first position by activating at least one stage of the multi-stage telescoping hydraulic cylinders 33. Typically, this is accomplished by flowing hydraulic fluid into at least one port, which typically is the lower port 71, of each the multi-stage telescoping hydraulic cylinder 33. Additional ports can be utilized to expedite the process. Depending on the weight holding requirements and snubbing requirements, either the first stage 61, first stage 61 and second stage 62, or all three stages (61, 62 and 63) are activated in a three stage telescoping cylinder. Each stage requires additional hydraulic fluid and thus, additional time to insert the fluid and activate based on the weight load and snubbing capacity of the hydraulically actuated multi-stage telescoping cylinders 33. Accordingly, the operator will only activate additional stages beyond the first stage 61, if necessary, to support the weight load or provide the necessary snubbing pressure. In the embodiment described above, if a snubbing

force of up to 68,000 pounds or a load bearing weight of up to 189,000 pounds is needed the first stage 61 is activated; if a snubbing force of up to 92,000 pounds or a load bearing weight of up to 340,000 pounds is needed the first stage 61 and second stage 62 are activated; and if a snubbing force of up to 102,000 pounds or a load bearing weight of up to 470,000 pounds is needed the first stage 61, second stage 62 and third stage 63 are activated.

[00064] e) Closing the travelling slip assembly about the tubular member. After the traveling slip is positioned by activating the hydraulic cylinders 33 to the required height, the slip is closed and the interior of the slip grips the tubular member or tubular string.

[00065] f) Opening the stationary slip. After the travelling slip is closed and grips the tubular, the stationary slip is opened and thus, the entire weight of the tubular or tubular string is supported by the traveling slip.

[00066] g) Moving the travelling slip closed around the tubular to move the tubular string through the bottom plate opening 4 into a wellbore. The hydraulic cylinders 33 are deactivated by removing hydraulic fluid from the port. The deactivation of the hydraulic cylinders 33 provides the force necessary to overcome any wellbore pressure and insert the tubular or tubular string into the wellbore.

[00067] h) The method may further comprise lifting a tubular into the snubbing unit 1 with a gin pole assembly 80 pivotally attached to the snubbing unit 1. The gin pole accepts a tubular with the tong and wrenches, as discussed above. The gin pole can then pivotally rotate with the tubular to position the tubular in a vertical position over the travelling slip assembly on the jack head for insertion. The pivoting of the gin pole assembly 80 can be accomplished with a pulley system 90 attached to the gin pole assembly 80. The tubular can then be threaded into the drill string and/or inserted into the snubbing assembly. This snubbing unit 1 can insert and remove

tubulars from a wellbore without the need for a derrick and/or mast assembly.

[00068] In an alternative method embodiment, the multi-stage telescoping cylinders 33 connecting the bottom plate 3 with the top plate 5 are quickly replaceable in the field. The clevis pin 34 and nut 38 is removed, along with the saddle bracket 55, which is unbolted. The multi-stage telescoping cylinders 33 are removed and replaced with different multi-stage telescoping cylinders 33 and then the clevis pin 34 and nut 38 are reinserted along with the saddle brackets 55 that are reattached.

Example

[00069] An example snubbing unit with a connected gin pole was created using the features of the various embodiments discussed above. This example is described below as a “Stand Alone Rig Assist Snubbing Work Over Unit” with a power unit designed for use in a wide variety of operations utilizing a crane or service rig to move the snubbing unit up and down. This unit was engineered, designed and manufactured to be one of the safest and most efficient in the snubbing industry providing versatility, reliability and minimal maintenance, even in extremely harsh oilfield environments. Furthermore, the unit was designed and built to OEM standards and all pressure containing equipment meets NACE TRIM specifications and can operate in temperature ranges of -15 °C to +50 °C. The example snubbing frame unit and related equipment is only a working example and is not meant to be limiting in any manner.

[00070] FIG. 11 depicts a portion of the example Stand Alone Rig Assist Snubbing Work Over Unit wherein similar elements in FIGS. 3-10 have the same reference numerals. This example shows the snubbing unit 1 with an attached gin pole assembly 80 as described above. In addition, the working example shows the base frame 2 connected to an annular BOP 122. The annular BOP is shown connected to a shear BOP 121 which can be connected to additional

pressure control equipment (not shown) or connected to the wellhead 120 in contact with the wellbore (not shown) below the wellhead 120. The example unit consists of three components. First, a power system (not shown) that measures 132 inches long, 78 inches wide and 104 inches tall and weighs 6.5 tons wet. Second, a snubbing unit 1, or a jack assembly, capable of 470,000 pounds of lift and 120,000 pounds of snub force with a 10-foot stroke and an overall height from base plate to handrail of only 105 inches with removable parts to allow jack weight to be as low as 2.5 tons. Third, a work opening 31 which can be used to perform more complicated work over operations, measuring 80 inches tall with an 11 inch bore therethrough. The jack is designed to be put on the back of a bobtail tractor for rig assist type transport, but can also be moved on standard type trucks.

[00071] The hydraulic system comprises a hydraulic tank (not shown) of steel construction for the floor and wall. The mounted capacity of the hydraulic tank is 300 U.S. gallons. The tank has a top mounted return filter for cleaning returning hydraulic fluid and system top mounted filler cap for filing the hydraulic tank. In addition, a top mounted venting system comprises filters and dehumidifiers. The hydraulic tank further comprises suction strainers with internal bypasses, an inspection hatch and sight, glasses and internal thermometers. An internal baffle system minimizes slosh while in transit. Tables 1, 2 and 3 provide the specifications for the Power Pack, Hydraulic Lines, and Hydraulic Couplers, respectively.

[00072] Table 1 (Power Pack):

Primary Engine	Detroit V-8
Secondary Engine	Detroit V-6
Jack Circuit	110 Gallons Per Minute (GPM)
Tong Auxiliary	32 Gallons Per Minute (GPM)

Basket BOP	27 Gallons Per Minute (GPM)
Two inches	22 Gallons Per Minute (GPM)/ each

[00073] Table 2 (Hydraulic Lines):

Jack	Hose and Steel Lines 3000psi WP
Tong	Hose and Steel Lines 2500psi WP
Accumulator	Hose and Steel Lines 3000psi WP
All Hoses:	45 feet in length

[00074] Table 3 (Hydraulic Couplers – Hydraulic, 2 inches, 3000 psi WP):

Jack	1 inch Quick Coupler
Accumulator	1 inch Quick Coupler
Tong	1 inch Quick Coupler
Return	1 inch Quick Coupler
Air Supply	1 inch Quick Coupler
Throttle & Air Kill	¼ inch Quick Coupler

[00075] The snubbing unit frame was designed and built with the specifications and components described above. The cylinders provide the necessary force to hydraulically jack the pipe into and out of the hole during heavy or snubbing operations. The bore and bore to rod ratio of these cylinders dictates the maximum force that the snubbing unit can exert. The force applied by these cylinders can be continuously controlled by the unit's hydraulic system.

[00076] The specifications of the telescoping hydraulic cylinder of the example unit are as

follows: a 10-inch base tube diameter, 8.5-inch stage one diameter, 6.5-inch stage two diameter, and 3.75-inch stage three diameter, with a total stroke length of 120 inches. The cylinders further comprise induction hardened chrome rods, with the rod ends chamfered to facilitate quick jack plate removal for wireline operations. In addition, there were anti-wear bands on the packing glands and pistons, and anti-shock cushions on the top and bottom of the cylinders. The cylinders had a 3000 pound per square inch of maximum working pressure, snub force of up to 102,000 pounds and lift force of up to 470,000 pounds. An internal Husco braking circuit was used for the lifting and snubbing along with a Husco 64004 directional valve and Husco 5000A62 pilot control.

[00077] The passive rotary used in this example unit allows the rotation of the string in both pipe light and pipe heavy mode. In addition, the passive rotary gives the unit the ability to set tools requiring rotation while in the pipe light mode, or to perform drilling or milling operations in snubbing mode or pipe heavy mode with the use of a power swivel (not shown).

[00078] The jack plate is physically connected with two removable hydraulic cylinders 33. The design facilitates quick removal for wireline operations and access to BOP or other wellbore equipment under the structure of the unit. In this example, the passive rotary table and traveling slip attachment points were built into the plates.

[00079] The snubbing frame unit is designed to have a set of travelling slips attached during stripping operations and pipe heavy modes. The travelling slips are attached to the top of the passive rotary. The travelling slips are Langley bowls with slip inserts and carriers supplied for 2.375 inches, 2.775 inches, and 3.5 inches with a slip bowl comprising a 7.0625 inch bore. The stationary slips hold the pipe from falling into the well during tripping heavy operations. These slips are mounted in a fixed position in the slip opening above and to the center plate of the

removable cylinders. The stationary slips are a Cavin model with slip inserts and carriers supplied for 2.375 inches, 2.775 inches, and 3.5 inches with a slip bowl comprising an 11 inch bore.

[00080] A control system allows a single operator of the snubbing unit to control all the systems on the jack. A panel on the control system allows quick reference and setting to all circuit pressures and open or close functions. A remote positive air shut down control is also mounted within the panel. A single operator working a single panel can control all the operations of the snubbing unit. The control panel can include the following controls and instruments: a 5-station stripping BOP bank, 4-station slip bank, panel mounted reducing valves for the slip and BOP banks, jack control pilot valve, jack brake pressure adjust valve, panel mounted gauges for all circuit pressures, jack control handles, and any combination thereof.

[00081] There are two work platforms mounted on the unit. The upper basket is the primary operational basket. All controls are mounted on control consoles in the upper basket. The lower work platform allows the crew easy access to the stationary slip assemblies for maintenance and repair when needed. The specifications are for the upper basket (or work area) 125, work opening 31 and walk around area (not shown) is described in data Table 4.

Table 4 (work areas):

Outside Diameter Upper basket	138 inches long by 92 inches wide by 46 inches tall
Ladder to Upper Basket	20 feet expandable to 35 feet
Post	Hydraulic tong back up post option with a 1500-pound rating
Operation Panel	Mounted

Escape Poles	One for egress
Outside Diameter Work Window	63 inches long by 30 inches wide by 80 inches tall
Outside Diameter Walk Around	120 inches long by 95 inches wide by 47 inches tall

[00082] The removable gin pole is manufactured with two counterbalance winches capable of lifting 2000 pounds each. Winches are designed to lift tubing with tubing nubbins or elevators. Gin pole is steel construction and rated to 5000 pounds. Standard height is 46 feet from the slips to sheaves when extended allowing for drilling swivel and full joint. The two sheaves at the top allow for two separate winches. This gin pole is built with three pieces with two arms extending out and locking mechanically to eliminate the need to climb or install pins,

[00083] The hydraulically driven winch system (not shown) is mounted in the work basket 125 and is utilized for raising and lowering tools or tubulars during the workover operation. This system is operated from the work basket 125. The example system has a work capacity of 2000 pounds with the anti-rotational cable and swivel. The tong arm can handle a 5 ½ inch tong with hydraulic backups.

[00084] While various embodiments usable within the scope of the present disclosure have been described with emphasis, it should be understood that within the scope of the appended claims, the present invention can be practiced other than as specifically described herein. It should be understood by persons of ordinary skill in the art that an embodiment of the snubbing frame, snubbing unit, and snubbing method in accordance with the present disclosure can comprise all of the features described above. However, it should also be understood that each

feature described above can be incorporated into the snubbing frame, snubbing unit, and snubbing method by itself or in combinations, without departing from the scope of the present disclosure.

CLAIMS

What is claimed is:

1. A snubbing frame, wherein the snubbing frame comprises:

a bottom plate supporting a load weight of the snubbing frame, wherein the bottom plate comprises a bottom plate opening;

a top plate, wherein the top plate comprises a top plate opening;

at least two columns connecting the bottom plate with the top plate; and

at least two hydraulically actuated multi-stage telescoping cylinders, each comprising a first end and a second end, wherein each of the first ends are connected to the top plate, and wherein each of the second ends are connected to a jack head.
2. The snubbing frame of claim 1, further comprising a stationary slip mounted between the bottom plate and the top plate, and a travelling slip mounted above the jack head.
3. The snubbing frame of claim 1, wherein the first ends of the at least two hydraulically actuated multi-stage telescoping cylinders are connected to the top plate using a clevis pin assembly, and to the jack head using a nut.
4. The snubbing frame of claim 1, further comprising an interior frame mounted to the top plate, wherein the interior frame comprises an interior cavity surrounding the top plate opening and the bottom plate opening and a plurality of removable cylinder saddles, wherein the plurality of saddles are positioned over the multi-stage telescoping cylinders and bolted onto the interior frame.
5. The snubbing frame of claim 1, wherein each of the at least two hydraulically actuated multi-stage telescoping cylinders further comprises a bottom port and lower port for moving hydraulically fluid into and out of each of the at least two hydraulically actuated multi-stage telescoping cylinders.

6. The snubbing frame of claim 1, wherein the total weight of the snubbing frame is less than 7-tons.
7. The snubbing frame of claim 1, further comprising a gin pole attached to the snubbing frame for inserting tubulars into the snubbing frame.
8. The snubbing frame of claim 1, wherein the gin pole is pivotally attached to the snubbing frame with a box comprising a plurality of connectors.
9. A method of using a snubbing unit comprising the steps of:

obtaining a snubbing unit comprising a bottom plate supporting the load weight of the snubbing unit, wherein the bottom plate comprises a bottom plate opening; a top plate, wherein the top plate comprises a top plate opening; at least two columns connecting the bottom plate with the top plate; and at least two hydraulically actuated multi-stage telescoping cylinders connected to the top plate on a first end and a jack head on a second end, and wherein a travelling slip is mounted on the jack head and a stationary slip is mounted on the top plate;

inserting a tubular member of a tubular string through the travelling slip and the stationary slip of the snubbing unit;

closing the stationary slip around the tubular member;

moving the travelling slip assembly to a first position;

closing the travelling slip assembly around the tubular member;

opening the stationary slip; and

moving the travelling slip closed about the tubular to move the tubular string through the bottom plate opening into a well.
10. The method of claim 9, further comprising the step of lifting a tubular into the snubbing unit with a gin pole pivotally attached to the snubbing unit frame.

11. The method of claim 11, wherein the at least two hydraulically actuated multi-stage telescoping cylinders comprise three stages and further comprising the step of activating a first stage of the at least two hydraulically actuated multi-stage telescoping cylinder to create a snubbing force of up to 68,000 pounds.
12. The method of claim 11, wherein the at least two hydraulically actuated multi-stage telescoping cylinders comprise three stages and further comprising the step of activating a first stage and a second stage of the at least two hydraulically actuated multi-stage telescoping cylinder to create a snubbing force of up to 92,000 pounds.
13. The method of claim 11, further comprising the step of activating a first stage, a second stage and a third stage of the at least two hydraulically actuated multi-stage telescoping cylinder to create a snubbing force of up to 102,000 pounds.
14. The method of claim 11, wherein the at least two hydraulically actuated multi-stage telescoping cylinders comprise three stages and further comprising the step of flowing fluid through at least two ports on each of the at least two hydraulically actuated multi-stage telescoping cylinders to raise or lower the jack head.
15. A snubbing unit system for moving pipe into or out of a wellbore, wherein the snubbing unit system comprises:
 - a bottom plate supporting the load weight of a snubbing frame, wherein the bottom plate has a bottom plate opening over the wellbore;
 - a top plate, wherein the top plate has a top plate opening and a stationary slip attached to the top plate;
 - at least two columns connecting the bottom plate with the top plate;
 - at least two hydraulically actuated multi-stage telescoping cylinders comprising a first end and a second end, wherein the first end is connected to the top plate and the second end is connected to a jack head, wherein a travelling slip is attached to the jack head; and
 - a control unit for controlling the at least two hydraulically actuated multi-stage

telescoping cylinders.

16. The snubbing unit system of claim 15, wherein the at least two hydraulically actuated multi-stage telescoping cylinders connecting the bottom plate with the top plate are connected to the top plate using a clevis pin assembly and are connected to the jack head using a nut.
17. The snubbing unit system of claim 15, further comprising an interior frame mounted to the top plate, wherein the interior frame comprises an interior cavity surrounding the top plate opening and the bottom plate opening, and a plurality of removable cylinder saddles, wherein the plurality of removable cylinder saddles are positioned over the at least two hydraulically actuated multi-stage telescoping cylinders and bolted onto the interior frame.
18. The snubbing unit system of claim 15, wherein each of the at least two hydraulically actuated multi-stage telescoping cylinders further comprises a bottom port and lower port for moving hydraulic fluid into and out of each of the hydraulically actuated multi-stage telescoping cylinders.
19. The snubbing unit system of claim 15, wherein the total weight of the snubbing frame is less than 8 tons.
20. The snubbing unit system of claim 15, further comprising a gin pole attached to the snubbing frame for inserting tubulars into the snubbing frame.

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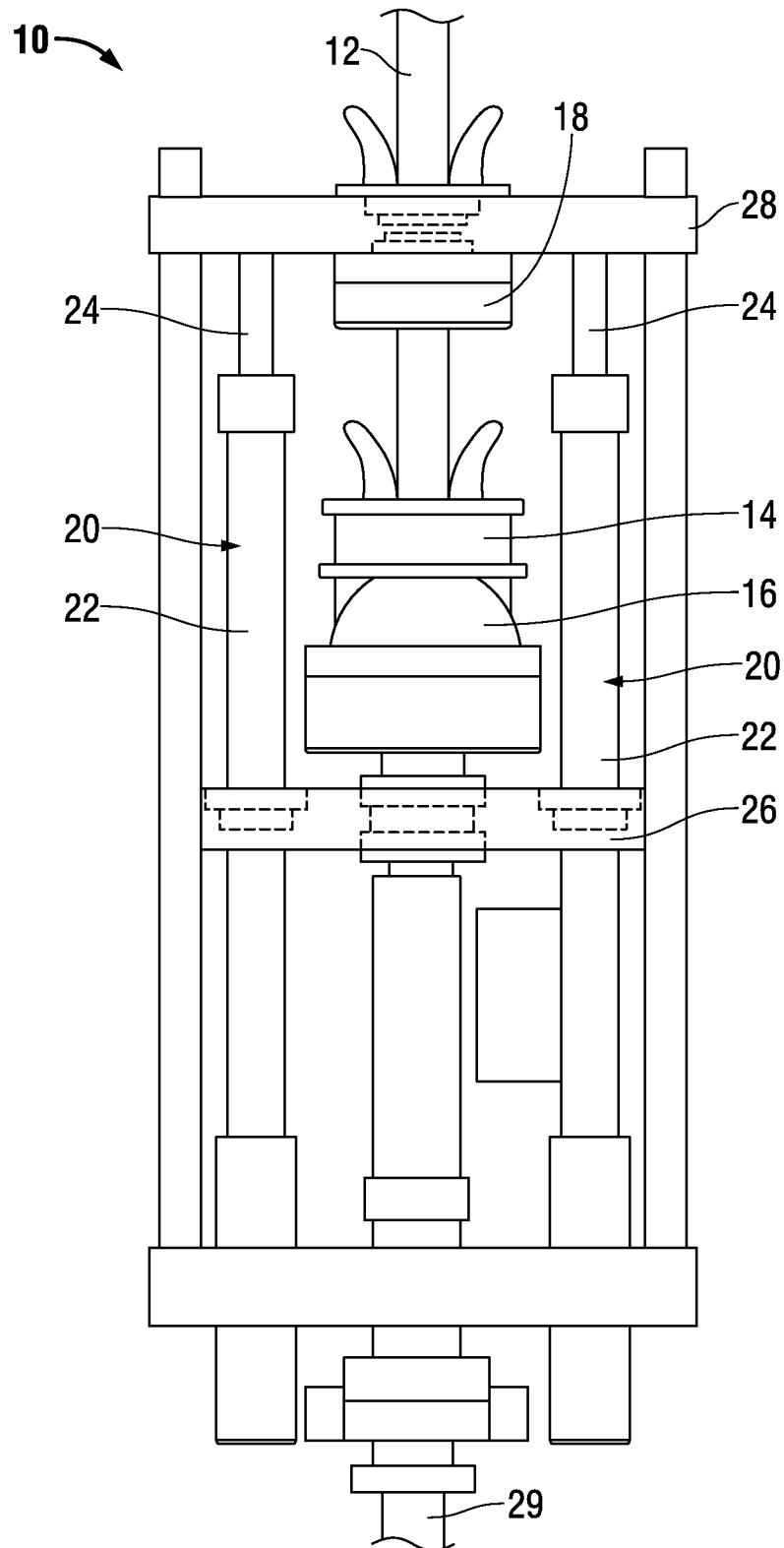


FIG. 1
(Prior Art)

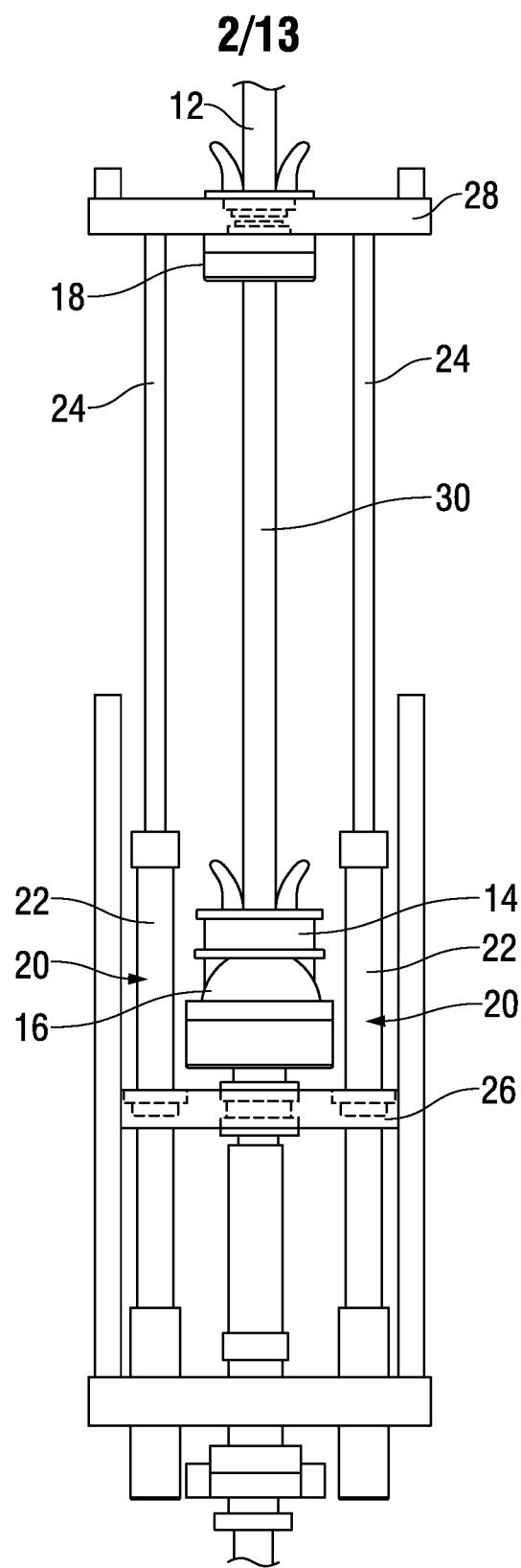


FIG. 2
(Prior Art)

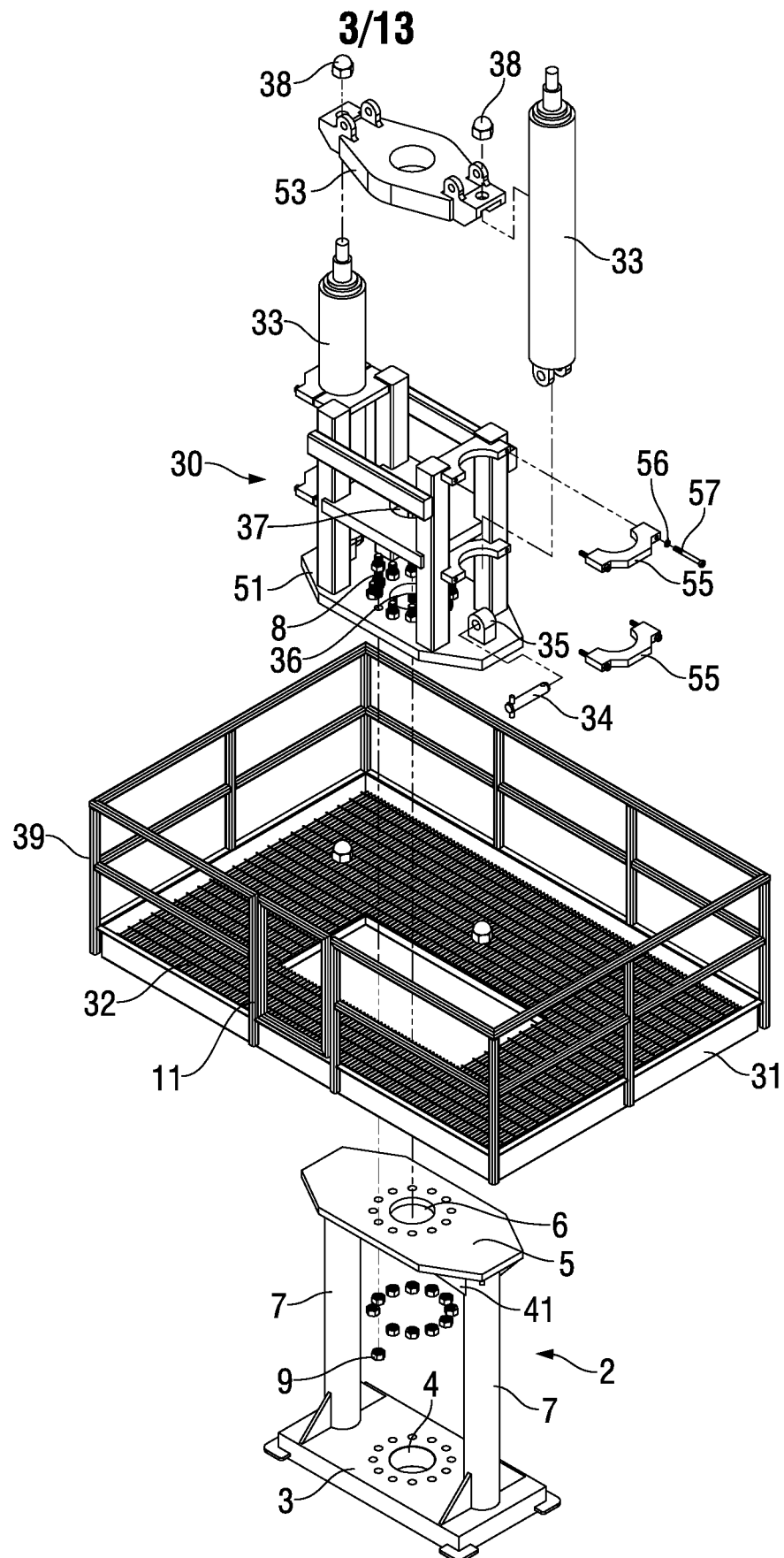


FIG. 3

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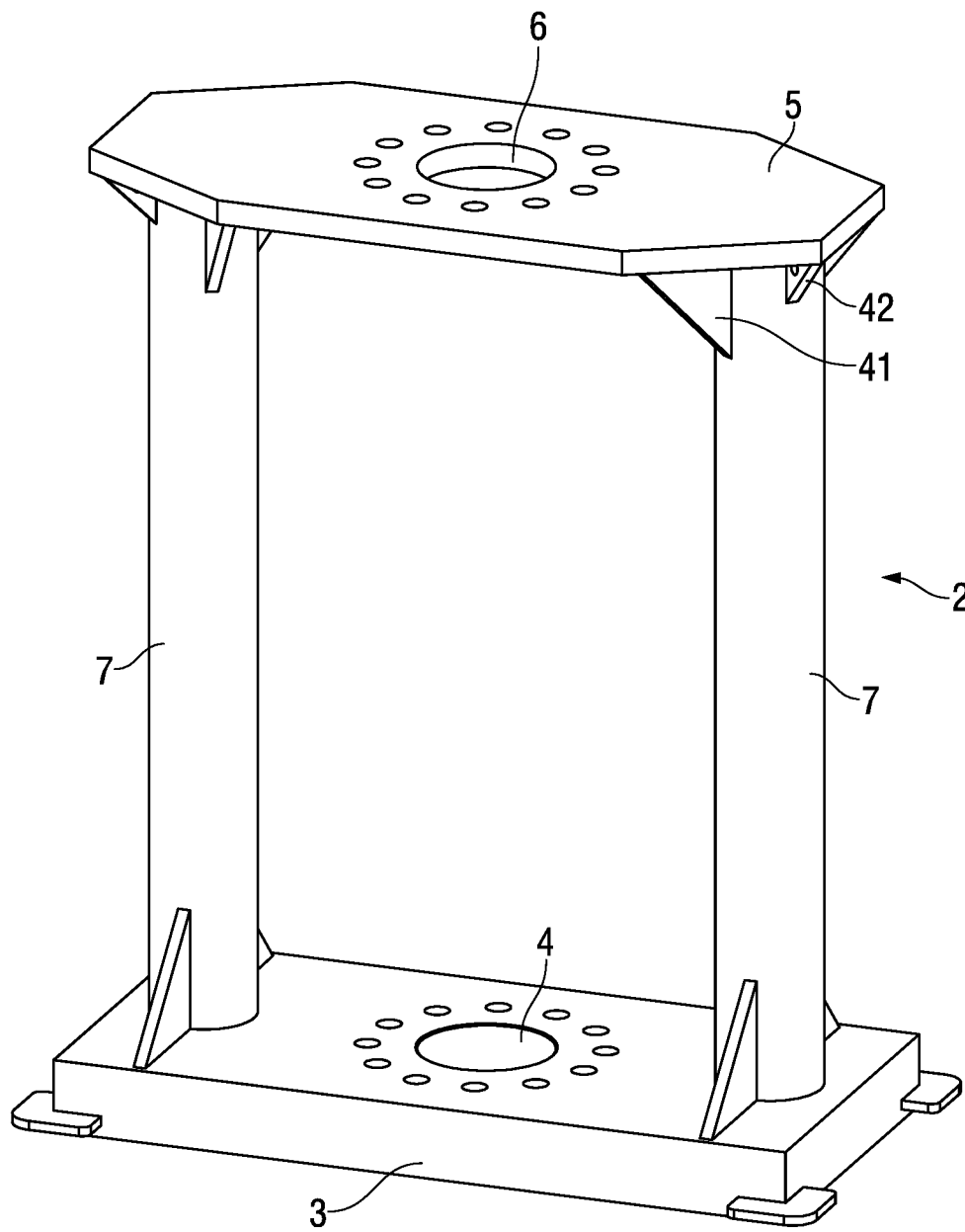


FIG. 4

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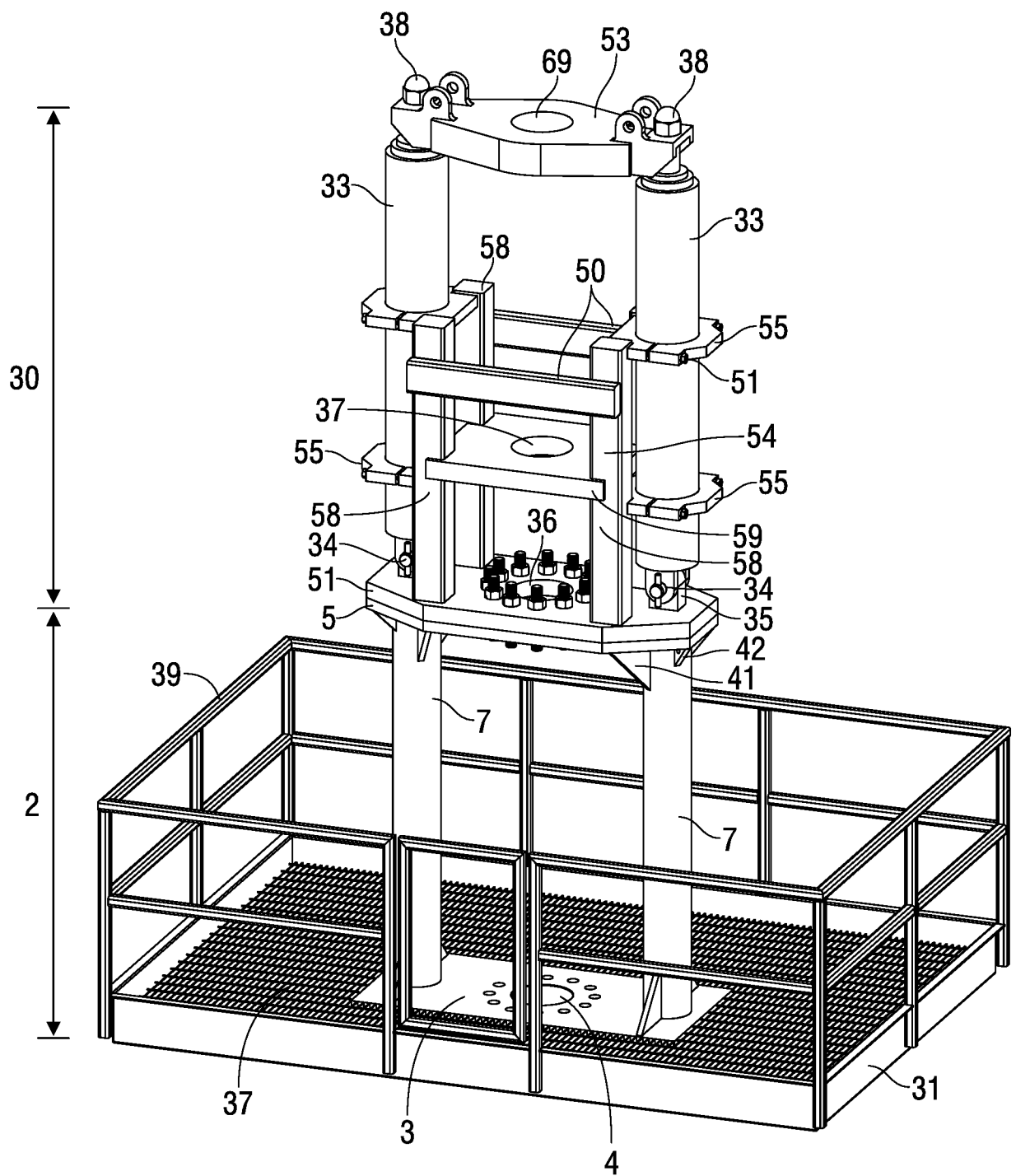


FIG. 5

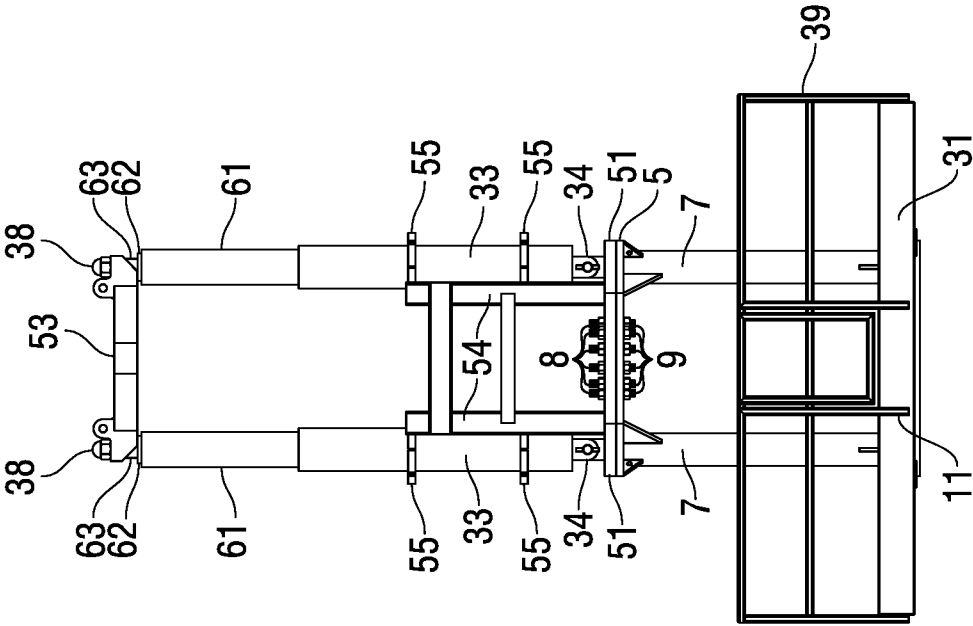


FIG. 6B

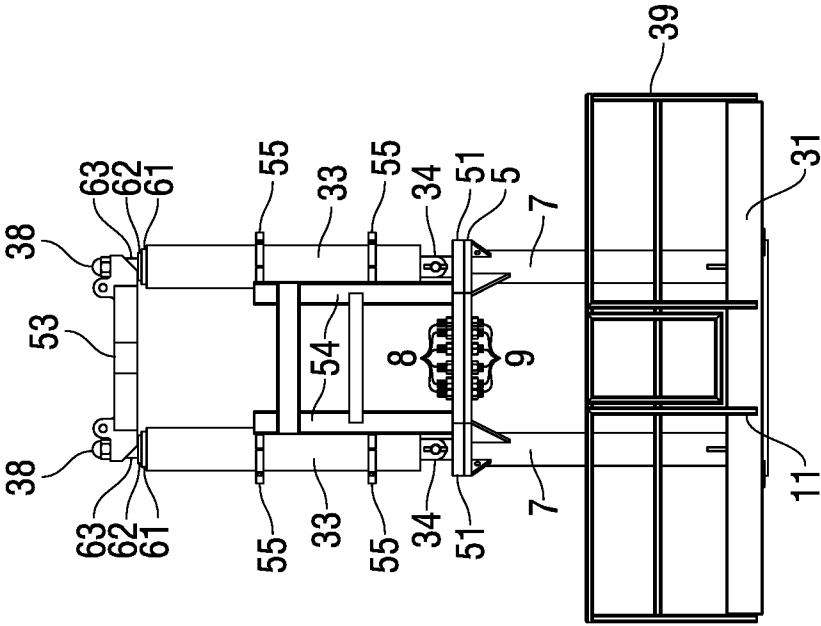


FIG. 6A

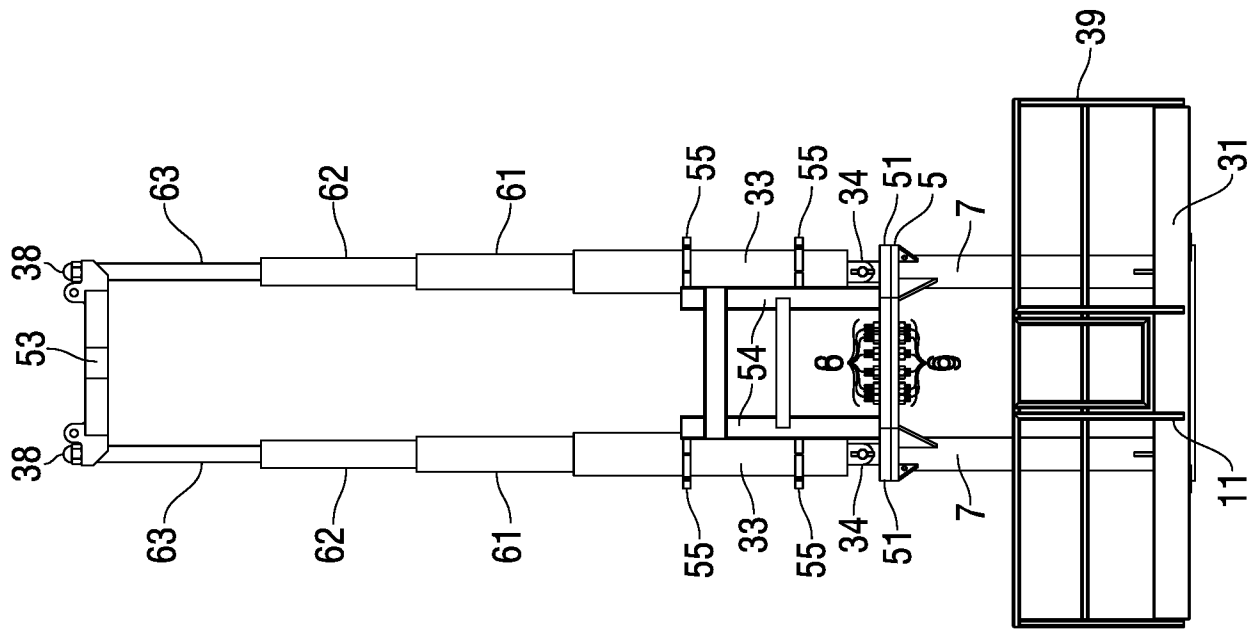


FIG. 6D

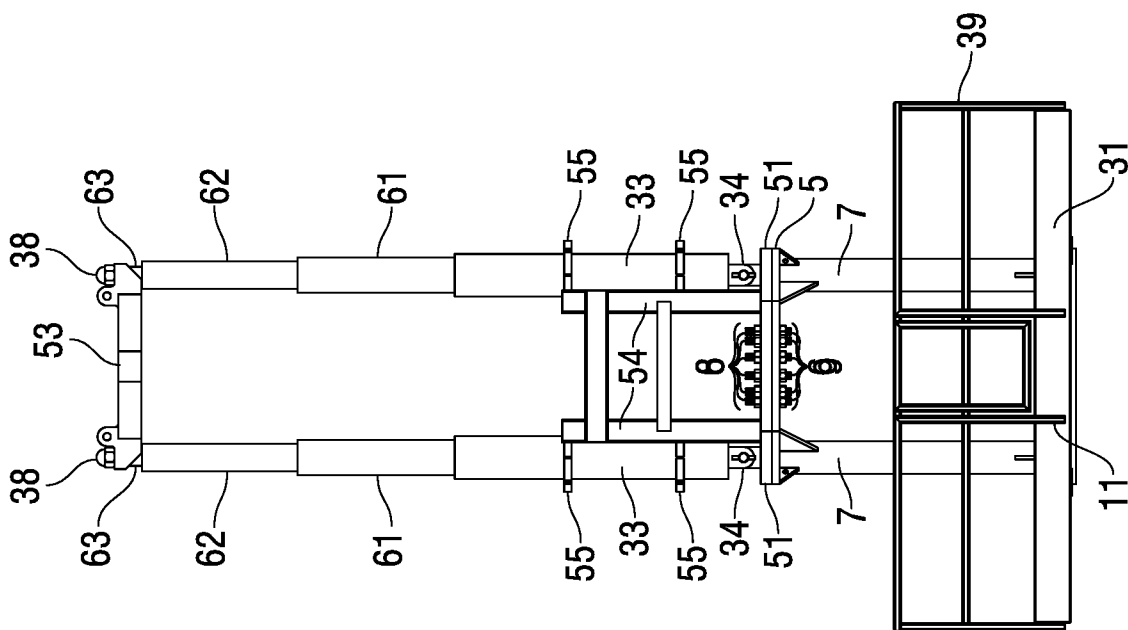


FIG. 6C

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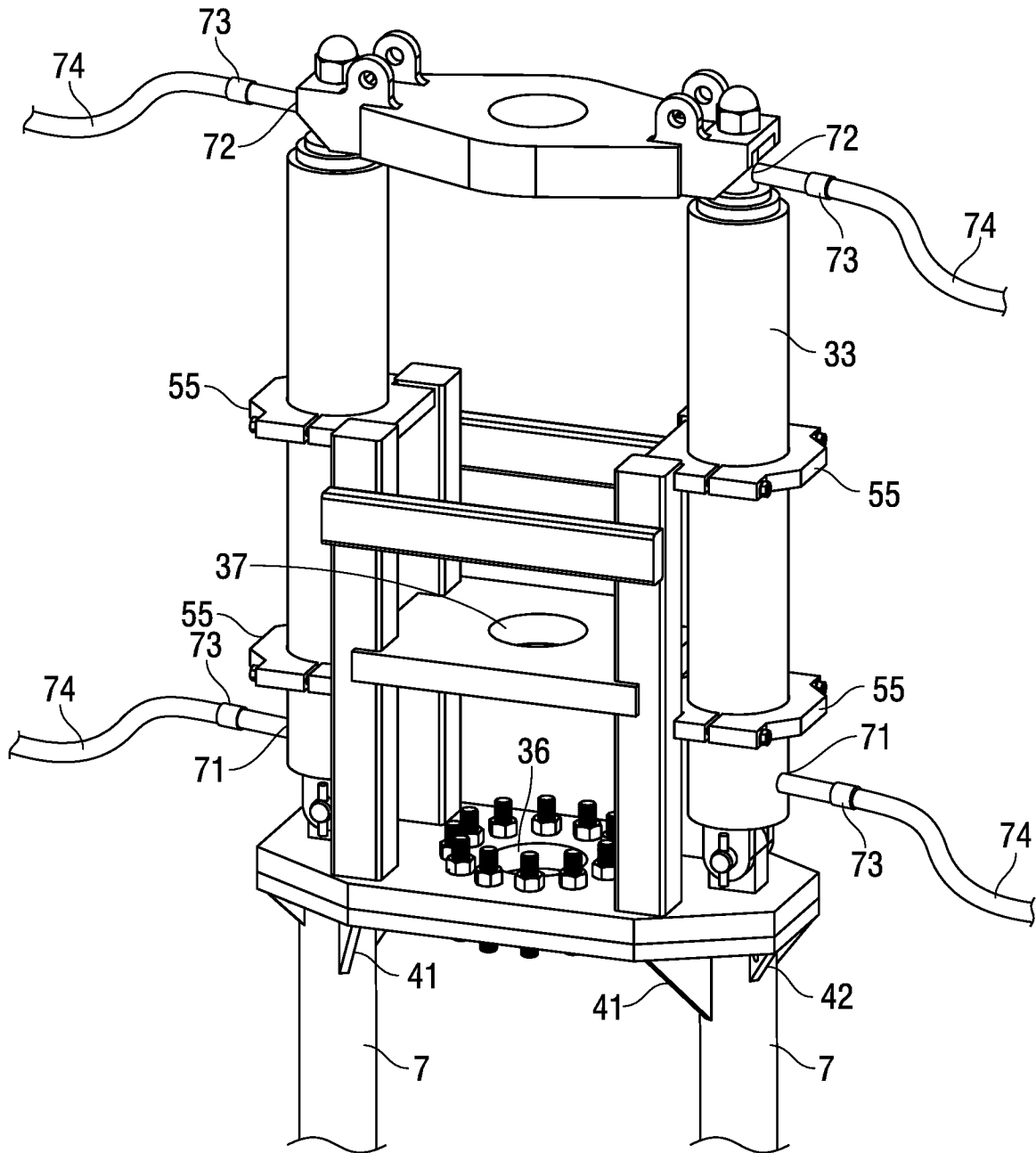


FIG. 7

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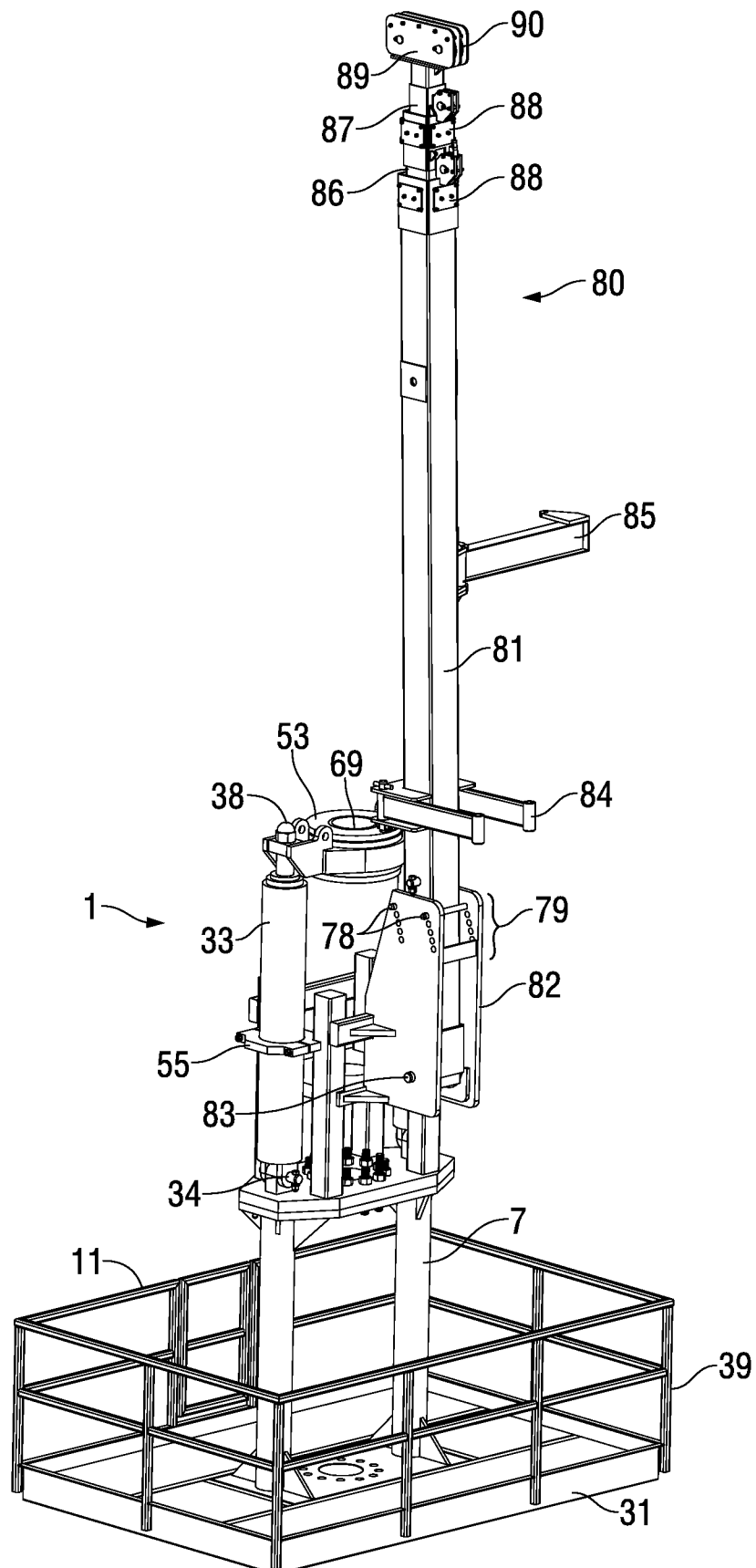


FIG. 8A

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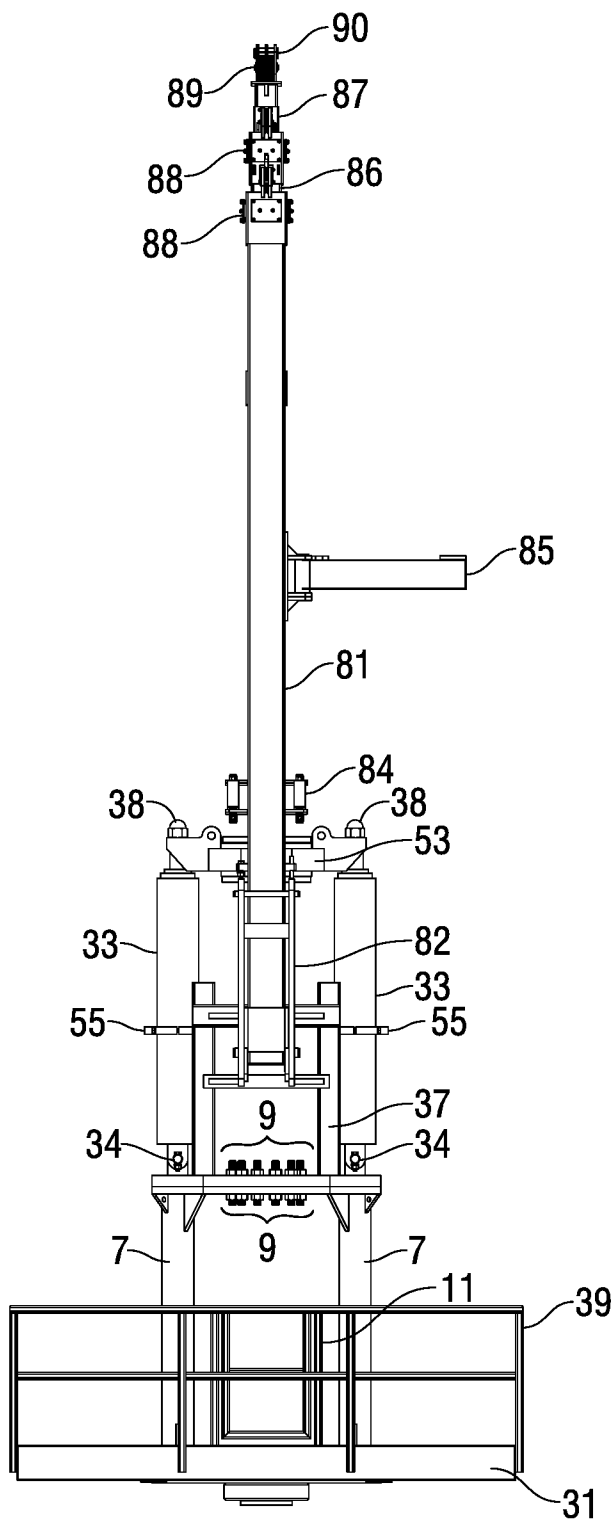


FIG. 8B

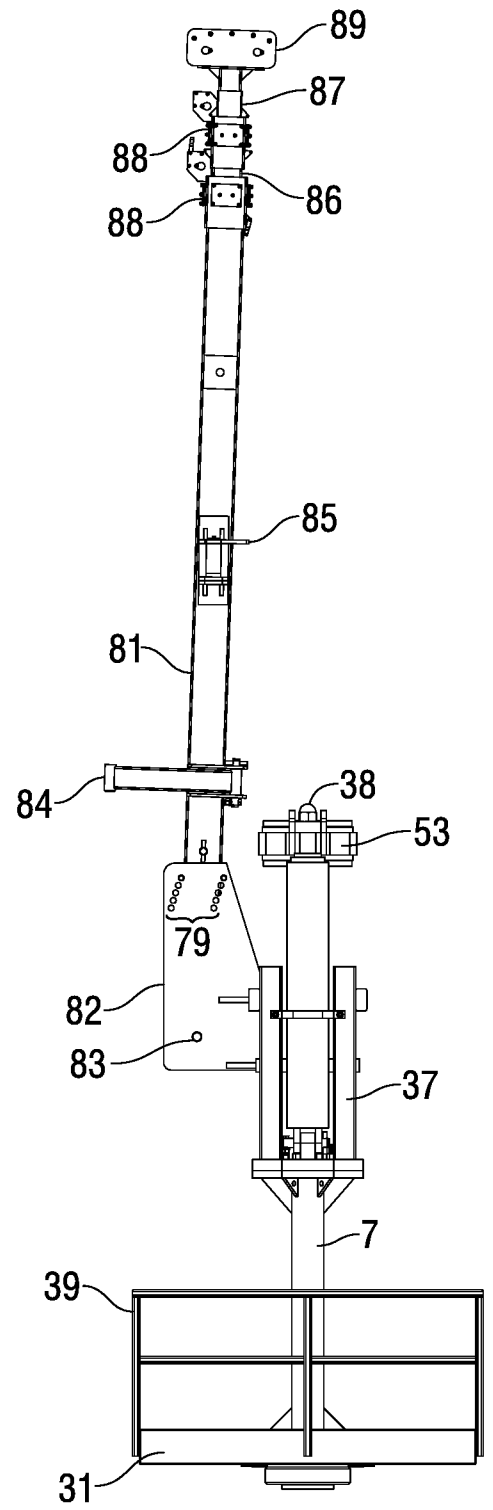


FIG. 8C

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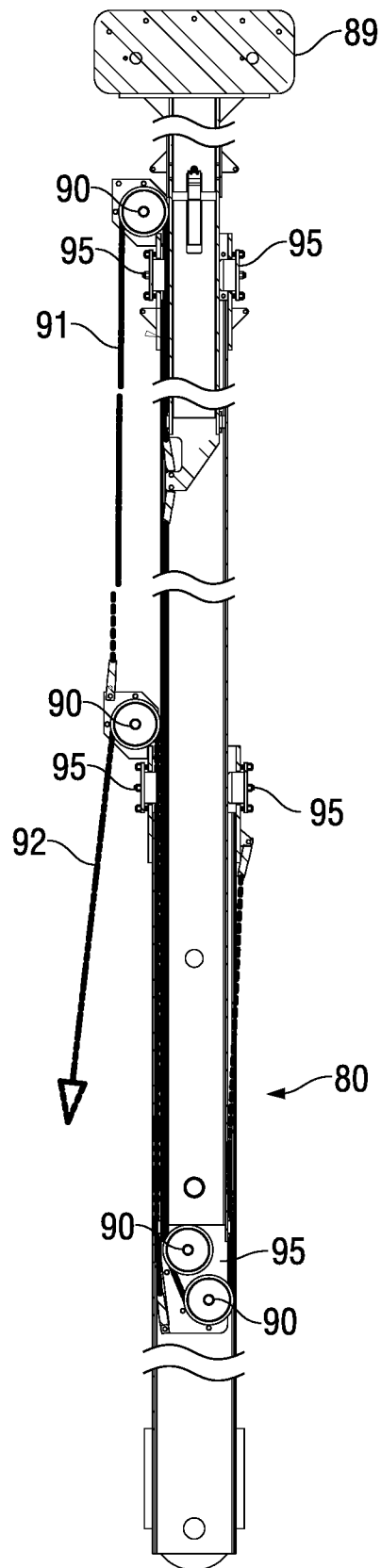


FIG. 9

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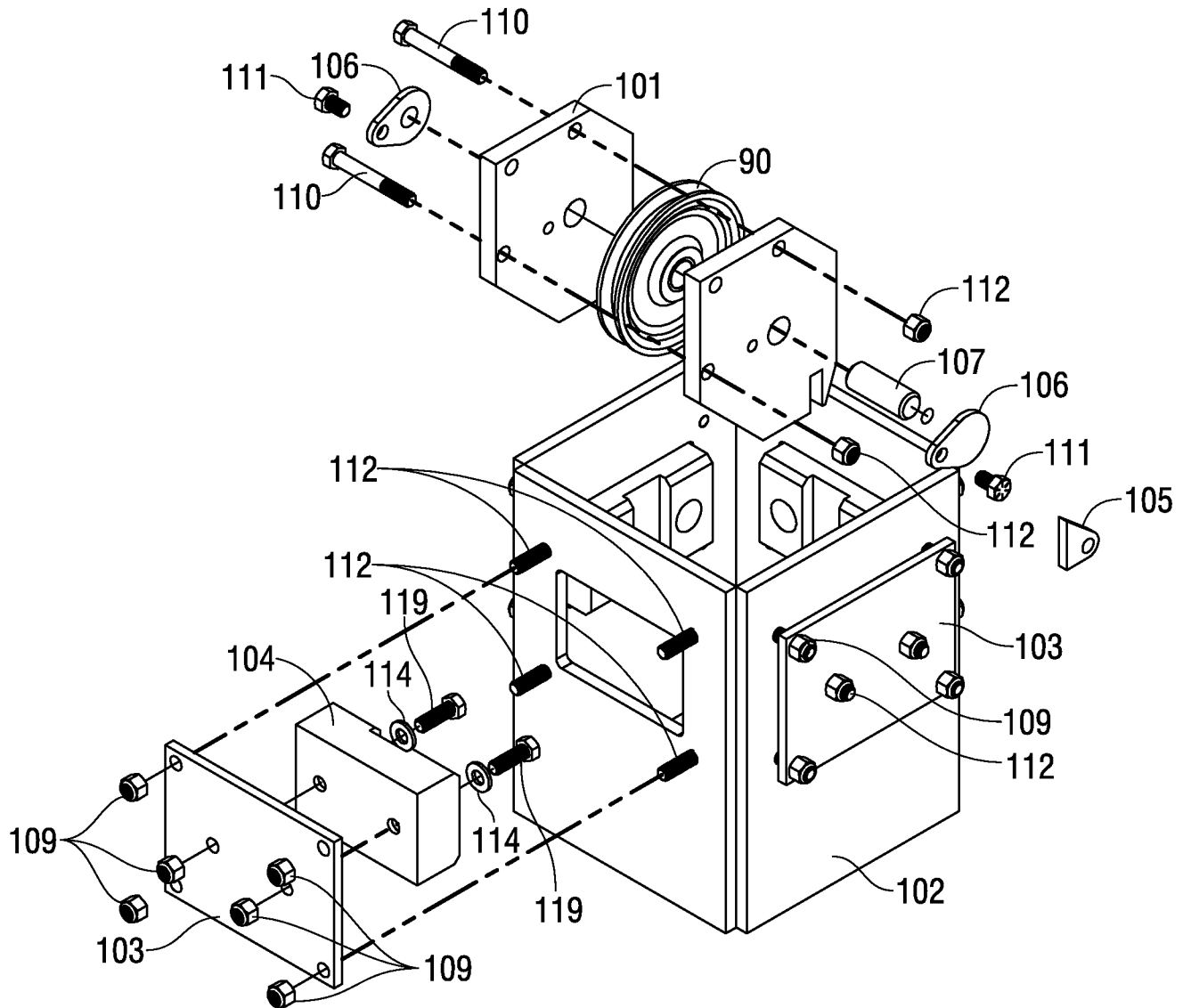


FIG. 10

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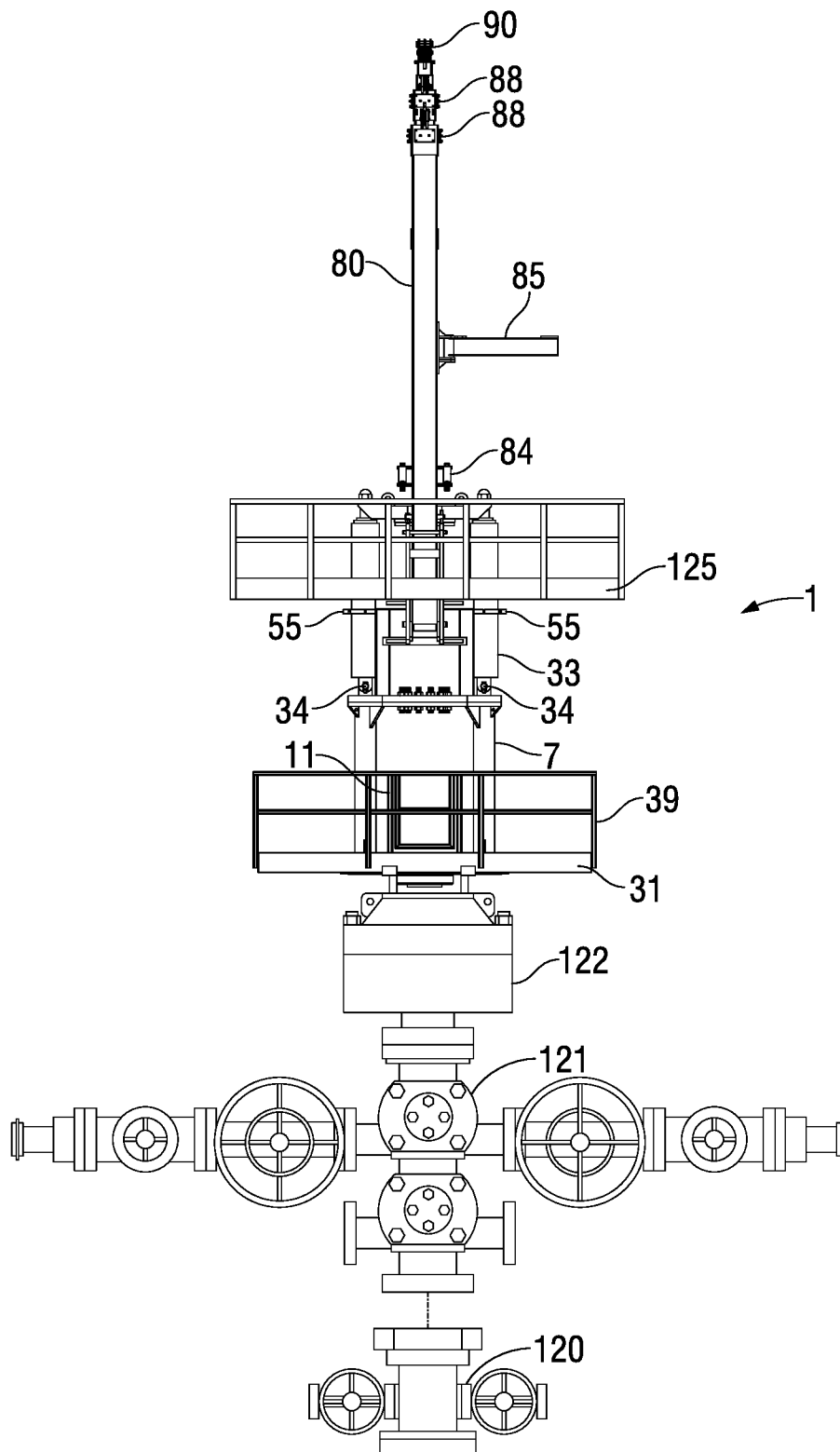


FIG. 11