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Orgeron

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(54) **APPARATUS AND METHOD FOR PRE-LOADING OF A MAIN ROTATING STRUCTURAL MEMBER**

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(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 229 days.

This patent is subject to a terminal disclaimer.

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(51) **Int. Cl.**
E21B 19/00 (2006.01)
H01L 21/68 (2006.01)

(52) **U.S. Cl.**
USPC **414/22.55**; 414/783; 414/742; 901/48

(58) **Field of Classification Search**
USPC 166/77.52–77.53; 175/85; 212/231; 414/22.54, 22.55, 22.56, 22.57, 22.58, 22.59, 414/22.62, 23, 546, 680, 729, 738, 740, 742, 414/746.8, 783; 52/115, 116, 119, 120; 74/103, 74/110; 901/15, 21–22
See application file for complete search history.

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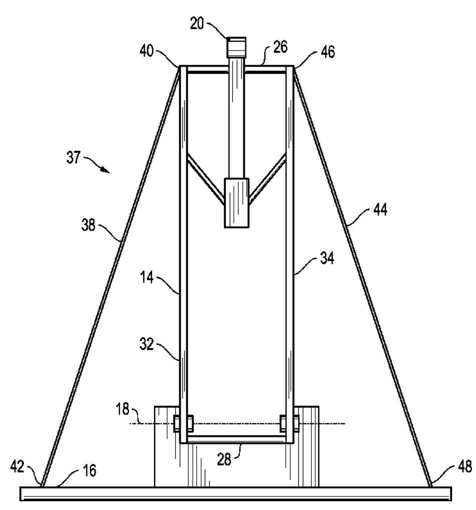
(57) **ABSTRACT**

An apparatus for a pipe handling apparatus has a main rotating structural member rotating about a pivot axis relative to a skid and moving from a first position to a second position. A tensioning mechanism is affixed to the main rotating structural member. The tensioning mechanism applies a tension to the main rotating structural member when the main rotating structural member is in the second position. The tensioning mechanism has a first cable having an end attached adjacent a top of the main rotating structural member, and a second cable having an end attached adjacent the top of the main rotating structural member. The first and second cables have opposite ends attached to a fixed surface. The first and second cables extend angularly outwardly from a front of the main rotating structural member. The first and second cables extend angularly outwardly from the sides of the main rotating structural member.

22 Claims, 12 Drawing Sheets



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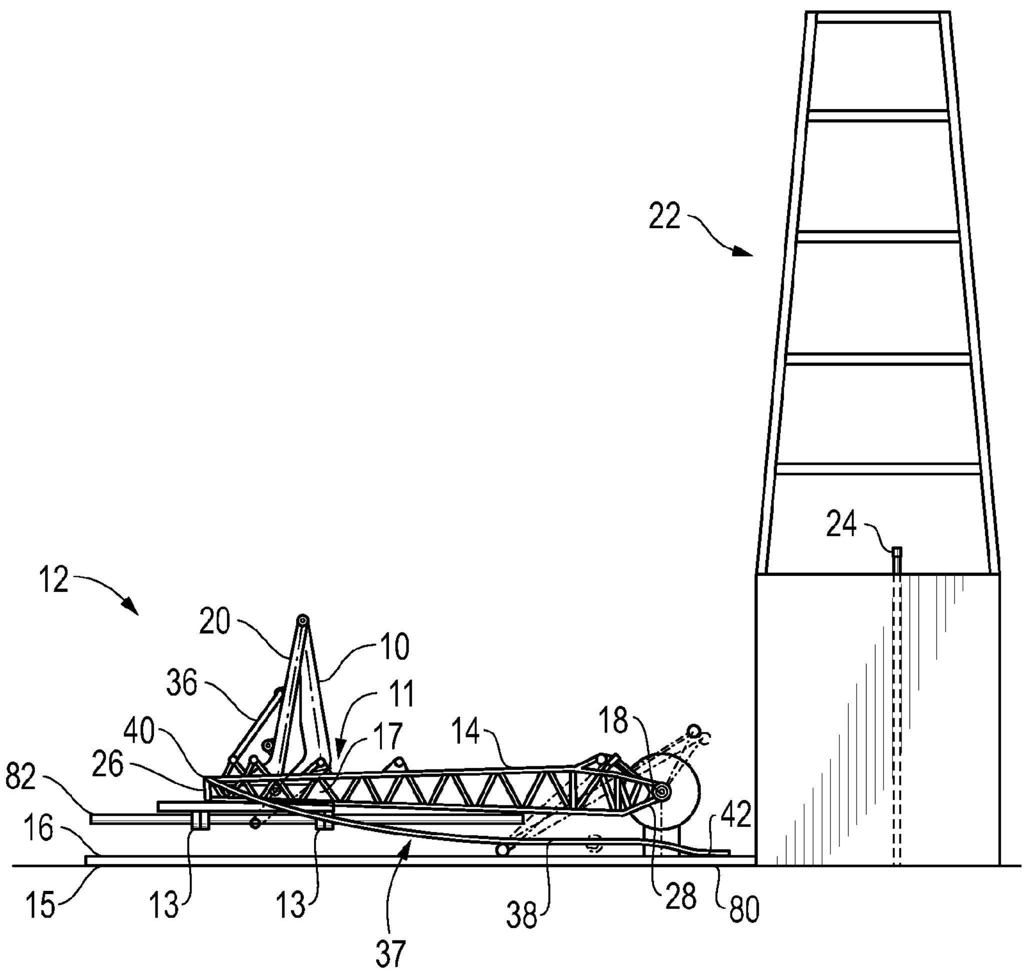

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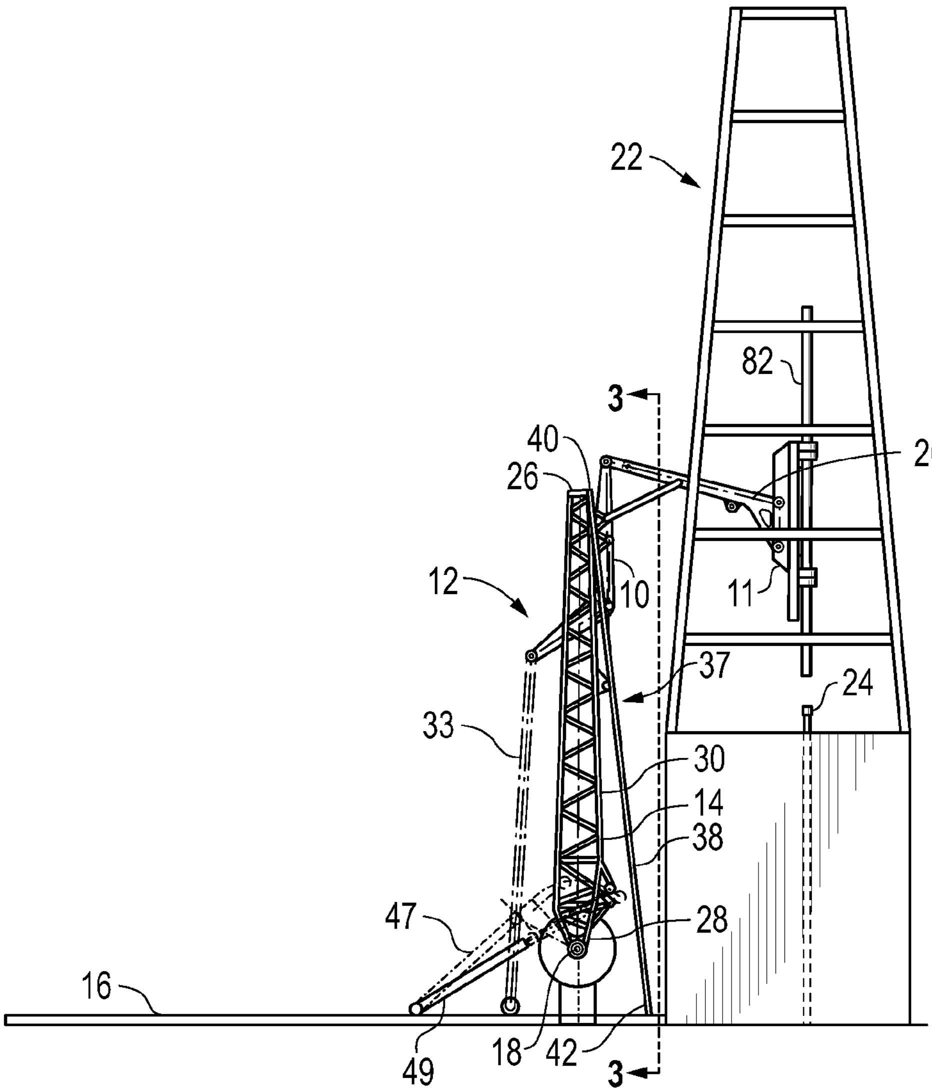

FIG. 2

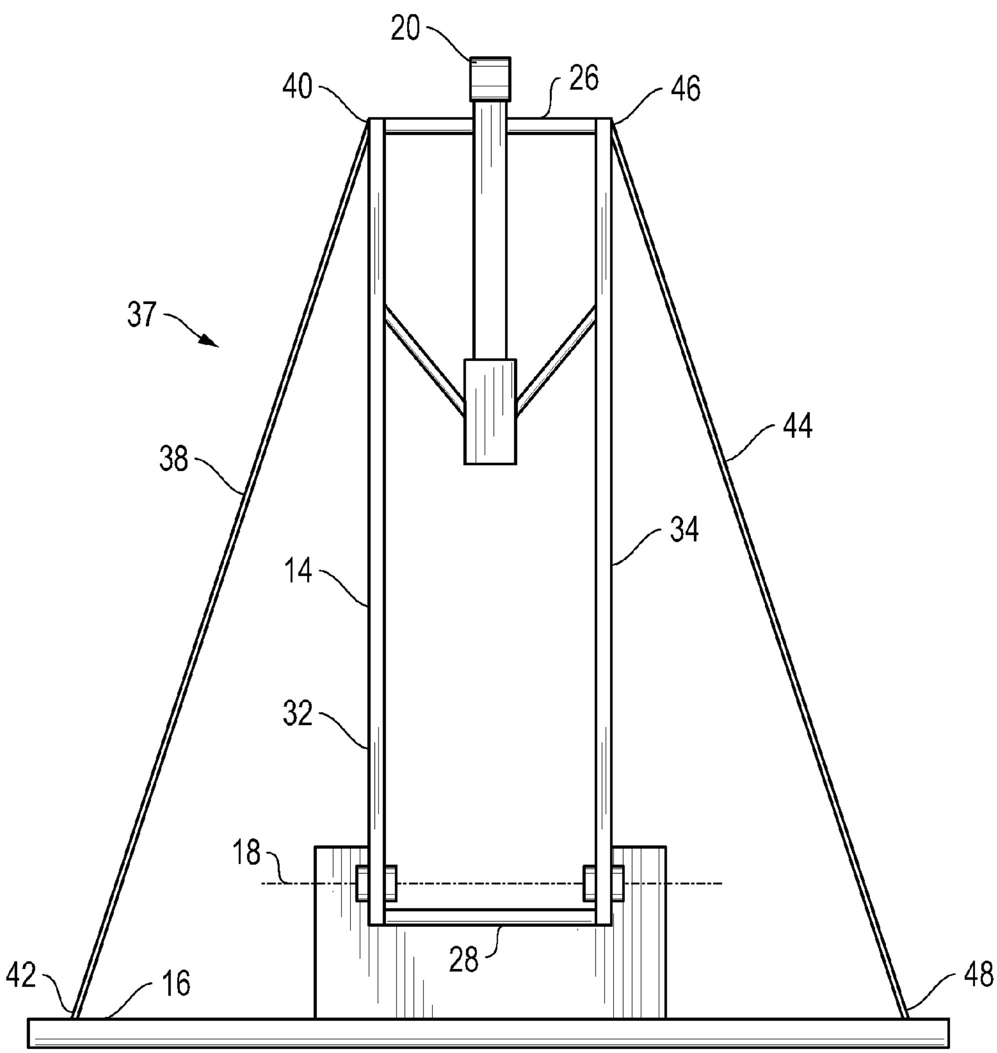

FIG. 3

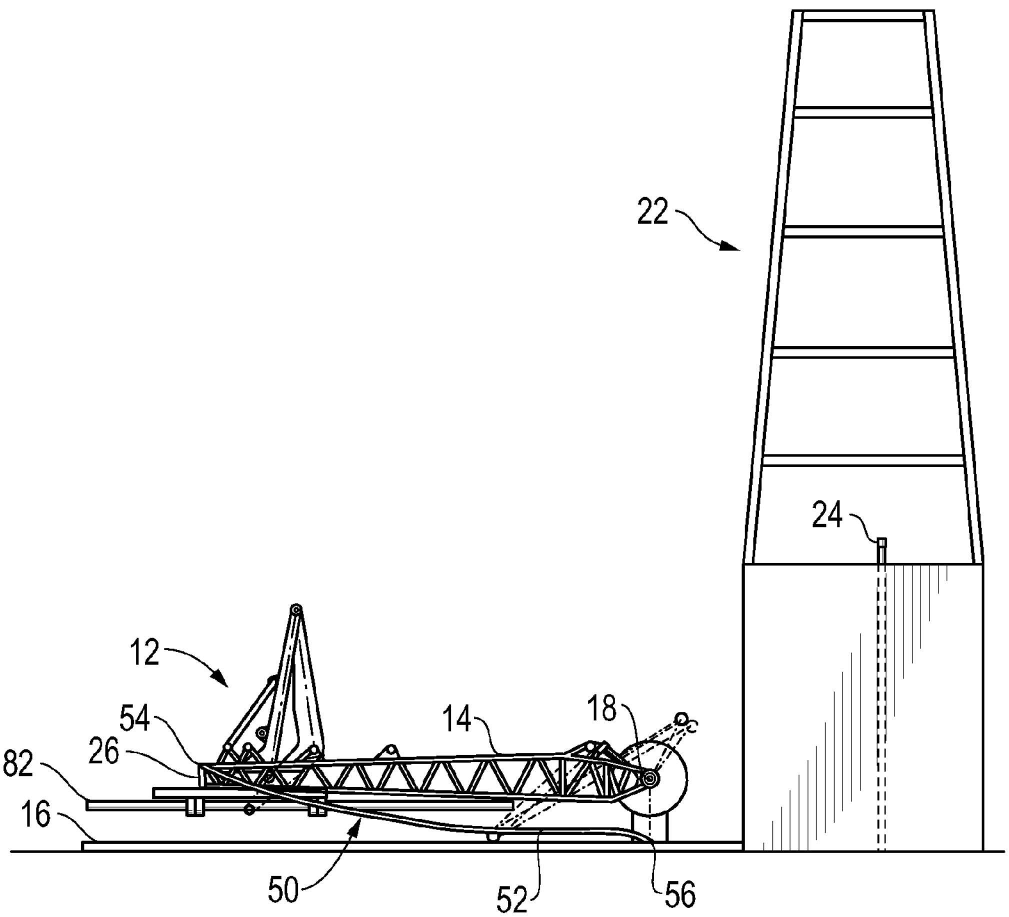

FIG. 4

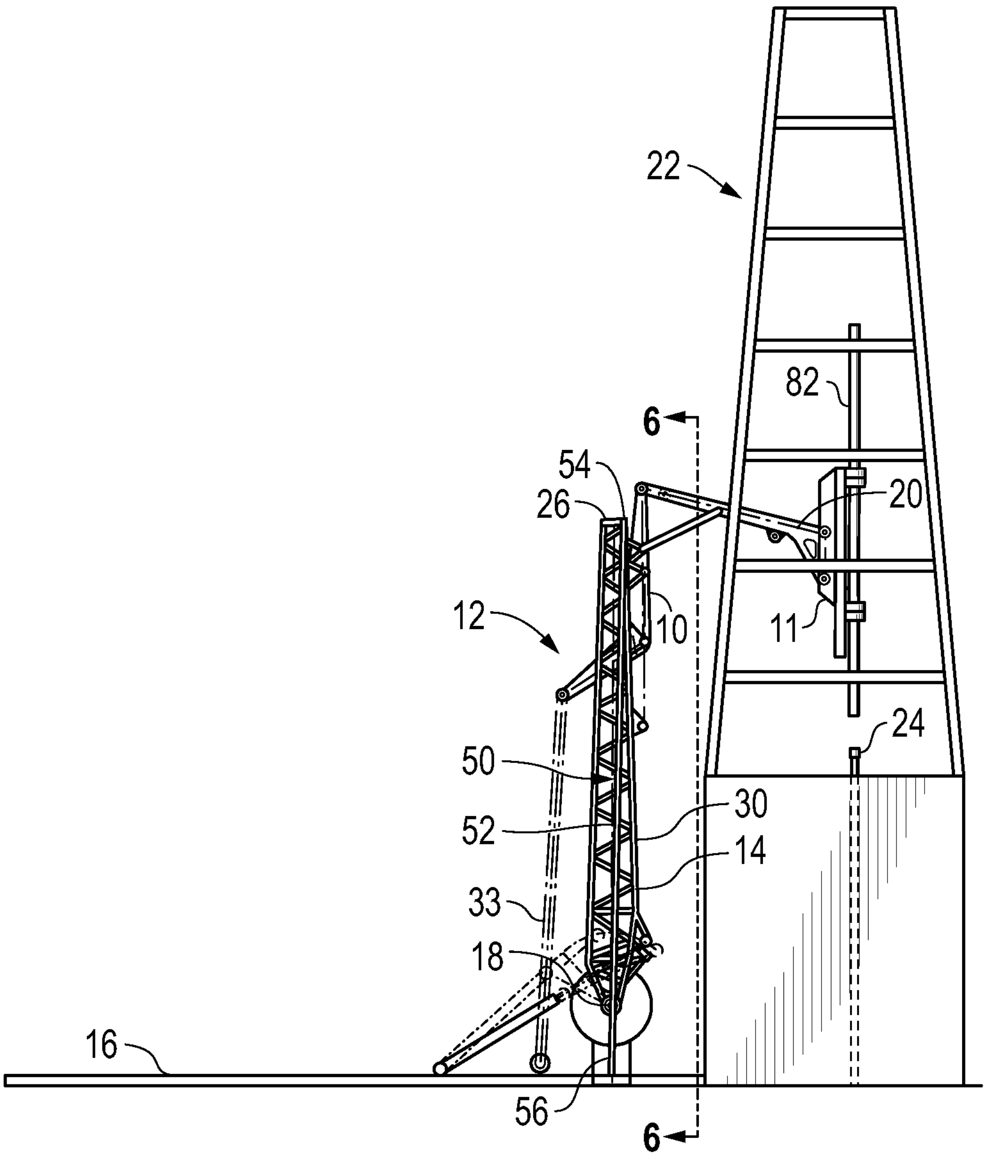

FIG. 5

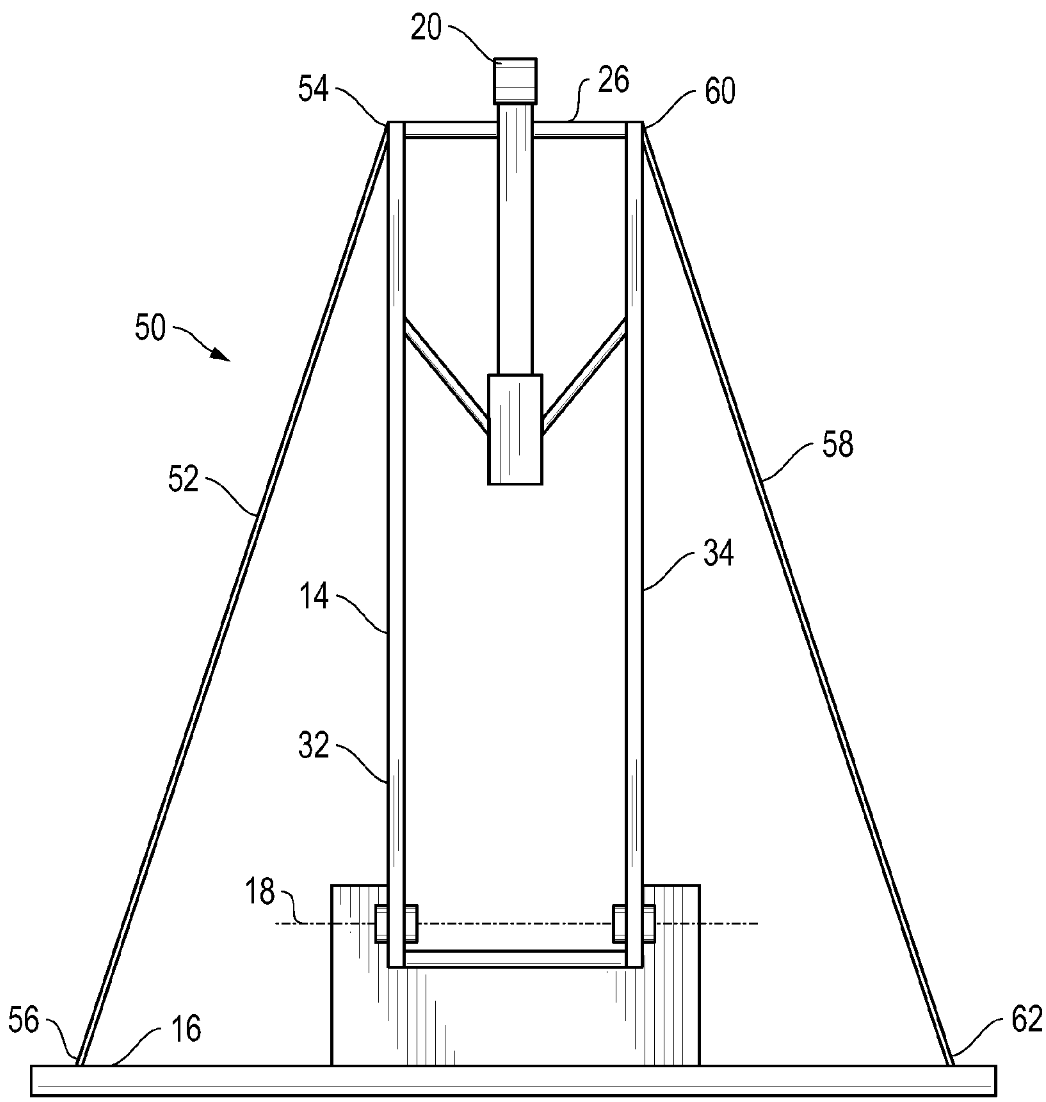

FIG. 6

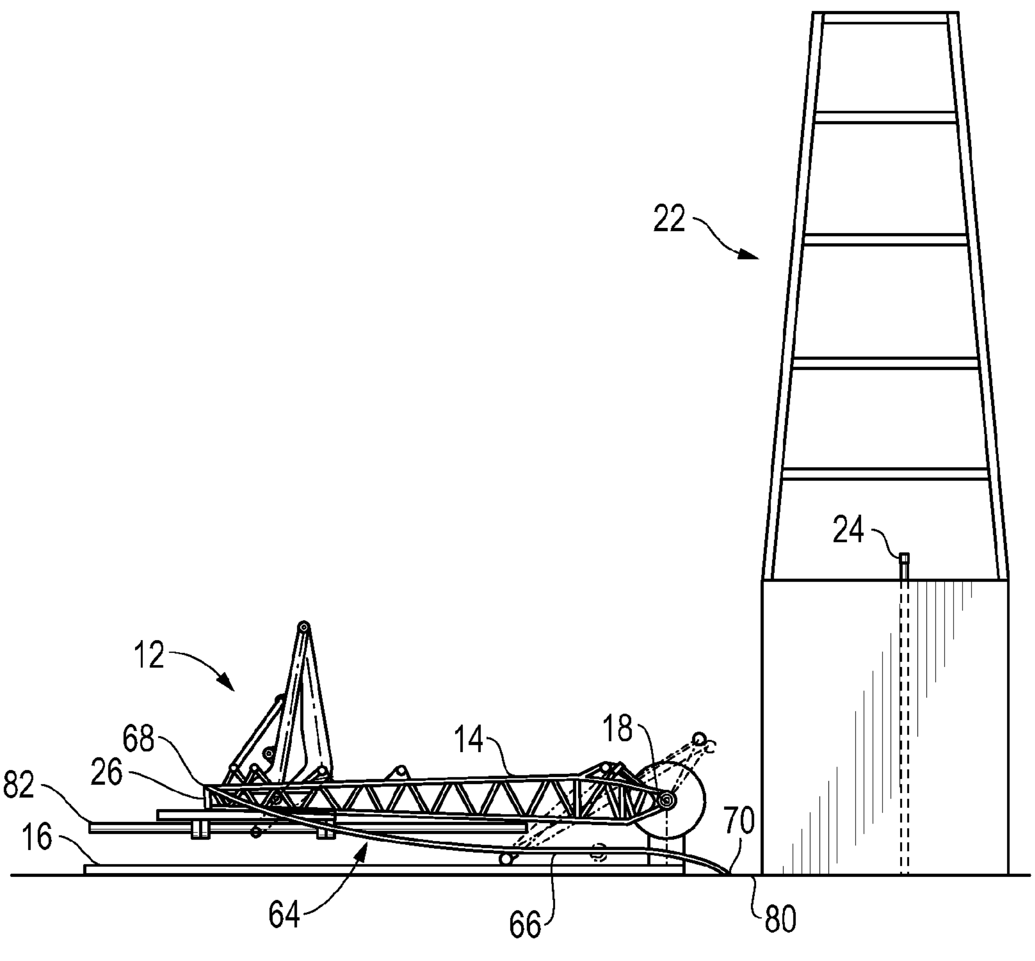

FIG. 7

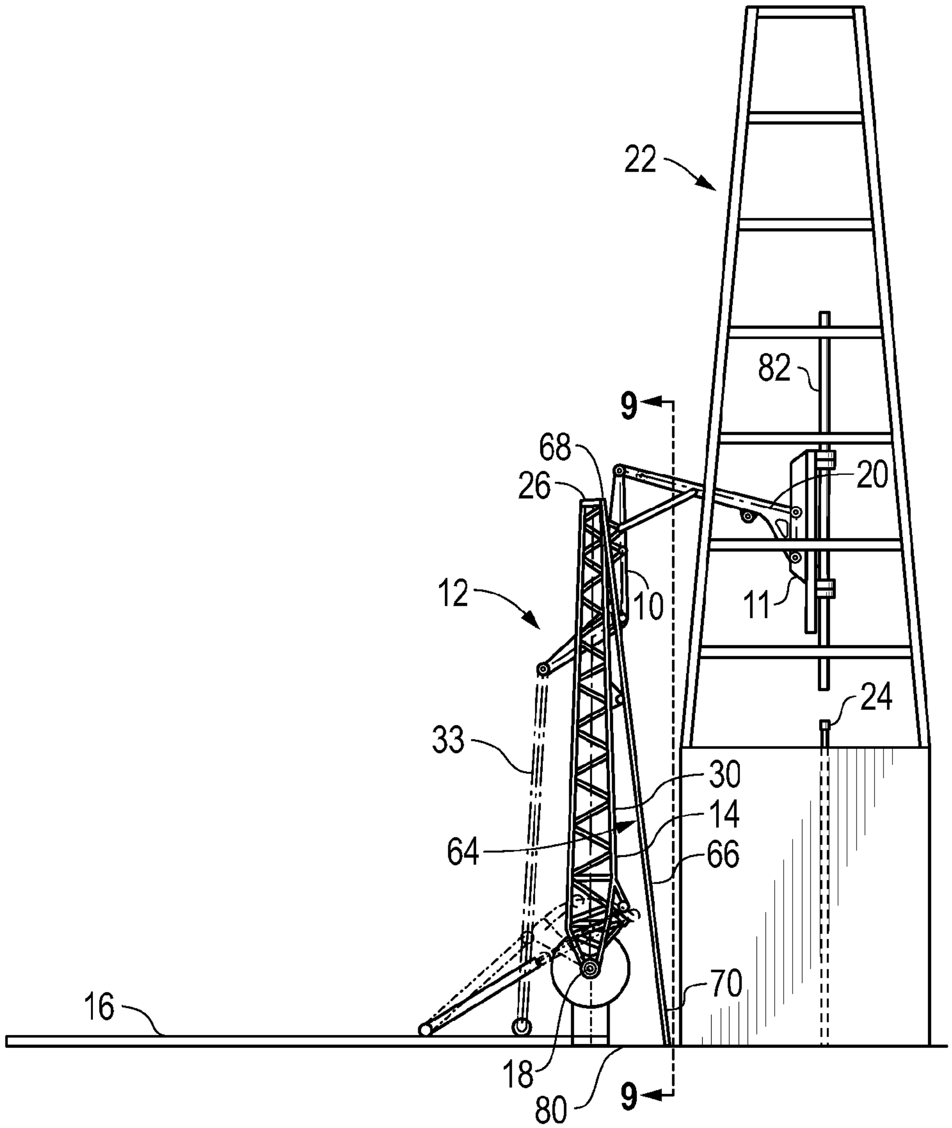

FIG. 8

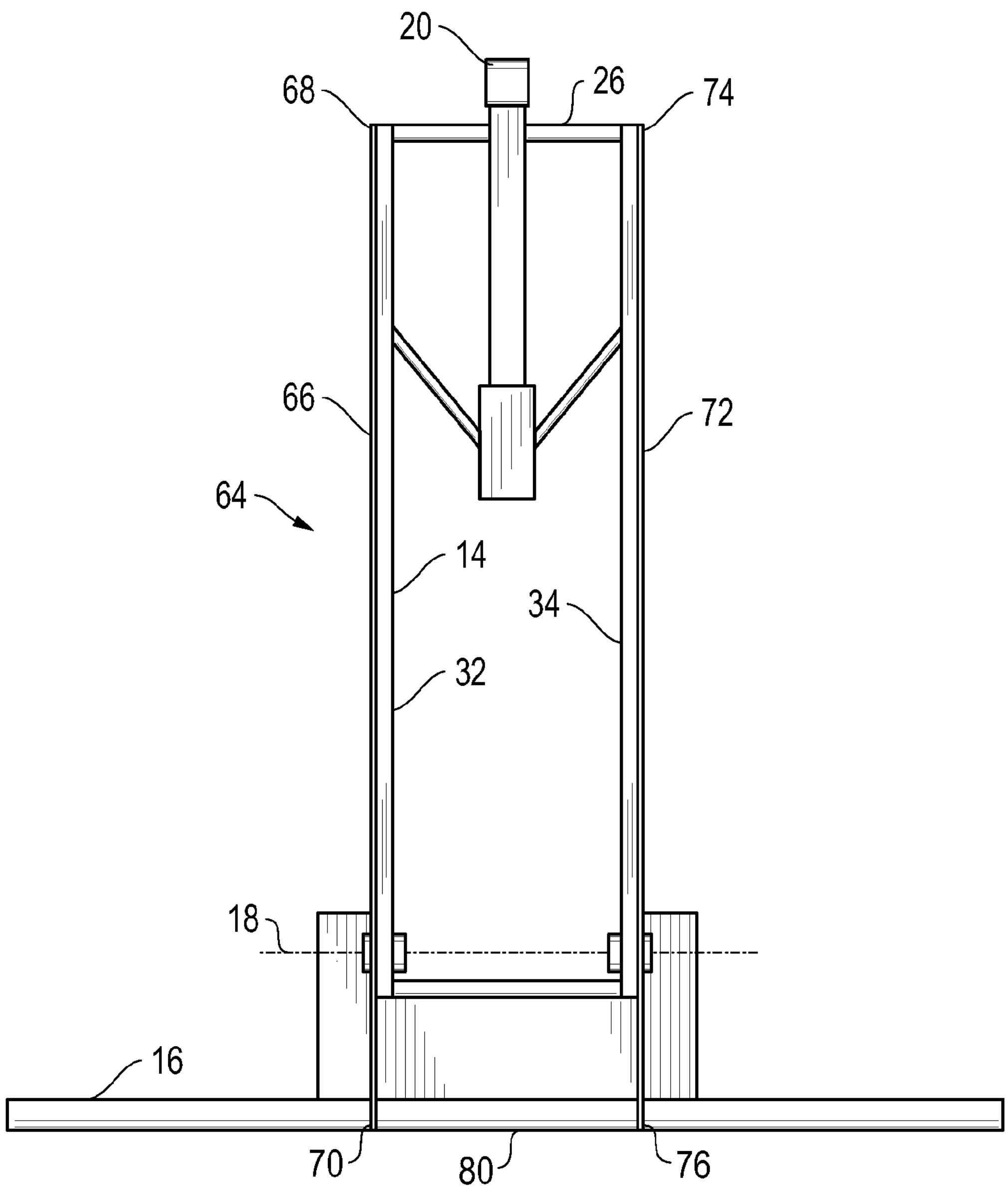

FIG. 9

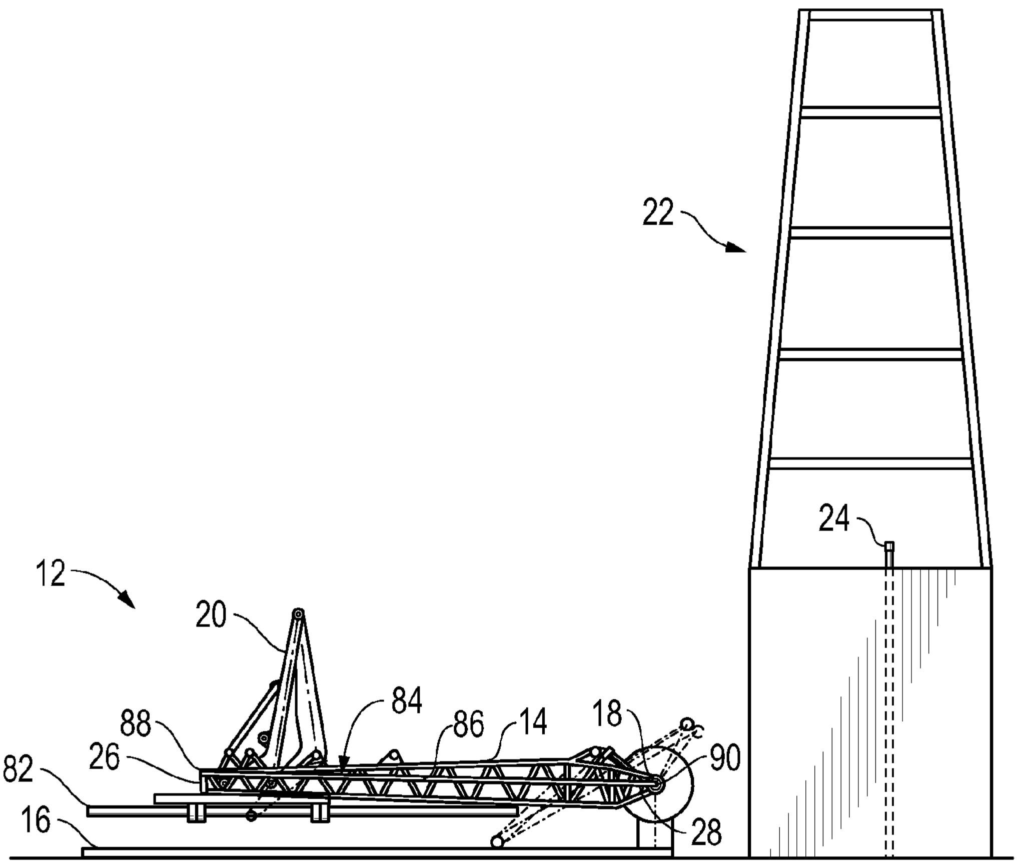

FIG. 10

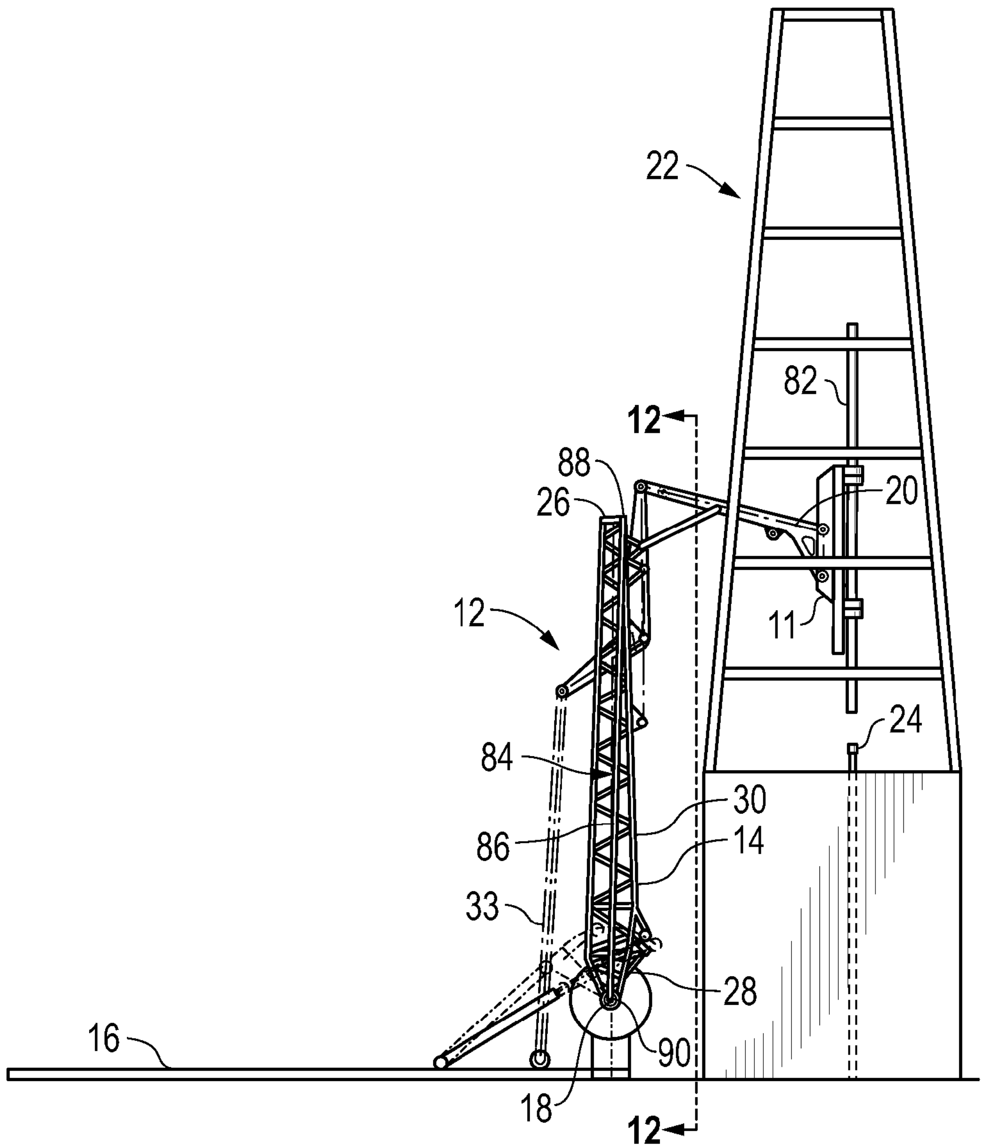

FIG. 11

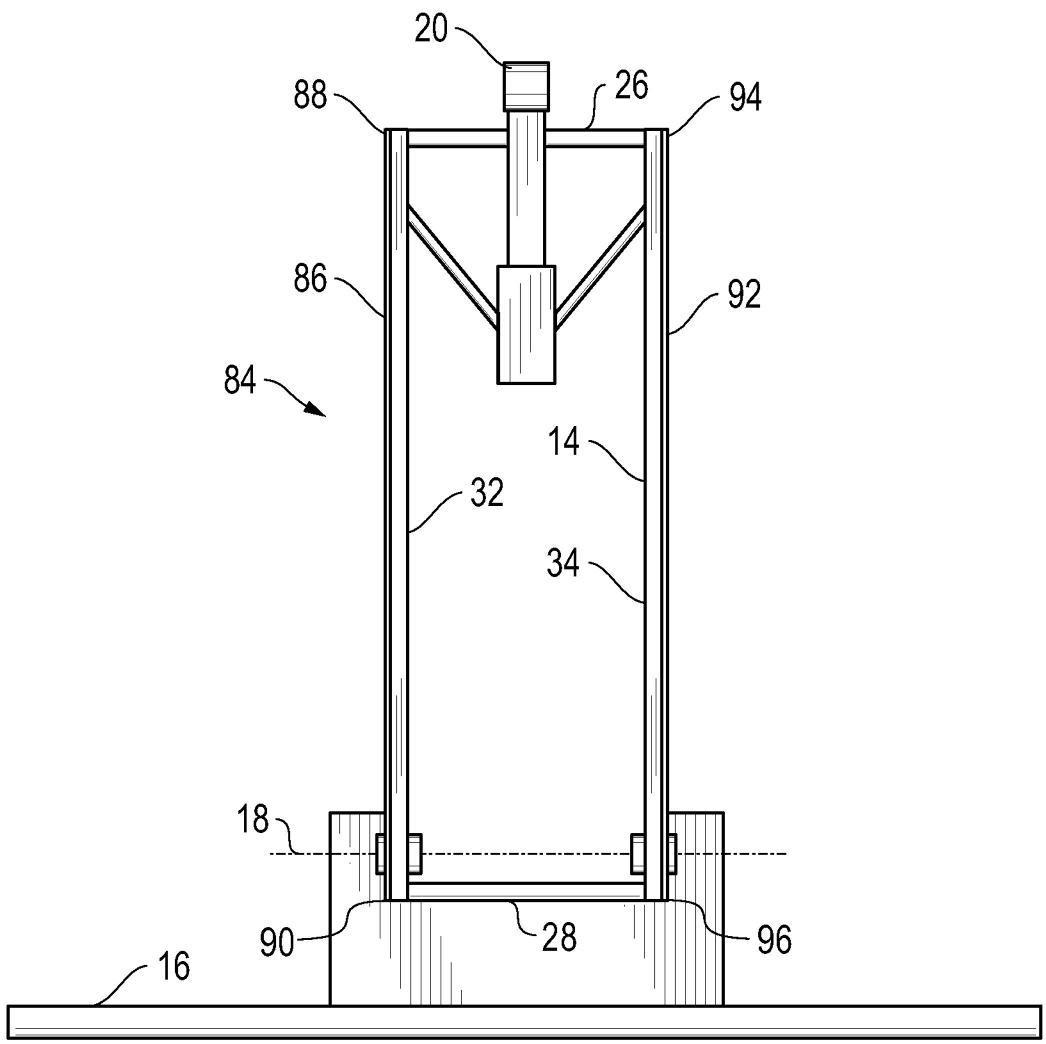

FIG. 12

APPARATUS AND METHOD FOR PRE-LOADING OF A MAIN ROTATING STRUCTURAL MEMBER

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to pipe handling apparatus. More particularly, the present invention relates to pipe handling apparatus that have a main rotating structural member rotating about a pivot axis. More particularly, the present invention relates to controlling undesirable forces that are created while positioning a tubular at a well head. More particularly, the present invention relates to apparatus for tensioning the main rotating structural member of the pipe handling apparatus.

2. Description of Related Art Including Information Disclosed Under 37 CFR 1.97 and 37 CFR 1.98.

Drill rigs have utilized several methods for transferring tubular members from a pipe rack adjacent to the drill floor to a mousehole in the drill floor or the well bore for connection to a previously transferred tubular or tubular string. The term "tubular" as used herein includes all forms of pipe, drill pipe, drill collars, casing, liner, bottom hole assemblies (BHA), and other types of tubulars known in the art.

Conventionally, drill rigs have utilized a combination of the rig cranes and the traveling system for transferring a tubular from the pipe rack to a vertical position above the center of the well. The obvious disadvantage with the prior art systems is that there is a significant manual involvement in attaching the pipe elevators to the tubular and moving the pipe from the drill rack to the rotary table at the well head. This manual transfer operation in the vicinity of workers is potentially dangerous and has caused numerous injuries in drilling operations. Further, the hoisting system may allow the tubular to come into contact with the catwalk or other portions of the rig as the tubular is transferred from the pipe rack to the drill floor. This can damage the tubular and may affect the integrity of the connections between successive tubulars in the well.

One method of transferring pipe from the rack to the well platform comprises tying one end of a line on the rig around a selected pipe on the pipe rack. The pipe is thereafter lifted up onto the platform and the lower end thereof is placed into the mousehole. The mousehole is simply an upright, elongate cylindrical container adjacent to the rotary table which supports the pipe temporarily. When it is necessary to add the pipe to the drill string, slips are secured about the drill string on the rotary table thereby supporting the same in the well bore. The pipe is disconnected from the traveling equipment, and the elevators, or the kelly, are connected to the pipe in the mousehole. Next, the traveling block is raised by positioning the pipe over the drill string. Tongs are used to secure the pipe to the upper end of the drill string. The drill pipe elevators suspend the drill pipe from a collar, which is formed around one end of the pipe and does not clamp the pipe, thereby permitting rotational pipe movement in order to threadably engage the same to the drill string.

A prior art technique for moving joints of casing from racks adjacent to the drilling rig comprises tying a line from the rig onto one end of a selected casing joint on the rack. The line is raised by lifting the casing joint up a ramp leading to the rig platform. As the rope lifts the casing from the rack, the lower end of the casing swings across the platform in a dangerous manner. The danger increases when a floating system is used in connection with drilling. Because the rope is tied around the casing at one end thereof, the casing does not hang vertically, but rather tilts somewhat. A man working on a platform elevated above the rig floor must hold the top of the casing and straighten it out while the casing is threaded into the casing string which is suspended in the well bore by slips positioned on the rotary table.

It is desirable to be able to grip casing or pipe positioned on a rack adjacent a drilling well, move the same into vertical orientation over the well bore, and thereafter lower the same onto the string suspended in the well bore.

In the past, various devices have been created which mechanically move a pipe from a horizontal orientation to a vertical orientation such that the vertically oriented pipe can be installed into the well bore. Typically, these devices have utilized several interconnected arms that are associated with a main rotating structural member. In order to move the pipe, a succession of individual movements of the levers, arms, and other components of the main rotating structural member must be performed in a coordinated manner in order to achieve the desired result. Typically, a wide variety of hydraulic actuators are connected to each of the components so as to carry out the prescribed movement. A complex control mechanism is connected to each of these actuators so as to achieve the desired movement. Advanced programming is required of the controller in order to properly coordinate the movements in order to achieve this desired result.

Unfortunately, with such systems, the hydraulic actuators, along with other components, can become worn with time. Furthermore, the hydraulic integrity of each of the actuators can become compromised over time. As such, small variations in each of the actuators can occur. These variations, as they occur, can make the complex mechanism rather inaccurate. The failure of one hydraulic component can exacerbate the problems associated with the alignment of the pipe in a vertical orientation. Adjustments of the programming are often necessary so to as to continue to achieve the desired results. Fundamentally, the more hydraulic actuators that are incorporated into such a system, the more likely it is to have errors, inaccuracies, and deviations in the desired delivery profile of the tubular. Typically, very experienced and knowledgeable operators are required so as to carry out this pipe movement operation. This adds significantly to the cost associated with pipe delivery.

In the past, pipe handling apparatus have not been used for the installation of casing. The problem associated with casing is that the threads of the casing are formed on an inner wall and on an outer wall at the ends of each of the casing sections. Whenever these threads are formed, the relatively thin wall thickness of the casing is further minimized. Additionally, great precision is required so as to properly thread the threads of one casing section within the threads of an adjacent casing section. The amount of accuracy required for the delivery of the casing by a pipe handling apparatus, in the past, has not been sufficient so as to achieve the desired degree of accuracy for the installation of the casing sections in their threaded connection. The improper installation of one casing section upon another casing section can potentially damage the threads associated with such casing sections. Additionally, in the past, the pipe handling apparatus could potentially damage the thin-walled casing sections during the delivery. As such, a need has developed to adapt a pipe handling apparatus so as to achieve the desired amount of accuracy for the installation of casing sections.

To address these problems and needs, U.S. application Ser. No. 11/923,451, filed on Oct. 24, 2007, by the present inventor discloses a pipe handling apparatus that has a boom pivotally movable between a first position and a second position, a riser assembly pivotally connected to the boom, an arm pivotally connected at one end to the first portion of the riser assembly and extending outwardly therefrom, a gripper affixed to an opposite end of the arm suitable for gripping a diameter of the pipe, a link pivotally connected to the riser assembly and pivotable so as to move relative to the movement of the boom between the first and second positions, and a brace having one end pivotally connected to the boom and an opposite end pivotally connected to the arm between the ends of the arm. The riser assembly has a first portion extending outwardly at an obtuse angle with respect to the second portion.

The pipe handling apparatus delivers a pipe to a well head in the second position. Pipes can be of extraordinary lengths and weights. Once the pipe is connected to other pipe in the well head, the grippers of the pipe handling apparatus release the pipe. A problem associated with the pipe handling apparatus is that once the grippers release the pipe at the well head, the apparatus springs upwardly and away from the well head. This is due to the release of the massive weight of the pipe. This springback causes unnecessary stresses on the pipe handling apparatus and can cause structural damage to the apparatus, such as cracking and bending. Upon the release of the pipe, the grippers and the arm of the pipe handling apparatus can have a springback of up to ten inches. This creates large spikes in the stresses on the boom of the pipe handling apparatus. In addition to creating unnecessary stresses on the boom, the springback can cause the pipe to be deflected at the well head. Moreover, the accuracy of the pipe handling apparatus decreases when this springback occurs. Thus, there is a need to avoid the springback and minimize the deflection of the apparatus that is caused by the release of the pipe at the well head. These problems also occur when casing is delivered to the well head by the pipe handling apparatus.

In the past, various patents and patent applications relate to apparatus and methods for stiffening a pipe handling apparatus. For example, U.S. patent application Ser. No. 12/013,979, filed on Jan. 14, 2008, by the present applicant, discloses a pre-loading system for a pipe handling apparatus in which a boom is pivotally mounted at one end to a skid and in which an arm is interconnected to an opposite end of the boom. The pre-loading system has a tensioning system with one end affixed to the arm and an opposite end fixedly mounted so as to apply tension to the arm when the arm has a load applied to an end of the arm opposite the boom. The tensioning system includes a first cable assembly having one end interconnected to the arm and an opposite end fixedly mounted, and a second cable assembly interconnected to the arm and having an opposite end fixedly mounted. The first and second cable assemblies extend from opposite sides of the arm.

U.S. Pat. No. 3,177,944, issued on Apr. 13, 1965, to R. N. Knights, describes a racking mechanism for earth boring equipment that provides for horizontal storage of pipe lengths on one side of and clear of the derrick. This is achieved by means of a transport arm which is pivoted toward the base of the derrick for swing movement in a vertical plane. The outer end of the arm works between a substantially vertical position in which it can accept a pipe length from, or deliver a pipe length to, a station in the derrick, and a substantially horizontal portion in which the arm can deliver a pipe length to, or accept a pipe length from, a station associated with storage means on one side of the derrick.

U.S. Pat. No. 3,464,507, issued on Sep. 2, 1969, to E. L. Alexander et al., teaches a portable rotary pipe handling system. This system includes a mast pivotally mounted and movable between a reclining transport position to a desired position at the site drilling operations which may be at any angle up to vertical. The mast has guides for a traveling mechanism that includes a block movable up and down the mast through operation of cables reeved from the traveling block over crown block pulleys into a drawwork. A power drill drive is carried by the traveling block. An elevator for drill pipe is carried by an arm swingably mounted relative to the power unit. Power tongs, slips, and slip bushings are supported adjacent the lower end of the mast and adapted to have a drill pipe extend therethrough from a drive bushing connected to a power drive whereby the drill pipe is extended in the direction of the hole to be drilled.

U.S. Pat. No. 3,633,771, issued on Jan. 11, 1972, to Woolslayer et al., discloses an apparatus for moving drill pipe into and out of an oil well derrick. A stand of pipe is gripped by a strongback which is pivotally mounted to one end of a boom. The boom swings the strongback over the rotary table thereby vertically aligning the pipe stand with the drill string. When both adding pipe to and removing pipe from the drill string, all vertical movement of the pipe is accomplished by the elevator suspended from the traveling block.

U.S. Pat. No. 3,860,122, issued on Jan. 14, 1975, to L. C. Cemosek, describes an apparatus for transferring a tubular member, such as a pipe, from a storage area to an oil well drilling platform. The positioning apparatus includes a pipe positioner mounted on a platform for moving the pipe to a release position whereby the pipe can be released to be lowered to a submerged position. A load means is operably attached or associated with the platform and positioning means in order to move the pipe in a stored position to a transfer position in which the pipe is transferred to the positioner. The positioner includes a tower having a pipe track pivotally mounted thereon with pipe clamp assemblies which are adapted to receive a pipe length. The pipe track is pivotally movable by a hydraulic power mechanism or gear mechanism between a transfer position in which pipe is moved into the clamp assemblies and the release position in which the pipe is released for movement to a submerged position.

U.S. Pat. No. 3,986,619, issued on Oct. 19, 1976, to Woolslayer et al., shows a pipe handling apparatus for an oil well drilling derrick. In this apparatus, the inner end of the boom is pivotally supported on a horizontal axis in front of a well. A clamping means is pivotally connected to the outer end of the boom on an axis parallel to the horizontal axis at one end. The clamping means allows the free end of the drill pipe to swing across the boom as the outer end of the boom is raised or lowered. A line is connected at one end with the traveling block that raises and lowers the elevators and at the other end to the boom so as to pass around sheaves.

U.S. Pat. No. 4,172,684, issued on Oct. 30, 1979, to C. Jenkins, shows a floor-level pipe handling apparatus which is mounted on the floor of an oil well derrick. The apparatus includes a support that is rockable on an axis perpendicular to the centerline of a well being drilled. One end of an arm is pivotally mounted on the support on an axis transverse to the centerline of the well. The opposite end of the arm carries a pair of shoes having laterally opening pipe-receiving seats facing away from the arm. The free end of the arm can be swung toward and away from the well centerline and the arm support can be rocked to swing the arm laterally.

U.S. Pat. No. 4,403,666, issued on Sep. 13, 1983, to C. A. Willis, shows self-centering tongs and a transfer arm for a drilling apparatus. The clamps of the transfer arm are resiliently mounted to the transfer arm so as to provide limited axial movement of the clamps and thereby of a clamped down hole tubular. A pair of automatic, self-centering, hydraulic tongs are provided for making up and breaking out threaded connections of tubulars.

U.S. Pat. No. 4,407,629, issued on Oct. 4, 1983, to C. A. Willis, teaches a lifting apparatus for downhole tubulars. This lifting apparatus includes two rotatably mounted clamps which are rotatable between a side loading-position so as to facilitate the loading and unloading in the horizontal position, and a central position, in which a clamped tubular is aligned with the drilling axis when the boom is in the vertical position. An automatic hydraulic sequencing circuit is provided to automatically rotate the clamps into the side-loading position whenever the boom is pivoted with a down-hole tubular positioned in the clamp. In this position, the clamped tubular is aligned with a safety plate mounted on the boom to prevent a clamped tubular from slipping from the clamps.

U.S. Pat. No. 4,492,501, issued on Jan. 8, 1985, to K. M. Haney, provides a platform positioning system for a drilling operation which includes a support structure and a transfer arm pivotally connected to the support structure to rotate about a first axis. This platform positioning system includes a platform which is pivotally connected to the support structure to rotate about a second axis, and rod which is mounted between the transfer arm and the platform. The position of the arm and platform axes and the length of the rod are selected such that the transfer arm automatically and progressively raises the platform to the raised position by means of the rod as the transfer arm moves to the raised position. The transfer arm automatically and progressively lowers the platform to the lowered position by means of the rod as the transfer arm moves to the lowered position.

U.S. Pat. No. 4,595,066, issued on Jun. 17, 1986, to Nelmark et al., provides an apparatus for handling drill pipes and used in association with blast holes. This system allows a drill pipe to be more easily connected and disconnected to a drill string in a hole being drilled at an angle. A receptacle is formed at the lower end of the carrier that has hydraulically-operated doors secured by a hydraulically-operated lock. A gate near the upper end is pneumatically operated in response to the hydraulic operation of the receptacle lock.

U.S. Pat. No. 4,822,230, issued on Apr. 18, 1989, to P. Slettedal, teaches a pipe handling apparatus which is adapted for automated drilling operations. Drill pipes are manipulated between substantially horizontal and vertical positions. The apparatus is used with a top mounted drilling device which is rotatable about a substantially horizontal axis. The apparatus utilizes a strongback provided with clamps to hold and manipulate pipes. The strongback is rotatably connected to the same axis as the drilling device. The strongback moves up or down with the drilling device. A brace unit is attached to the strongback to be rotatable about a second axis.

U.S. Pat. No. 4,834,604, issued on May 30, 1989, to Brittain et al., provides a pipe moving apparatus and method for moving casing or pipe from a horizontal position adjacent a well to a vertical position over the well bore. The machine includes a boom movable between a lowered position and a raised position by a hydraulic ram. A strongback grips the pipe and holds the same until the pipe is vertically positioned. Thereafter, a hydraulic ram on the strongback is actuated thereby lowering the pipe or casing onto the string suspended in the well bore and the additional pipe or casing joint is threaded thereto.

U.S. Pat. No. 4,708,581 issued on Nov. 24, 1987, H. L. Adair, provides a method for positioning a transfer arm for the movement of drill pipe. A drilling mast and a transfer arm are mounted at a first axis adjacent the mast to move between a lowered position near ground level and an upper position aligned with the mast. A reaction point anchor is fixed with respect to the drilling mast and spaced from the first axis. A fixed length link is pivotably mounted to the transfer arm at a second axis, spaced from the first axis, and a first single stage cylinder is pivotably mounted at one end to the distal end of the link and at the other end to the transfer arm. A second single stage hydraulic cylinder is pivotably mounted at one end to the distal end of the link and at the other end to the reaction point.

U.S. Pat. No. 4,759,414, issued on Jul. 26, 1988, to C. A. Willis, provides a drilling machine which includes a drilling superstructure skid which defines two spaced-apart parallel skid runners and a platform. The platform supports a drawworks mounted on a drawworks skid and a pipe boom is mounted on a pipe boom skid sized to fit between the skid runners of the drilling substructure skid. The drilling substructure skid supports four legs which, in turn, support a drilling platform on which is mounted a lower mast section. The pipe boom skid mounts a pipe boom as well as a boom linkage, a motor, and a hydraulic pump adapted to power the pipe boom linkage. Mechanical position locks hold the upper skid in relative position over the lower skid.

U.S. Pat. No. 5,458,454, issued on Oct. 17, 1995, to R. S. Sorokan, describes a pipe handling method which is used to move tubulars used from a horizontal position on a pipe rack adjacent the well bore to a vertical position over the wall center. This method utilizes bicep and forearm assemblies and a gripper head for attachment to the tubular. The path of the tubular being moved is close to the conventional path of the tubular utilizing known cable transfer techniques so as to allow access to the drill floor through the V-door of the drill rig. U.S. Pat. No. 6,220,807 describes apparatus for carrying out the method of U.S. Pat. No. 5,458,454.

U.S. Pat. No. 6,609,573, issued on Aug. 26, 2003, to H. W. F. Day, teaches a pipe handling system for an offshore structure. The pipe handling system transfers the pipes from a horizontal pipe rack adjacent to the drill floor to a vertical orientation in a set-back area of the drill floor where the drill string is made up for lowering downhole. The cantilevered drill floor is utilized with the pipe handling system so as to save platform space.

U.S. Pat. No. 6,705,414, issued on Mar. 16, 2004, to Simpson et al., describes a tubular transfer system for moving pipe between a substantial horizontal position on the catwalk and a substantially vertical position at the rig floor entry. Bundles of individual tubulars are moved to a process area where a stand make-up/break-out machine makes up the tubular stands. The bucking machine aligns and stabs the connections and makes up the connection to the correct torque. The tubular stand is then transferred from the machine to a stand storage area. A trolley is moved into position over the pick-up area to retrieve the stands. The stands are clamped to the trolley and the trolley is moved from a substantially horizontal position to a substantially vertical position at the rig floor entry. A vertical pipe-racking machine transfers the stands to the traveling equipment. The traveling equipment makes up the stand connection and the stand is run into the hole.

U.S. Pat. No. 6,779,614, issued on Aug. 24, 2004, to M. S. Oser, shows another system and method for transferring pipe. A pipe shuttle is used for moving a pipe joint into a first position and then lifting upwardly toward an upper second position.

It is an object of the present invention to provide an apparatus and method for enhancing the structural integrity of a main rotating structural member of a pipe handling apparatus when delivering a pipe to a well head.

It is another object of the present invention to provide an apparatus and method for stiffening a main rotating structural member of a pipe handling apparatus that minimizes the amount of calibration required in order to move the pipe from a horizontal orientation to a vertical orientation.

It is another object of the present invention to provide an apparatus and method for stiffening a main rotating structural member of a pipe handling apparatus that operates within a single degree of freedom so as to move the pipe without adjustments between the components.

It is still another object of the present invention to provide an apparatus and method for stiffening the main rotating structural member of a pipe handling apparatus that minimizes the number of components added to the apparatus so as to accomplish such stiffening.

It is another object of the present invention to provide an apparatus and method for stiffening a pipe handling apparatus that prevents damage of the components of the pipe handling apparatus.

It is another object of the present invention to provide an apparatus and method for stiffening a pipe handling apparatus that prevents sideways or transverse motions of the pipe handling apparatus.

It is another object of the present invention to provide an apparatus and method for stiffening that achieves greater precision in the delivery and insulation of pipe and/or casing.

It is another object of the present invention to provide an apparatus and method for stiffening a pipe handling apparatus that increases the structural stiffness of the apparatus.

It is another object of the present invention to provide an apparatus and method for stiffening pipe that serves to minimize the weight and size of the components of the main rotating structural member of a pipe handling apparatus.

These and other objects and advantages of the present invention will become apparent from a reading of the attached specification and appended claims.

BRIEF SUMMARY OF THE INVENTION

The present invention is a pipe handling apparatus that has a skid, and a main rotating structural member rotating about a pivot axis relative to a skid. The main rotating structural member moves between a first position and a second position. A tensioning apparatus is affixed adjacent to an upper end of the main rotating structural member. The tensioning apparatus applies a tension to the main rotating structural member when the main rotating structural member is in the second position.

In the preferred embodiment, the tensioning apparatus comprises a first cable having an end adjacent to a top of the main rotating structural member, and a second cable having an end adjacent to the top of the main rotating structural member. The first and second cables extend angularly outwardly from a front of said main rotating structural member. The first cable has an opposite end attached to a fixed surface. The second cable has an opposite end attached to the fixed surface. The first cable extends angularly outwardly from a side of the main rotating structural member. The second cable extends angularly outwardly from an opposite side of the main rotating structural member. The first and second cables tension the main rotating structural member in the second position. The first and second cables are slack when the main rotating structural member is in the first position.

In a first alternative embodiment, the tensioning apparatus comprises a first cable having an end attached adjacent a top of the main rotating structural member, and a second cable having an end attached adjacent the top of the main rotating structural member. The first cable has an opposite end attached to a fixed surface. The second cable has an opposite end attached to the fixed surface. The first and second cables extend angularly outwardly from a front of the main rotating structural member. The first and second cables are attached to the fixed surface in alignment with the main rotating structural member. The first cable is generally parallel to the side of the main rotating structural member. The second cable is generally parallel to the opposite side of the main rotating structural member.

In a second alternative embodiment, the tensioning apparatus comprises a first cable having an end adjacent a top of the main rotating structural member, and a second cable having an end attached adjacent the top of the main rotating structural member. The first cable has an opposite end attached to a fixed surface. The second cable has an opposite end attached to the fixed surface. The first and second cables are attached to the fixed surface along the pivot axis of the main rotating structural member. The first cable extends angularly outwardly from a side of the main rotating structural member. The second cable extends angularly outwardly from an opposite side of the main rotating structural member. The first and second cables tension the main rotating structural member in the second position. The first and second cables are slack when the main rotating structural member is in the first position.

In a third alternative embodiment, the tensioning apparatus comprises a first cable having an end adjacent a top of the main rotating structural member, and a second cable having an end adjacent the top of the main rotating structural member. The first cable has an opposite end attached in a location near a bottom of the main rotating structural member. The second cable has an opposite end attached in a location near the bottom of the main rotating structural member. The second cable is attached to the side of the main rotating structural member opposite the first cable. The first and second cables tension the main rotating structural member in the second position. The first and second cables are slack when the main rotating structural member is in the first position.

The present invention is a method of tensioning a main rotating structural member of a pipe handling apparatus where the main rotating structural member rotates about a pivot axis from a first position to a second position. The method includes the steps of attaching an end of a first cable adjacent a top of the main rotating structural member, attaching an end of a second cable adjacent the top of the main rotating structural member, and tensioning the main rotating structural member in the second position with the first and second cables.

The preferred method further includes the steps of attaching an opposite end of the first cable to the fixed surface, attaching an opposite end of the second cable to the fixed surface, extending the first cable angularly outwardly from a side of the main rotating structural member, and extending the second cable angularly outwardly from an opposite side of the main rotating structural member.

In a first alternative embodiment, the method further includes the step of attaching an opposite end of the first cable to a fixed surface, attaching an opposite end of the second cable to the fixed surface, and extending the first and second cables in alignment with the main rotating structural member.

In a second alternative embodiment, the method further includes the steps of attaching an opposite end of the first cable to a fixed surface, attaching an opposite end of the second cable to a fixed surface, extending the first cable angularly outwardly from a side of the main rotating structural member, extending the second cable angularly outwardly from an opposite side of the main rotating structural member, and attaching the first and second cables along the pivot axis of the main rotating structural member.

BRIEF DESCRIPTION OF THE SEVERAL VIEWS OF THE DRAWINGS

FIG. **1** shows a side elevational view of the preferred embodiment of the apparatus of the present invention, with the pipe handling apparatus in a first position.

FIG. **2** shows a side elevational view of the preferred embodiment of the apparatus of the present invention, with the pipe handling apparatus in a second position.

FIG. **3** shows a front elevational view of the preferred embodiment of the apparatus of the present invention.

FIG. **4** shows a side elevational view of the first alternative embodiment of the apparatus of the present invention, with the pipe handling apparatus in a first position.

FIG. **5** shows a side elevational view of the first alternative embodiment of the apparatus of the present invention, with the pipe handling apparatus in the second position.

FIG. **6** shows a front elevational view of the first alternative embodiment of the present invention.

FIG. **7** shows a side perspective view of a second alternative embodiment of the apparatus of the present invention, with the pipe handling apparatus in the first position.

FIG. **8** shows a side elevational view of the second alternative embodiment of the present invention, with the pipe handling apparatus in the second position.

FIG. **9** shows a front elevational view of the second alternative embodiment of the present invention.

FIG. **10** shows a side elevational view of a third alternative embodiment of the present invention, with the pipe handling apparatus in the first position.

FIG. **11** shows a side elevational view of the third alternative embodiment of the present invention, with the pipe handling apparatus in the second position.

FIG. **12** shows a front elevational view of the third alternative embodiment of the present invention.

DETAILED DESCRIPTION OF THE INVENTION

Referring to FIG. **1**, there is shown a side elevational view of the preferred embodiment of the pipe handling apparatus **12** of the present invention. The pipe handling apparatus **12** is mounted on a skid **16** that is supported upon the bed **15** of a vehicle, such as a truck. The pipe handling apparatus **12** in particular includes a main rotating structural member **14** that is pivotally movable between a first position and a second position. A lever assembly **10** is pivotally connected to the main rotating structural member **14**. An arm **20** is pivotally connected to an end of the lever assembly **10** opposite the main rotating structural member **16**. A gripping assembly **11** is fixedly connected to an end of the arm **20** opposite the lever assembly **10**. The gripping assembly **11** includes a body **17** and grippers **13**.

In the present invention, the main rotating structural member **14** is a structural framework of struts, cross members and beams. In particular, in the present invention, the main rotating structural member **14** is configured so as to have an open interior such that the pipe will be able to be lifted in a manner so as to pass through the interior of the main rotating structural member **14**. As such, the top **26** of the main rotating structural member **14** should be strongly reinforced so as to provide the necessary structural integrity to the main rotating structural member **14**. A lug extends outwardly from one side of the main rotating structural member **14**. This lug is suitable for pivotable connection to the lever assembly **10**. The main rotating structural member **14** is pivotally connected at the bottom **28** to a location on the skid **16**. The pivotable connection at bottom **28** of the main rotating structural member **14** is located in offset relationship and above the pivotable connection of the link with the skid **16**. A small frame member extends outwardly from the side of the main rotating structural member **14** opposite the link. This frame assembly has a pivotable connection with the brace. This unique arrangement of the lever assembly **10** facilitates the ability of the present invention to carry out the movement of the pipe **82** between the horizontal orientation and the vertical orientation.

The arm **20** has an end pivotally connected to the lever assembly **10**. The opposite end of the arm **20** is connected to the gripping assembly **11**. In particular, a pair of pin connections engages a surface of the body **17** of the gripping assembly **11** so as to fixedly position the gripping assembly **11** with respect to the end of the arm **20**. The pin connections can be in the nature of bolts, or other fasteners, so as to strongly connect the body **17** of the gripping assembly **11** with the arm **20**. The bolts associated with pin connections can be removed such that other gripping assemblies **11** can be affixed to the end of the arm **20**. As such, the pipe handling apparatus **12** of the present invention can be adaptable to various sizes of pipe **82** and various heights of drilling rigs **22**.

The gripping assembly **11** includes the body **17** with the grippers **13** translatable along the length of the body **17**. This vertical translation of the grippers **13** allows the pipe **82** to be properly moved upwardly and downwardly once the vertical orientation of the pipe **82** is achieved. The grippers **13** are in the nature of conventional grippers which can open and close so as to engage the outer diameter of the pipe **82**, as desired.

The link **33** is an elongate member that extends from the pivotable connection on the skid **16** to the pivotable connection of the lever assembly **10**. The link is non-extensible and extends generally adjacent to the opposite side from the main rotating structural member **14** from that of the arm **20**. The link **33** will generally move relative to the movement of the main rotating structural member **14**. The brace **36** is pivotally connected to the small framework associated with main rotating structural member **14** and also pivotally connected at a location along the arm **20** between the ends thereof. The brace **36** provides structural support to the arm **20** and also facilitates the desired movement of the arm **20** during the movement of the pipe **82** between the horizontal orientation and the vertical orientation.

Actuators **47**, **49** have an end connected to the skid **16** and an opposite end connected to the main rotating structural member **14** in a location above the end. When the actuators **47**, **49** are activated, they will pivot the main rotating structural member **14** upwardly from the horizontal orientation ultimately to a position beyond vertical so as to cause the pipe **82** to achieve a vertical orientation. Within the concept of the present invention, a single hydraulic actuator can be utilized instead of the pair of hydraulic actuators.

The drilling rig **22** is illustrated as having drill pipe **24** extending upwardly so as to have an end above the drill floor. When the pipe **82** is in its vertical orientation, the translatable movement of the grippers **13** can be utilized so as to cause the end of the pipe **82** to engage with the box of the drill pipe **24**.

In the present invention, the coordinated movement of each of the non-extensible members of the pipe handling apparatus **12** is achieved with proper sizing and angular relationships. In essence, the present invention provides a four-bar link between the various components. As a result, the movement of the drill pipe **82** between a horizontal orientation and a vertical orientation can be achieved purely through the mechanics associated with the various components. Only a single hydraulic actuator may be necessary so as to achieve this desired movement. There does not need to be coordinated movement of hydraulic actuators **47**, **49**. The hydraulic actuators **47**, **49** are only used for the pivoting of the main rotating structural member **14**. Because the skid **16** is located on the bed of a vehicle **15**, the vehicle **15** can be maneuvered into place so as to properly align with the centerline of the drill pipe **24** of the drilling rig **22**. Once the proper alignment is achieved by the vehicle **15**, the apparatus **12** can be operated so as to effectively move the drill pipe **82** to its desired position. The gripping assembly **11** of the present invention allows the drill pipe **82** to be moved upwardly and downwardly for the proper stabbing of the drill pipe **24**. The present invention is adaptable to various links of pipe **82**.

Various types of gripping assemblies **11** can be installed on the end of the arm **20** so as to properly accommodate longer lengths of pipe **82**. As such, instead of the complex control mechanisms that are required with prior art systems, the present invention achieves its results by simple maneuvering of the vehicle **15**, along with operation of the hydraulic cylinders. All other linkages and movement of the pipe **82** are achieved purely because of the mechanical connections between the various components. As such, the present invention assures a precise, self-centering of the pipe **82** with respect to the desired connecting pipe. This is accomplished with only a single degree of freedom in the pipe handling system.

Referring still to FIG. **1**, the pipe handling apparatus **12** is in a first position. The gripper **17** grips a tubular **82** in a horizontal orientation. The tubular **82** can be any tubular structure used in drilling, such as pipe or casing. The tensioning apparatus **37** is attached to the main rotating structural member **14**. The tensioning apparatus **37** has a first cable **38**. The end **40** of the first cable **38** is attached adjacent a top **26** of the main rotating structural member **14**. An opposite end **42** of the first cable **38** is attached to a fixed surface. In FIG. **1**, the fixed surface is the skid **16**. However, the present invention contemplates that the fixed surface could be the ground **80** or any other structure in a fixed position relative to the main rotating structural member **14**. When the pipe handling apparatus **12** is in the first position, the tensioning apparatus **37** is slack. The first cable **38** can be seen as slack in FIG. **1**. The pipe handling apparatus **12** is typically placed next to a drilling rig **22**. The drilling rig **22** is placed over the drill pipe **24**. The pipe handling apparatus **12** is typically located at a height less than the height of the drill pipe **24**.

Referring to FIG. **2**, there is shown a side elevational view of the preferred embodiment of the tensioning apparatus **37**, with the pipe handling apparatus **12** in a second position. In the second position, the main rotating structural member **14** of pipe handling apparatus **12** is in an approximately vertical orientation. The arm **20** of the pipe handling apparatus **12** extends outwardly from the lever assembly **10**, pivotally attached to the main rotating structural member **14** so that the gripping assembly **11** holds the tubular **82** in a vertical orientation above the drill pipe **24**. The first cable **38** can be seen as having end **40** attached adjacent the top **26** of the main rotating structural member **14** and opposite end **42** attached to the fixed surface, the skid **16**. The first cable **38** and a second cable (not shown) extend angularly outwardly from a front **30** of the main rotating structural member **14**. Having the first cable **38** and second cable (not shown) extending outwardly from the front **30** of the main rotating structural member **14** prevents forward and backward movement of the main rotating structural member **14** while delivering the tubular **82** to the drill pipe **24**. It can be seen in FIG. **2** that the first cable **38** and second cable (not shown) tension the main rotating structural member **14** when the main rotating structural member **14** is in the second position. The tension cable **38** gives the main rotating structural member **14** structural rigidity against forward and backward movement. The tension cable **38** provides structural integrity to the main rotating structural member **14** in the second position. This allows the main rotating structural member **14** to be formed of a lighter weight and of smaller and lighter components.

Referring to FIG. **3**, there is shown a front elevational view of the preferred embodiment of the tensioning apparatus **37** of the present invention, taken along sight line **3**-**3** of FIG. **2**. The first cable **38** of the apparatus **12** has end **40** connected to a top **26** of the main rotating structural member **14** and an opposite end **42** attached to the fixed surface of the skid **16**. The second cable **44** of the apparatus **12** has an end **46** connected to a top **26** of the main rotating structural member **14** and an opposite end **48** connected to the fixed surface of the skid **16**. The main rotating structural member **14** in FIG. **3** is in the second position, which means that the main rotating structural member **14** is in a substantially vertical orientation. The arm **20** of the pipe handling apparatus **12** can be seen as pivotally interconnected to the main rotating structural member **14**. The main rotating structural member **14** is pivotally connected to the skid **16** by the pivot axis **18**. The first cable **38** extends angularly outwardly from a side **32** of the main rotating structural member **14**. The second cable **44** extends angularly outwardly from an opposite side **34** of the main rotating structural member **14**. The first and second cables **38** and **44** tension the main rotating structural member **14** when the main rotating structural member **14** is in the vertical orientation of the second position. The first and second cables **38** and **44** prevent sideways or transverse motion of the main rotating structural member **14** due to wind gusts and other sideways forces imparted upon the main rotating structural member **14**. Because the first and second cables **38** and **44** angle outwardly from the main rotating structural member **14**, they prevent such sideways motion of the main rotating structural member **14**.

Another advantage of having the first and second cables **38** and **44** angle outwardly from the front **30** of the main rotating structural member **14** is the cables **38** and **44** tension the main rotating structural member **14** and help prevent springback of the main rotating structural member **14** that can occur when the grippers **13** of the pipe handling apparatus **12** release the tubular **82** at the drill pipe **24**.

Referring to FIG. **4**, there is shown a side elevational view of the first alternative embodiment of the tensioning apparatus **50** of the present invention, with the pipe handling apparatus **12** in a first position. The first cable **52** of the tensioning apparatus **50** can be seen as slack when the pipe handling apparatus **12** is in the first position. The end **54** of the first cable **52** is attached to the top **26** of the main rotating structural member **14**. The opposite end **56** of the first cable **52** is attached to a fixed surface, such as the skid **16**, in alignment with the pivot axis **18** of the main rotating structural member **14**.

Referring to FIG. **5**, there is shown a side elevational view of the first alternative embodiment of the apparatus **50** of the present invention, with the pipe handling apparatus **12** in the second position. In the second position, the main rotating structural member **14** of the pipe handling apparatus **12** is in a vertical orientation. The arm **20** of the pipe handling apparatus **12** extends outwardly from the main rotating structural member **14** so that the gripping assembly **11** holds the tubular **82** in a vertical orientation above the drill pipe **24**. When the pipe handling apparatus **12** is in the second position, the first cable **52** tensions the main rotating structural member **14**. Because the cable **52** is aligned with the pivot axis **18** of the main rotating structural member **14**, the cable **52** helps prevent forward and backward movement of the main rotating structural member **14**. The tensioned cable **52** adds rigidity to the main rotating structural member **14** so as to help prevent sideways or transverse movement of the main rotating structural member **14** while delivering the tubular **82** to the drill pipe **24**.

Referring to FIG. **6**, there is shown a front elevational view of the first alternative embodiment of the apparatus **50** of the present invention, taken along line **6-6** of FIG. **5**. The first cable **52** of the apparatus **50** has an end **54** attached to a top **26** of the main rotating structural member **14** and an opposite end **56** attached to the skid **16**, which is a fixed surface. The second cable **58** of the apparatus **50** has an end **60** attached to the top **26** of the main rotating structural member **14** and an opposite end **62** attached to the skid **16**. End **54** of the first cable **52** is attached to the side **32** of the main rotating structural member **14**. End **60** of the second cable **58** is attached to an opposite side **34** of the main rotating structural member **14**. The first cable **52** extends angularly outwardly from the side **32** of the main rotating structural member **14**. The second cable **58** extends angularly outwardly from the opposite side **34** of the main rotating structural member **14**. The first and second cables **52** and **58** are shown in FIG. **6** as tensioning the main rotating structural member **14**. The outwardly-angled nature of the first and second cables **52** and **58** tensions the main rotating structural member **14** so as to prevent sideways movement of the main rotating structural member **14** due to wind gusts and other sideways forces imparted upon the main rotating structural member **14**. Opposite ends **56** and **62** of the first and second cables **52** and **58**, respectively, are located at a distance from the sides **32** and **34** of the main rotating structural member **14** further than the distance of the ends **54** and **60** of the cables **52** and **58**, respectively. The location of the ends **56** and **62** of the first and second cables **52** and **58**, respectively, along the pivot axis **18** of the main rotating structural member **14** helps prevent springback of the main rotating structural member **14** when the pipe handling apparatus **12** releases the tubular **82** at the drill pipe **24**.

Referring to FIG. **7**, there is shown a side elevational view of a second alternative embodiment of the tensioning apparatus **64** of the present invention. The pipe handling apparatus **12** is shown in the first position. The first cable **66** of the tensioning apparatus **64** is shown as slack when the pipe handling apparatus **12** is in the first position. The end **68** of the first cable **66** is attached to the top **26** of the main rotating structural member **14**. The opposite end **70** of the first cable **66** is attached to a fixed surface. The fixed surface in FIG. **7** is the ground **80**. The fixed surface can also be any other surface that is stationary, such as the skid **16**. It is important that the first cable **66** of the tensioning apparatus **64** is slack when the pipe handling apparatus **12** is in the first position so that the pipe handling apparatus **12** can easily move from a first position to a second position. End **70** of the first cable **66** is connected to the ground **80** in front of the pivot axis **18** of the main rotating structural member **14**.

Referring to FIG. **8**, there is shown a side elevational view of the second alternative embodiment of the tensioning apparatus **64** of the present invention, with the pipe handling apparatus **12** in the second position. In the second position, the main rotating structural member **14** of the pipe handling apparatus **12** is in a substantially vertical orientation. The arm **20** of the pipe handling apparatus **12** extends angularly outwardly from the main rotating structural member **14** so that the gripping assembly **11** holds the tubular **82** in a vertical orientation over the drill pipe **24**. The first cable **66** of the tensioning apparatus **64** can be seen as angularly outwardly from the front **30** of the main rotating structural member **14**. Because the first cable **66** angles outwardly, the first cable **66** adds structural rigidity to the main rotating structural member **14** so as to prevent backward and forward movement of the main rotating structural member **14** when delivering the tubular **82** to the drill pipe **24**. Moreover, the first cable **66** helps prevent springback of the main rotating structural member **14** which sometimes occurs when the gripping assembly **11** of the pipe handling apparatus **12** releases the tubular **82** at the drill pipe **24**.

Referring to FIG. **9**, there is shown a front elevational view of the second alternative embodiment of the apparatus **12** of the present invention, taken along line **9-9** of FIG. **8**. The first cable **66** of the tensioning apparatus **64** has an end **68** attached to the top **26** of main rotating structural member **14** and an opposite end **70** attached to the ground **80** in front of the main rotating structural member **14** of the pipe handling apparatus **12**. The second cable **72** of the tensioning apparatus **64** has an end **74** attached to the top **26** of the main rotating structural member **14** and an opposite end **76** attached to the ground **80** in front of the skid **16** and the main rotating structural member **14** of the pipe handling apparatus **12**. The first and second cables **66** and **72** of the second alternative embodiment of the tensioning apparatus **64** do not angle outwardly from the main rotating structural member **14**. Instead, the first cable **66** is parallel to the side **32** of the main rotating structural member **14**. The second cable **72** is parallel to the opposite side **34** of the main rotating structural member **14**. Extending the first and second cables **66** and **72** parallel to the sides **32** and **34** of the main rotating structural member **14**, respectively, adds rigidity to the main rotating structural member **14** so as to help prevent sideways motion of the main rotating structural member **14** due to wind gusts and other transverse forces.

Referring to FIG. **10**, there is shown a side elevational view of a third alternative embodiment of the apparatus **84**, with the pipe handling apparatus **12** in the first position. In the third alternative embodiment, the first cable **86** of the tensioning apparatus **84** has an end **88** attached to the top **26** of the main rotating structural member **14** and an opposite end **90** attached to a bottom **28** of the main rotating structural member **14**. Thus, both ends **88** and **90** of the cable **86** are attached to the main rotating structural member **14**. That is, neither end **88** or **90** is attached to a fixed surface. Because neither end **88** or **90** is attached a fixed surface, the cable **86** is tensioned when the main rotating structural member **14** is in the first position. The tension of the first cable **86** adds rigidity to the main rotating structural member **14** when in the first position.

Referring to FIG. **11**, there is shown a side elevational view of the third alternative embodiment of the tensioning apparatus **84**, with the pipe handling apparatus **12** in the second position. In the second position, the main rotating structural member **14** of the pipe handling apparatus **12** is in a vertical orientation. The arm **20** extends outwardly from the main rotating structural member **14** so that the gripping assembly **11** of the pipe handling apparatus **12** holds tubular **82** in a vertical orientation above the drill pipe **24** of the drilling rig **22**. The first cable **86** is tensioned when the pipe handling apparatus **12** is in the second position. Thus, the first cable **86** tensions the main rotating structural member **14** continuously as the main rotating structural member moves between the first position and the second position.

Referring to FIG. **12**, there is shown a front elevational view of the third alternative embodiment of the tensioning apparatus **84** of the present invention, taken along line **12-12** of FIG. **11**. The first cable **86** of the apparatus **84** has an end **88** attached to a top **26** of the main rotating structural member **14** and an opposite end **90** attached to the bottom **28** of the main rotating structural member **14**. The second cable **92** has an end **94** attached to the top **26** of the main rotating structural member **14** and an opposite end **96** attached to the bottom **28** of the main rotating structural member **14**. The cables **86** and **92** continuously tension the main rotating structural member **14** as the main rotating structural member moves between the first position and the second position. Cable **86** is parallel to the side **32** of the main rotating structural member **14**. The cable **92** is parallel to the opposite side **34** of the main rotating structural member **14**. The tension of the cables **86** and **92** provides rigidity to the main rotating structural member **14** so as to help prevent sideways motions of the main rotating structural member **14** due to various forces imparted on the main rotating structural member when delivering tubulars to a well head.

The various embodiments discussed above all add structural rigidity to the main rotating structural member **14** of the pipe handling apparatus **12**. The preferred embodiments shown in FIGS. **1-3** add the most rigidity to the main rotating structural member **14** because the cables **38** and **44** extend angularly outwardly from the front **30** of the main rotating structural member **14** and from the sides **32** and **34** of the main rotating structural member **14**. The cables **52** and **58** of the first alternative embodiment **50** are aligned with the pivot axis **18** of the main rotating structural member **14**. The cables **52** and **58** do extend angularly outwardly from the sides **32** and **34** of the main rotating structural member **14**. Therefore, the cables **52** and **58** of the first alternative embodiment prevent sideways motions to a greater extent than they prevent forward and backward motions of the main rotating structural member **14**. The cables **52** and **58** add structural rigidity to the main rotating structural member **14** and are a viable alternative to the preferred embodiment in the event that the cables **52** and **58** cannot be extended in front of the main rotating structural member **14**. The cables **66** and **72** of the second alternative embodiment **64** extend angularly outwardly from the front **30** of the main rotating structural member **14**. The cables **66** and **72** are parallel to the sides **32** and **34** of the main rotating structural member **14**, respectively. Thus, the cables **66** and **72** of the second alternative embodiment prevent forward and backward movement of the main rotating structural member **14** to a greater extent than they prevent sideways movement of the main rotating structural member **14**. The orientation of the cables **66** and **72** in the second alternative embodiment **64** is an alternative to the preferred embodiment in the case that it is not practical to angle the cables **66** and **72** outwardly from the sides **32** and **34** of the main rotating structural member **14**. The cables **86** and **92** of the third alternative embodiment **84** are attached to the main rotating structural member **14**, but are not attached to a fixed surface. The cables **86** and **92** add rigidity to the main rotating structural member **14** so as to help prevent forward and backward and sideways movement of the main rotating structural member **14**. The third alternative embodiment **84** of cables **86** and **92** are a viable alternative to the preferred embodiment in the case that the cables **86** and **92** cannot be attached to a fixed surface.

The main rotating structural member **14** may be a boom. The main rotating structural member **14** rotates through delivery of the pipe **82** and achieves between 45°-90° of rotation.

The foregoing disclosure and description of the invention is illustrative and explanatory thereof. Various changes in the details of the illustrated construction and method can be made within the scope of the claims without departing from the true spirit of the invention. The present invention should only be limited by the following claims and their legal equivalents.

I claim:

1. A pipe handling apparatus comprising:

a skid;

a main rotating structural member pivoting about a pivot point relative to the skid, the main rotating structural member pivoting between a first position and a second position;

a lever pivotally connected to the main rotating structural member, the lever having a first end extending outwardly from a well side of the main rotating structural member, the lever having a second end extending outwardly from an opposite side of the main rotating structural member;

an arm pivotally connected to the first end of the lever;

a gripper assembly connected to an end of the arm opposite the lever for gripping a tubular therein; and,

a first tensioning member affixed adjacent to an upper end of the main rotating structural member and extending outward away from the main rotating structural member, the first tensioning member applying no tension to the main rotating structural member when the main rotating structural member is in the first position, and the first tensioning member applying a tension to the main rotating structural member when the main rotating structural member is in the second position.

2. The apparatus of claim **1**, further comprising:

the first tensioning member having an opposite end attached to a location near a bottom of the main rotating structural member; and

a second tensioning member having an end attached adjacent to the top of the main rotating structural member, the second tensioning member having an opposite end attached to a location near the bottom of the main rotating structural member.

3. The apparatus of claim **2**, wherein the second tensioning member is attached to a side of the main rotating structural member opposite the first tensioning member.

4. The apparatus of claim **3**, wherein the first and second tensioning members tension the main rotating structural member in the second position, the first and second tensioning members applying no tension when the main rotating structural member is in the first position.

5. The apparatus of claim **4**, wherein the first and second tensioning members are attached in a location in front of the main rotating structural member.

6. The apparatus of claim **2**, wherein the first and second tensioning members are cables.

7. The apparatus of claim **1**, further comprising:

wherein the first tensioning member has an opposite end attached to a fixed surface a from the main rotating structural member; and

a second tensioning member has an end attached adjacent the top of the main rotating structural member, the second tensioning member having an opposite end attached to the fixed surface.

8. The apparatus of claim **7**, wherein the first and second tensioning members are attached to the fixed surface along the pivot axis of the main rotating structural member.

9. The apparatus of claim **8**, wherein the first tensioning member extends angularly outwardly from a side of the main rotating structural member, and the second tensioning member extends angularly outwardly from an opposite side of the main rotating structural member.

10. The apparatus of claim **9**, wherein the first and second tensioning members tension the main rotating structural member in the second position, the first and second tensioning members applying no tension when the main rotating structural member is in the first position.

11. The apparatus of claim 7, wherein the first and second tensioning members extend angularly outwardly from a front of the main rotating structural member.

12. The apparatus of claim 11, wherein the first tensioning member extends angularly outwardly from a side of the main rotating structural member, and the second tensioning member extends angularly outwardly from an opposite side of the main rotating structural member.

13. The apparatus of claim 12, wherein the first and second tensioning members tension the main rotating structural member in the second position, the first and second tensioning members applying no tension when the main rotating structural member is in the first position.

14. The apparatus of claim 11, wherein the first and second tensioning members are attached to the fixed surface in alignment with the main rotating structural member, the first tensioning member being generally parallel to the side of the main rotating structural member, the second tensioning member being generally parallel to the opposite side of the main rotating structural member.

15. The apparatus of claim 1 further comprising a link having a first end pivotally connected to the second end of the lever, the link having a second end pivotally connected to the skid.

16. A method of tensioning a main rotating structural member of a pipe handling apparatus, the main rotating structural member rotating about a pivot axis from a first position to a second position, the method comprising:

attaching a first tensioning member adjacent a top of the main rotating structural member;

attaching an opposite end of the first tensioning member to a fixed location near a bottom of the main rotating structural member;

attaching a second tensioning member adjacent the top of the main rotating structural member;

attaching an opposite end of the second tensioning member to a fixed location near the bottom of the main rotating structural member;

applying no tension to the first and second tensioning members while in the first position;

pivoting the rotating main structural member from the first position, by lifting the top of the main rotating structural member, to a second position and tensioning the main rotating structural member in the second position with the first and second tensioning members;

pivoting a lever outwardly from the main rotating structural member when the main rotating structural member is in the second position, the lever having a first end extending outwardly from a well side of the main rotating structural member, the lever having a second end extending outwardly from an opposite side of the main rotating structural member;

pivoting an arm outwardly from the first end of the lever when the main rotating structural member is in the second position; and

gripping a tubular with one or more grippers at an end of the arm when the main rotating structural member is in the first position.

17. The method of claim 16, further comprising:

extending the first tensioning member angularly outwardly from a side of the main rotating structural member; and

extending the second tensioning member angularly outwardly from an opposite side of the main rotating structural member.

18. The method of claim 16, further comprising:

extending the first and second tensioning members angularly outwardly from a front of the main rotating structural member.

19. The method of claim 16, the fixed location being aligned with the pivot axis of the main rotating structural member.

20. The method of claim 16, the fixed location being a surface of the main rotating structural member.

21. The method of claim 16, wherein the first and second tensioning members are cables.

22. The method of claim 16 further comprising the step of pivoting a link in response to the rotation of the main rotating structural member, a first end of the link pivoting from the second end of the lever, a second end of the link pivoting near the bottom of the main rotating structural member.

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