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(12) **United States Patent**
Orgeron

(10) **Patent No.: US 8,128,332 B2**
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(54) **HEADER STRUCTURE FOR A PIPE HANDLING APPARATUS**

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(73) Assignee: **T & T Engineering Services, Inc.**, Tomball, TX (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 276 days.

(21) Appl. No.: **12/259,248**

(22) Filed: **Oct. 27, 2008**

(65) **Prior Publication Data**

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Related U.S. Application Data

(63) Continuation-in-part of application No. 12/013,979, filed on Jan. 14, 2008, now Pat. No. 7,726,929, which is a continuation-in-part of application No. 11/923,451, filed on Oct. 24, 2007, now Pat. No. 7,918,636.

(51) **Int. Cl.**
E21B 19/15 (2006.01)
E21B 19/00 (2006.01)

(52) **U.S. Cl.** **414/22.62**; 414/22.55

(58) **Field of Classification Search** 166/77.52, 166/77.53; 175/85; 269/139; 414/22.54, 414/22.55, 22.56, 22.57, 22.58, 22.59, 22.62, 414/222.04–222.06, 222.12, 226.04, 23, 414/546, 680, 729, 738, 740, 742, 744.7, 414/746.8, 749.6, 783, 694; 52/119, 120, 52/211, 213, 773, 86; 74/103, 110; 901/15, 901/21–22, 6; 212/292, 298, 306
See application file for complete search history.

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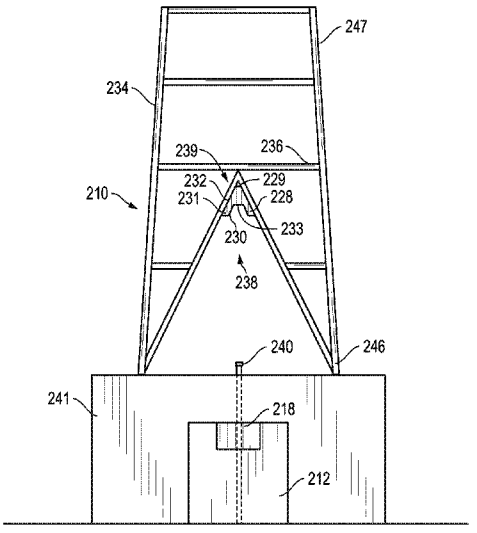
(57) **ABSTRACT**

A system has a pipe handling apparatus with an arm moving between a first position and a second position, a derrick having a window through which the pipe handling system delivers a pipe to a well head, and a header mounted in the window of the derrick. The header receives the arm of the pipe handling system when the arm is in the second position. An outside surface of the header suitably fits within the window of the derrick. An inside surface of the derrick suitably receives the arm. The inside surface resists an upward motion and a sideways motion of the arm. The header has a body that has a head and legs.

17 Claims, 7 Drawing Sheets



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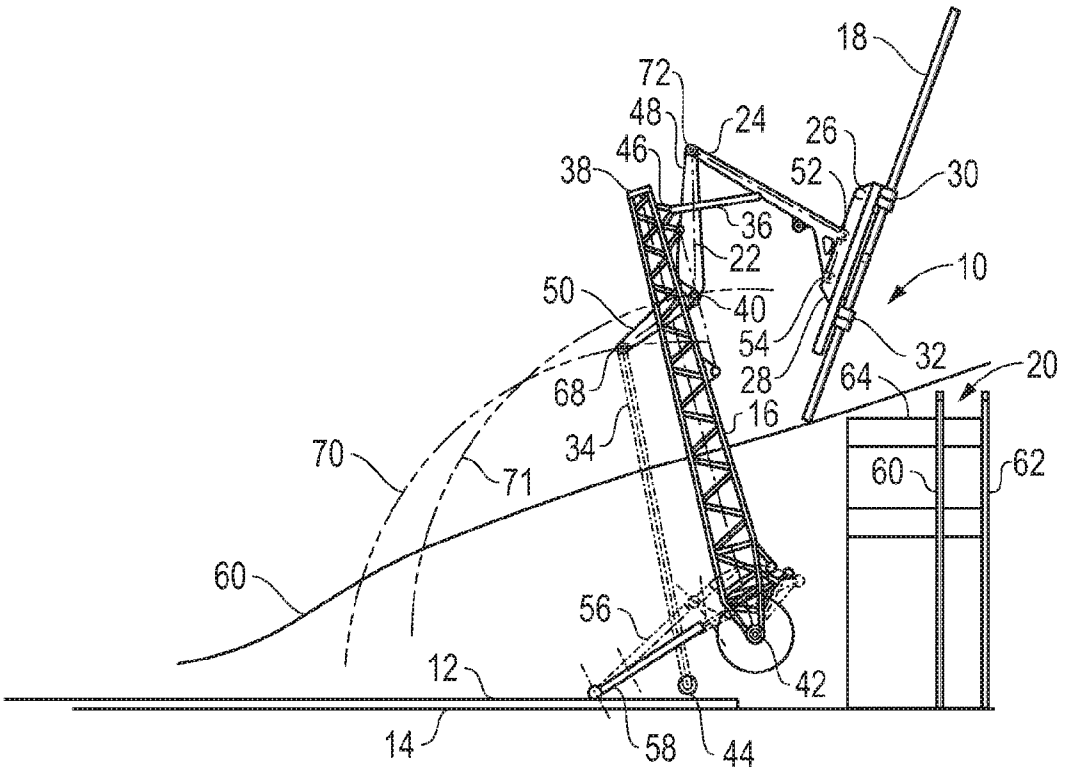
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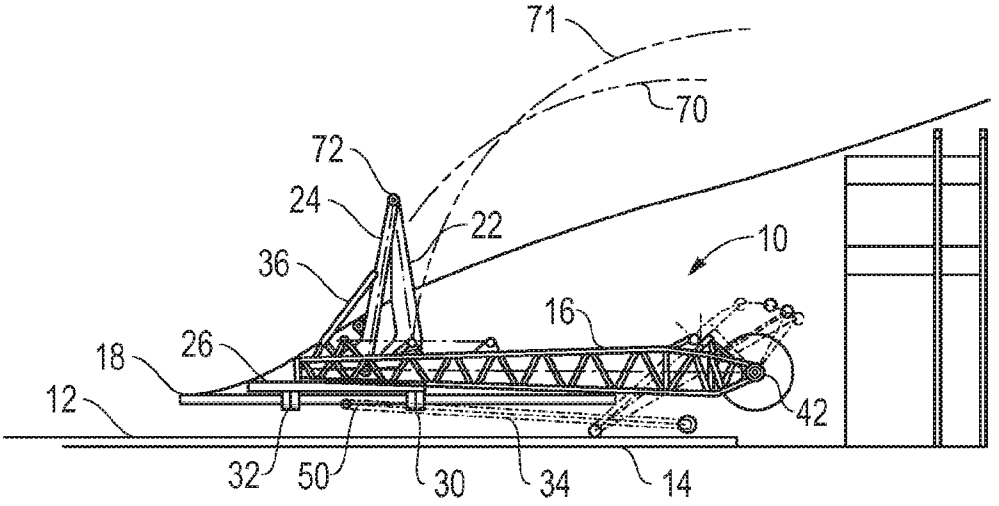
FIG. 1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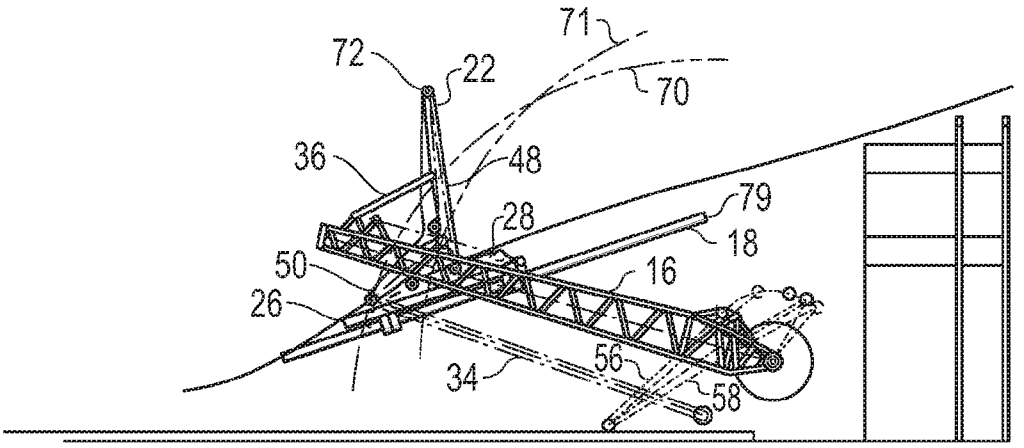
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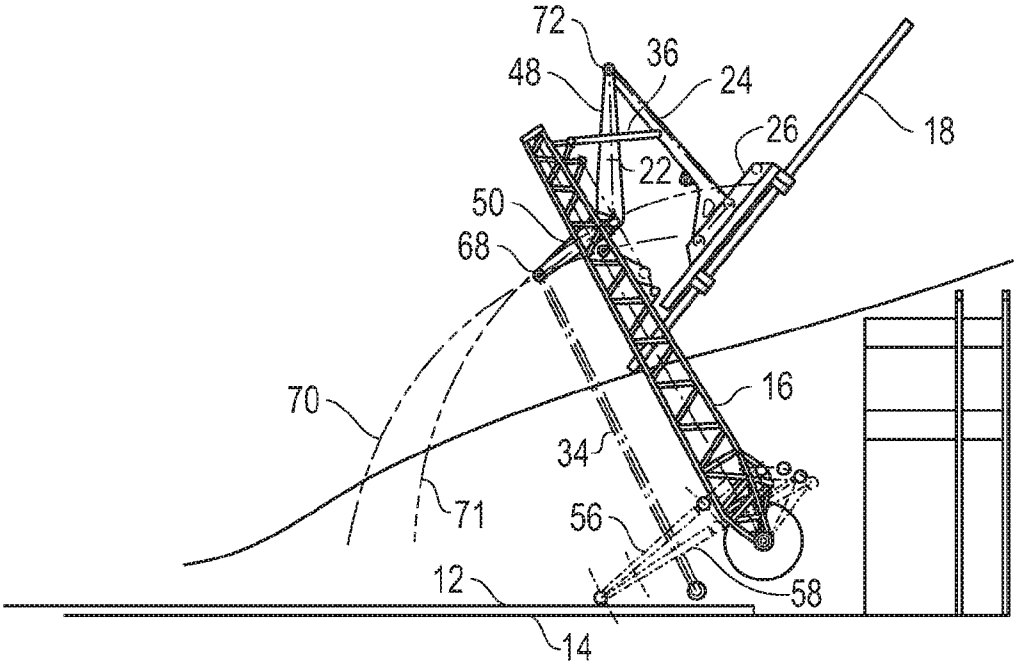
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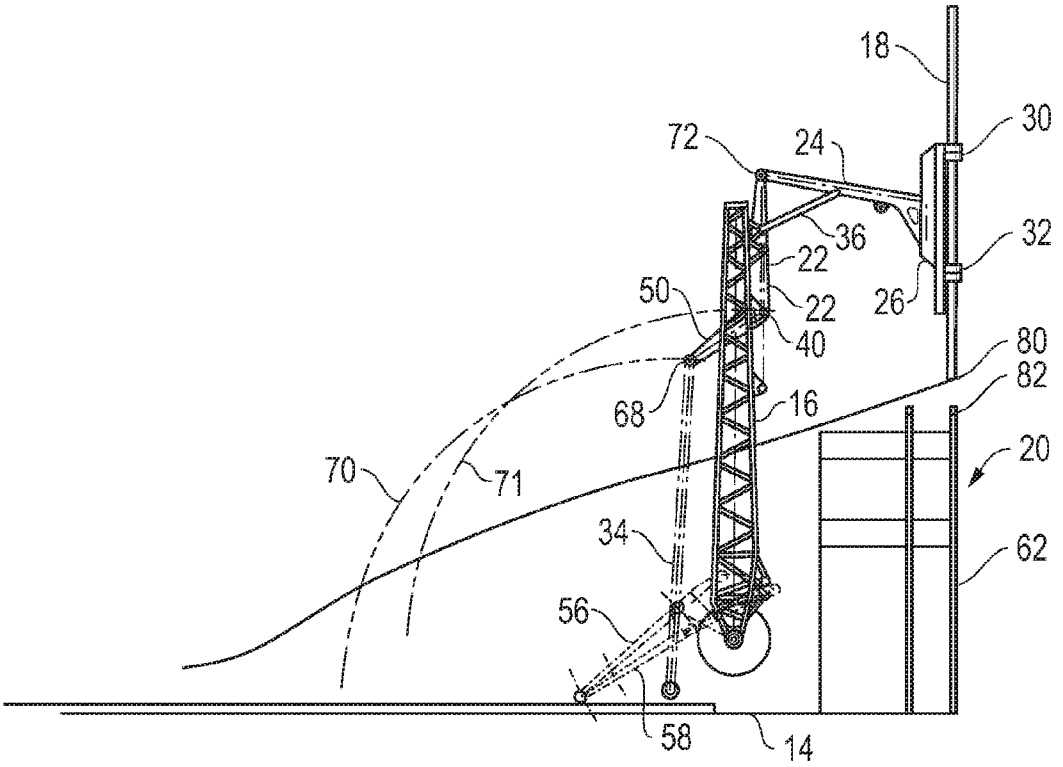
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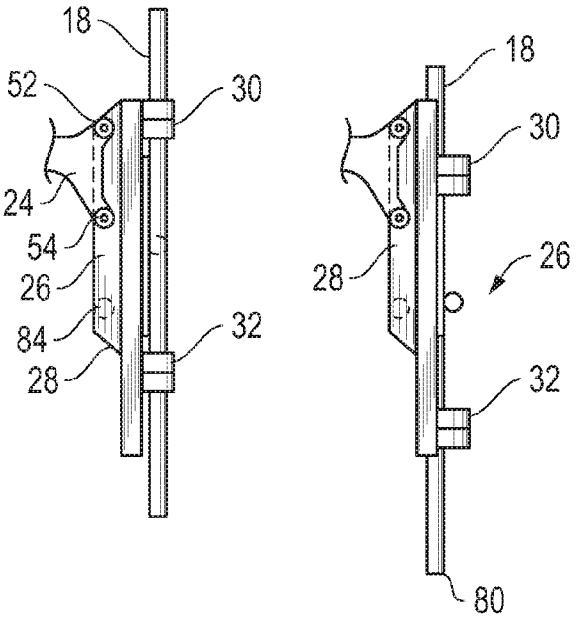
FIG. 5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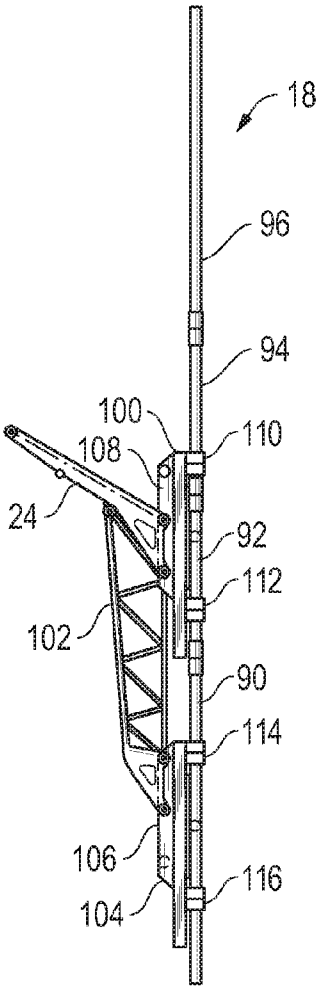

FIG. 7

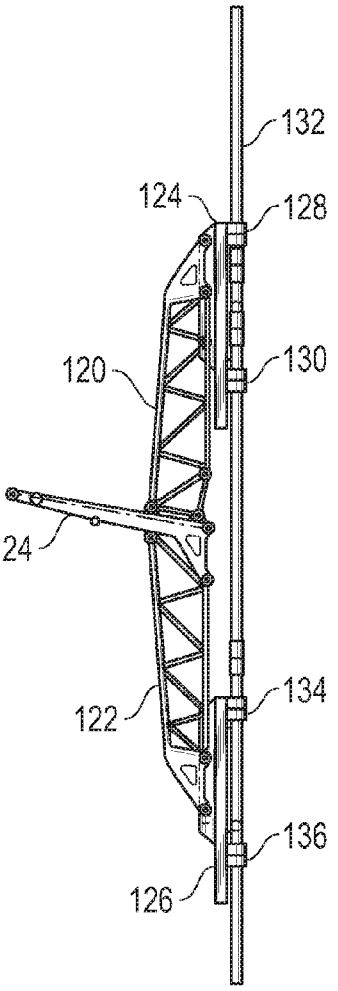

FIG. 8

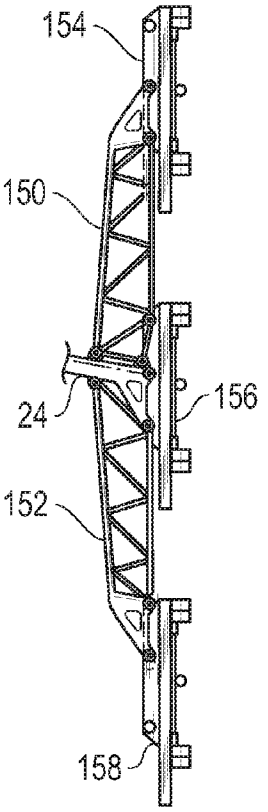

FIG. 9

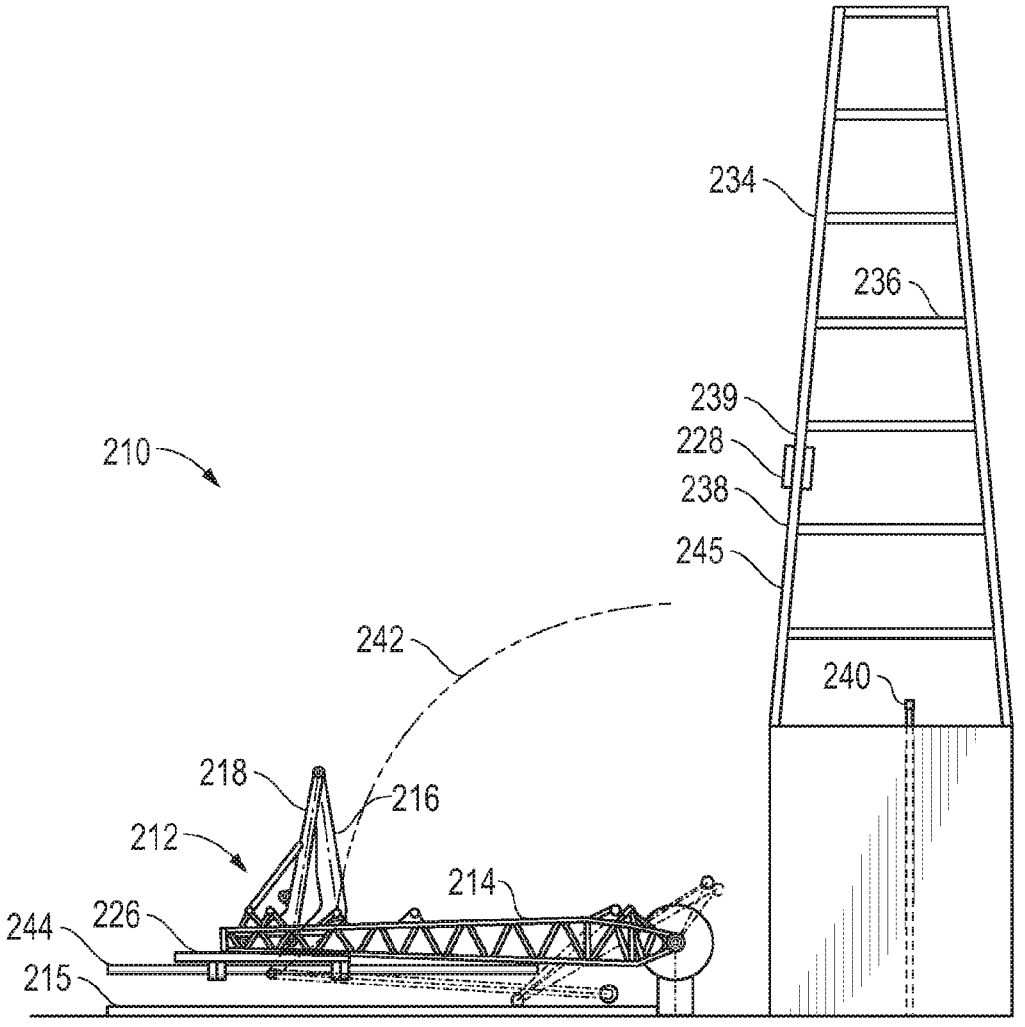

FIG. 10

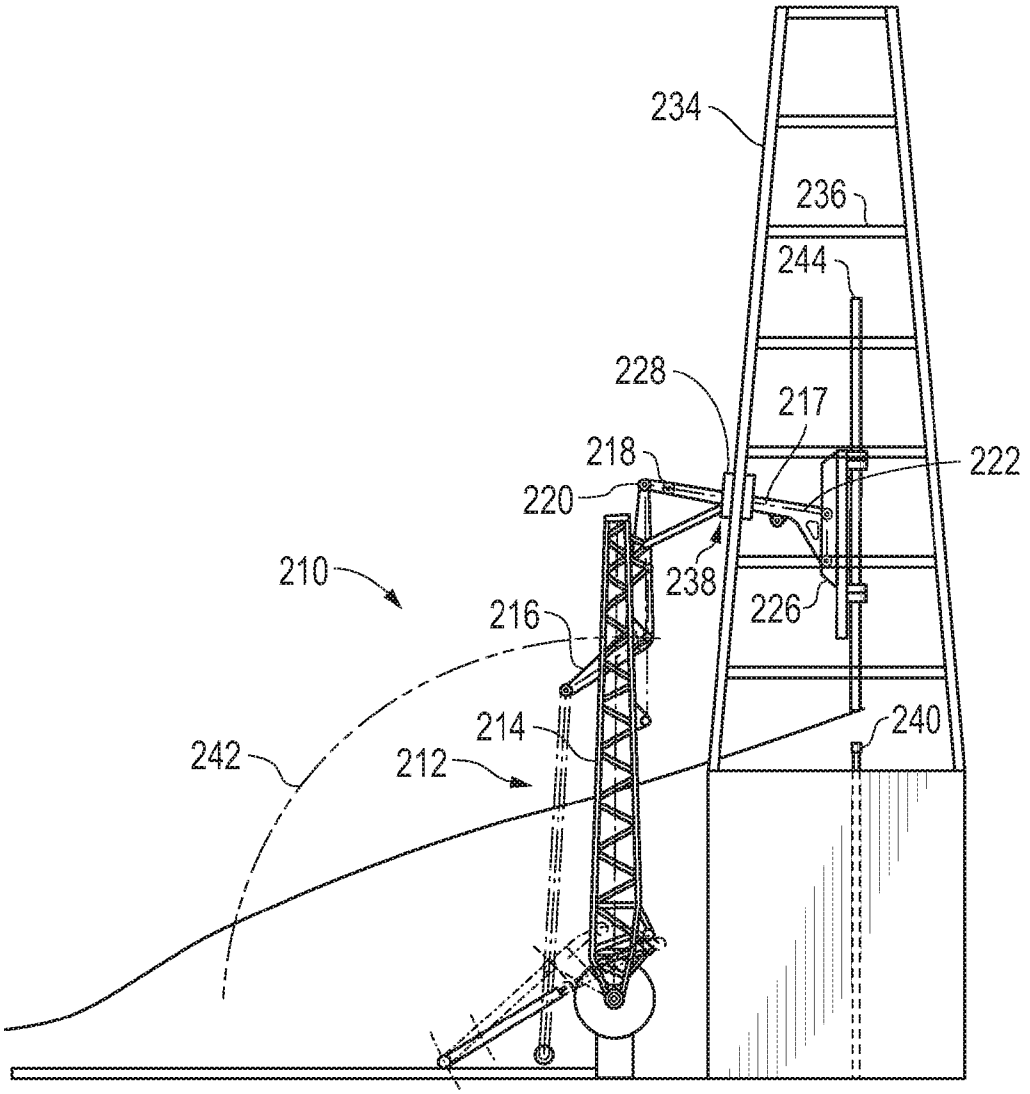

FIG. 11

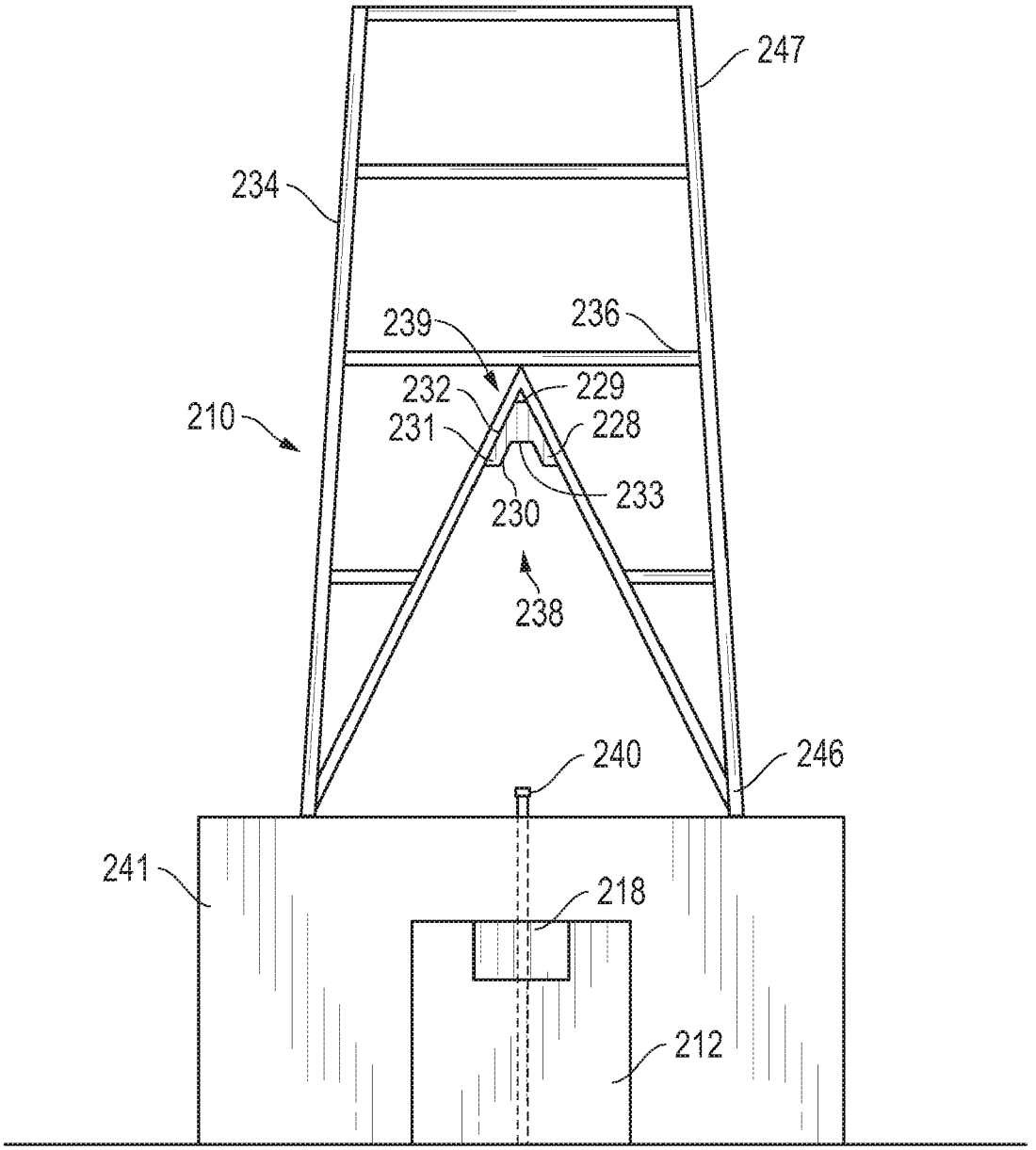
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FIG. 12

HEADER STRUCTURE FOR A PIPE HANDLING APPARATUS

CROSS-REFERENCE TO RELATED U.S. APPLICATIONS

The present application is a continuation-in-part of U.S. application Ser. No. 12/013,979, filed on Jan. 14, 2008 now U.S. Pat. No. 7,726,929, entitled "Pipe Handling and Casing Stabbing Apparatus and Method", presently pending. U.S. application Ser. No. 12/013,979 is a continuation-in-part of U.S. application Ser. No. 11/923,451, filed on Oct. 24, 2007 now U.S. Pat. No. 7,918,636, entitled "Pipe Handling Apparatus and Method", presently pending.

STATEMENT REGARDING FEDERALLY SPONSORED RESEARCH OR DEVELOPMENT

Not applicable.

NAMES OF PARTIES TO A JOINT RESEARCH AGREEMENT

Not applicable.

REFERENCE TO AN APPENDIX SUBMITTED ON COMPACT DISC

Not applicable.

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to the delivery of tubulars from a horizontal orientation to a vertical orientation at a wellhead. More particularly, the present invention relates to pipe handling apparatus that positions tubulars at a wellhead. More particularly, the present invention relates to controlling undesirable forces that are created while positioning a tubular at a wellhead.

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 boom. In order to move the pipe, a succession of individual movements of the levers, arms, and other components of the boom 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 programing 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 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, 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 a 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 wellhead in the second position. Pipes can be of extraordinary lengths and weights. Once the pipe is connected to other pipe in the wellhead, 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 wellhead, the apparatus springs upwardly and away from the wellhead. 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. In addition to creating unnecessary stresses on the apparatus, the springback can cause the pipe to be deflected at the wellhead. 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 wellhead. These problems also occur when casing is delivered to the wellhead by the pipe handling apparatus.

Various patents and patent applications relate to apparatus and methods for stiffening and improving the integrity of a pipe handling system. For example, U.S. patent application Ser. No. 12/013,979, filed on Jan. 14, 2008 by the present inventor, 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. patent 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 a 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 a one end pivotally connected to the boom and an opposite end pivotally 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.

U.S. Pat. No. 3,177,944, issued on Apr. 13, 1965 to R. N. Knight, 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. Cernosek, 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 loader is operably attached or associated with the platform and a positioner in order to move the pipe from 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. An 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 downhole 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 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 a 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 is 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 well 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 an 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 a system and method for preventing the springback of a pipe handling apparatus when delivering a pipe to a wellhead.

It is another object of the present invention to provide a system and method for stiffening 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 a system and method for stiffening 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 a system and method for stiffening a pipe handling apparatus that utilizes an existing derrick.

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

It is another object of the present invention to provide a system and method for stiffening a pipe handling apparatus that prevents sideways motions of the pipe handling apparatus caused by wind.

It is another object of the present invention to provide a system and method for stiffening that achieves greater precession in the delivery and installation of pipe and/or casing.

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

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 system for installing a pipe comprising a pipe handling apparatus having a first position and a second position, a derrick having a window through which the pipe handling apparatus delivers a pipe to a well head, and a header mounted in the window of the derrick. The header receives a portion of the pipe handling apparatus when the pipe handling apparatus is in the second position.

The pipe handling apparatus comprises a boom pivotally movable between a first position and a second position, a lever assembly pivotally connected to the boom, an arm having an end pivotally connected to the lever assembly and extending outwardly therefrom when the boom is in the second position, and a gripper means affixed to an opposite end of the arm for gripping a diameter of the pipe. The header receives a portion of the arm when the boom is in the second position.

The derrick has a plurality of structural members. The plurality of structural members arranged so as to form the window. The plurality of structural members form an inverted V-shape. The window has a top and a bottom. The header is mounted adjacent the top of the window. The header is mounted to the plurality of structural members so as to extend in a generally horizontal orientation or in generally parallel relation to the floor of the derrick.

The header has an outside surface and an inside surface. The outside surface is formed so as to suitably fit within the window of the derrick. The inside surface is formed so as to suitably receive the arm. The inside surface resists an upward motion of the arm. The inside surface of the header exerts a vertical force on the arm. The inside surface resists a sideways motion of the arm. The inside surface of the header exerts a horizontal force on the arm.

The header has a body. The body has a head and at least one leg. The head and leg are integrally formed. The head is mounted in the window so as to resist an upward motion of the arm when the pipe handling apparatus is in the second position. The leg extends downwardly from the head of the body. The leg is mounted in the window so as to resist a sideways motion of the arm when the pipe handling apparatus is in the second position. The body has a shape suitable for mounting in the window and suitable for receiving the arm therein. The head receives the arm when the pipe handling apparatus is in the second position. The leg receives the arm when the pipe handling apparatus is in the second position.

The present invention is a method of moving a pipe from a horizontal orientation for installation in a vertical orientation. The method includes the steps of extending a boom over the horizontally-oriented pipe such that grippers are positioned adjacent to the horizontally-oriented pipe, gripping the horizontally-oriented pipe with the grippers, pivoting the boom upwardly such that the pipe is moved angularly through an interior of the boom and until the pipe is in a vertical orientation, and receiving a portion of the arm in a header mounted in a window of a derrick. The grippers are affixed to an arm pivotally connected to a lever assembly. The lever assembly is pivotally mounted to the boom. The method further includes the steps of moving the arm and the grippers and the pipe through the window of the derrick, delivering the pipe to a well head in the vertical orientation, releasing the pipe at the well head in the vertical orientation, resisting an upward motion of the arm with the header, and resisting a sideways motion of the arm with the header. The method also includes forming an outside surface of the header so as to suitably fit in the window of the derrick, forming an inside surface of the header so as to suitably receive the portion of the arm, and mounting the header in the window of the derrick.

BRIEF DESCRIPTION OF THE SEVERAL VIEWS OF THE DRAWINGS

FIG. **1** is a side elevation view showing the pipe handling apparatus in accordance with the teachings of the preferred embodiment of the present invention.

FIG. **2** is a side elevational view showing the pipe handling apparatus in a first position.

FIG. **3** is a side elevational view showing the pipe handling apparatus moving from the first position toward the second position.

FIG. **4** is a side elevation view of the pipe handling apparatus showing the pipe handling apparatus as moving the pipe further to the second position.

FIG. **5** is a side elevational view showing the pipe handling apparatus in its second position in which the pipe extends in a vertical orientation.

FIG. **6** is an illustration of the gripper assembly as vertically translating the pipe.

FIG. **7** is a side elevational view of a first alternative embodiment of the gripper assembly of the pipe handling apparatus.

FIG. **8** is a side elevational view showing a second alternative embodiment of the gripper assembly pipe handling apparatus.

FIG. **9** is a side elevational view showing a third alternative embodiment of the gripper assembly of the pipe handling apparatus.

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

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

FIG. **12** shows a front elevational view of the preferred embodiment of the system of the present invention.

DETAILED DESCRIPTION OF THE INVENTION

Referring to FIG. **1**, there is shown the pipe handling apparatus **10** in accordance with the system of the present invention. The pipe handling apparatus **10** is mounted on a skid **12** that is supported upon the bed **14** of a vehicle, such as a truck. The pipe handling apparatus **10** in particular includes a boom **16** that is pivotally movable between a first position and a second position. In FIG. **1**, an intermediate position of the pipe handling apparatus **10** is particularly shown. In this position, the pipe **18** is illustrated in its position prior to installation on the drill rig **20**. A lever assembly **22** is pivotally connected to the boom **16**. An arm **24** is pivotally connected to an end of the lever assembly **22** opposite the boom **16**. A gripping means **26** is fixedly connected to an opposite end of the arm **24** opposite the lever assembly **22**. The gripping means **26** includes a body **28** and grippers **30** and **32**. A link **34** has one end pivotally connected to the skid **12** and an opposite end pivotally connected to the end of the lever assembly **22** opposite the arm **24**. A brace **36** is pivotally connected to the boom **16** and also pivotally connected to the arm **24** between the lever assembly **22** and the body **28** of gripping means **26**.

In the present invention, the boom **16** is a structural framework of struts, cross members and beams. In particular, in the present invention, the boom **16** is configured so as to have an open interior such that the pipe **18** will be able to be lifted in a manner so as to pass through the interior of the boom **16**. As such, the end **38** of the boom **16** should be strongly reinforced so as to provide the necessary structural integrity to the boom **16**. A lug **40** extends outwardly from one side of the boom **16**. This lug **40** is suitable for pivotable connection to the lever assembly **22**. The boom **16** is pivotally connected at the opposite end **42** to a location on the skid **12**. The pivotable connection at end **42** of the boom **16** is located in offset relationship and above the pivotable connection **44** of the link **34** with the skid **12**. A small frame member **46** extends outwardly from the side of the boom **16** opposite the link **34**. This frame assembly **46** has a pivotable connection with the brace **36**.

The lever assembly **22** includes a first portion **48** and a second portion **50**. The first portion **48** extends at an obtuse angle with respect to the second portion **50**. The link **34** is pivotally connected to the end of the second portion **50** opposite the first portion **48**. The arm **24** is pivotally connected to the end of the first portion **48** opposite the second portion **50**. The lug **40** of the boom **16** is pivotally connected in an area generally between the first portion **48** and the second portion **50**. This unique arrangement of the lever assembly **22** facilitates the ability of the present invention to carry out the movement of the pipe **18** between the horizontal orientation and the vertical orientation.

The arm **24** has an end pivotally connected to the end of the first portion **48** of the lever assembly **22**. The opposite end of the arm **24** is connected to the gripping means **26**. In particular, a pair of pin connections engage a surface of the body **28** of the gripping means **26** so as to fixedly position the gripping means **26** with respect to the end of the arm **24**. The pin connections **52** and **54** can be in the nature of bolts, or other fasteners, so as to strongly connect the body **28** of the gripping means **26** with the arm **24**. The bolts associated with pin connections **52** and **54** can be removed such that other gripping means **26** can be affixed to the end of the arm **24**. As such, the pipe handling apparatus **10** of the present invention can be adaptable to various sizes of pipe **18** and various heights of drilling rigs **20**.

The gripping means **26** includes the body **28** with the grippers **30** and **32** translatable along the length of the body **28**. This vertical translation of the grippers **30** and **32** allows the pipe **18** to be properly moved upwardly and downwardly once the vertical orientation of the pipe **18** is achieved. The grippers **30** and **32** are in the nature of conventional grippers which can open and close so as to engage the outer diameter of the pipe **18**, as desired.

The link **34** is an elongate member that extends from the pivotable connection **44** to the pivotable connection **68** of the second portion **50** of the lever assembly **22**. The link **34** is non-extensible and extends generally adjacent to the opposite side from the boom **16** from that of the arm **24**. The link **34** will generally move relative to the movement of the boom **16**. The brace **36** is pivotally connected to the small framework **46** associated with boom **16** and also pivotally connected at a location along the arm **26** between the ends thereof. Brace **36** provides structural support to the arm **24** and also facilitates the desired movement of the arm **24** during the movement of the pipe **18** between the horizontal orientation and the vertical orientation.

Actuators **56** and **58** are illustrated as having one end connected to the skid **12** and an opposite end connected to the boom **16** in a location above the end **42**. When the actuators **56** and **58** are activated, they will pivot the boom **16** upwardly from the horizontal orientation ultimately to a position beyond vertical so as to cause the pipe **18** 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 **56** and **58**, as illustrated in FIG. **1**.

The drilling rig **20** is illustrated as having drill pipes **60** and **62** extending upwardly so as to have an end above the drill floor **64**. When the pipe **18** is in its vertical orientation, the translatable movement of the grippers **30** and **32** can be utilized so as to cause the end of the pipe **18** to engage with the box of one of the drill pipes **60** and **62**.

In FIG. **1**, the general movement of the bottom end of the pipe **18** is illustrated by line **66**. The movement of the pivot

point **68** of the connection between the lever assembly **22** and the link **34** is illustrated by line **70**. Curved line **71** illustrates the movement of the pivotable connection **40** between the boom **16** and the lever assembly **22**.

In the present invention, the coordinated movement of each of the non-extensible members of the apparatus **10** 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 **18** between a horizontal orientation and a vertical orientation can be achieved purely through the mechanics associated with the various components. As can be seen, 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. The hydraulic actuators are only used for the pivoting of the boom. Since the skid **12** is located on the bed of a vehicle **14**, the vehicle **14** can be maneuvered into place so as to properly align with the centerline of the drill pipe **60** and **62** of the drilling rig **20**. Once the proper alignment is achieved by the vehicle **14**, the apparatus **10** can be operated so as to effectively move the drill pipe to its desired position. The gripper assemblies of the present invention allow the drill pipe **18** to be moved upwardly and downwardly for the proper stabbing of the drill pipes **60** and **62**. The present invention is adaptable to various links of pipe **18**.

Various types of gripping means **26** can be installed on the end of the arm **24** so as to properly accommodate longer lengths of pipe **18**. These variations are illustrated herein in connections FIGS. **6-9**.

As such, instead of the complex control mechanisms that are required with prior art systems, the present invention achieves it results by simple maneuvering of the vehicle **14**, along with operation of the hydraulic cylinders **56** and **58**. All other linkages and movement of the pipe **18** 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 **18** with respect to the desired connecting pipe. This is accomplished with only a single degree of freedom in the pipe handling system.

FIG. **2** illustrates the drill pipe **18** in a generally horizontal orientation. In the present invention, it is important to note that the drill pipe can be delivered to the apparatus **10** in a position below the boom **16**. In particular, the drill pipe can be loaded upon the skid **12** in a location generally adjacent to the grippers **30** and **32** associated with the gripping means **26**. As such, the present invention facilitates the easy delivery of the drill pipe to the desired location. The gripper **30** and **32** will grip the outer diameter of the pipe **18** in this horizontal orientation.

In FIG. **2**, it can be seen that the boom **16** resides above the drill pipe **18** and in generally parallel relationship to the top surface of the skid **12**. The lever assembly **22** is suitably pivoted so that the arm **24** extends through the interior of the framework of the boom **16** and such that the gripping means **26** engages the pipe **18**. The brace **36** resides in connection with the small framework of the boom **16** and also is pivotally connected to the arm **24**. The link **34** will reside below the boom **16** generally adjacent to the upper surface of the skid **12** and is connected to the second portion **50** of the lever assembly **22** below the boom **16**.

FIG. **3** shows an intermediate position of the drill pipe **18** during the movement from the horizontal orientation to the vertical orientation. As can be seen, the gripping means **26** has engaged with the pipe **18**. The lever assembly **22** is pivoting so that the end **79** of pipe **18** will pass through the interior of the framework of the boom **16**. Also, the arm associated with the gripping means **26** serves to move the body **28** of the gripping means **26** through the interior of the framework of the boom **16**. The brace **36** is pulling on the first portion **48** of lever assembly **22** so as to cause this motion to occur. The link **34** is pulling on the end of the second portion **50** of the lever assembly **22** so as to draw the first portion **48** upwardly and to cause the movement of the body **28** of the gripping means **26**. The hydraulic actuators **56** and **58** have been operated so as to urge the boom **16** pivotally upwardly.

FIG. **4** shows a further intermediate movement of the drill pipe **18**. Once again, the hydraulic actuators **56** and **58** urge the boom **16** angularly upwardly away from the top surface of the skid **12**. This causes the link **34** to have a pulling force on the pivotal connection **68** of the second portion **50** of the lever assembly **22**. This causes the first portion **48** of the lever assembly **22** to move upwardly thereby causing the arm **24**, in combination with the brace **36** to lift the gripping means **26** further upwardly and draw the pipe **18** completely through the interior of the boom **16**. As can be seen, the relative size and relation of the various components of the present invention achieve the movement of the pipe **18** without the need for separate hydraulic actuators.

FIG. **5** illustrates the drill pipe **18** in its vertical orientation. As can be seen, the drill pipe **18** is positioned directly above the underlying pipe **62** on the drilling rig **20**. The further upward pivotal movement of the boom **16** is caused by the hydraulic cylinders **56** and **58**. This causes the link **34** to rotate and draw the end of the second portion **50** of the lever assembly **22** downwardly. The lever assembly **22** rotates about the pivot point **40** such that the first portion **48** of the lever assembly **22** has a pivot **72** at its upper end. The brace **36** is now rotated in a position so as to provide support for the arm **24** in this upper position. The gripping means **26** has grippers **30** and **32** aligned vertically and in spaced parallel relationship to each other. If any further precise movement is required between the bottom end **80** of the pipe **18** and the upper end **82** of pipe **62**, then the vehicle **14** can be moved slightly so as to achieve further precise movement. In the manner described hereinbefore, the drill pipe **18** has achieved a completely vertical orientation by virtue of the interrelationship of the various components of the present invention and without the need for complex control mechanisms and hydraulics.

In order to install the drill pipe **18** upon the pipe **62**, it is only necessary to vertically translate the grippers **30** and **32** within the body **28** of the gripping means **26**. As such, the end **80** can be stabbed into the box connection **82** of pipe **62**. Suitable tongs, spinners, or other mechanisms can be utilized so as to rotate the pipe **18** in order to achieve a desired connection. The grippers **30** and **32** can then be released from the exterior of the pipe **18** and returned back to the original position such that another length of drill pipe can be installed.

FIG. **6** is a detailed view of the gripping means **26** of the present invention. In FIG. **6** the pin connections **52** and **54** have been installed into alternative holes formed on the body **28** of the gripping means **26**. The holes, such as hole **84** can be formed in a surface of the body **28** so as to allow selective connection between the end of the arm **24** and the body **28** of gripping means **26**. As such, the position of the gripping means **26** in relation to the arm **24** can be adapted to various circumstances.

It can be seen that the pipe **18** is engaged by grippers **30** and **32** of the gripping means **26**. The configuration of the grippers **30** and **32**, as shown in FIG. **6**, is particularly designed for short length (approximately 30 feet) of drill pipe. In FIG. **6**, it can be seen that the grippers **30** and **32** are translated relative to the body **28** so as to lower end **80** of pipe **18** downwardly for connection to an underlying pipe.

Occasionally, it is necessary to accommodate longer lengths of pipe. In other circumstances, it is desirable to accommodate pipes that are already assembled in an extended length. In FIG. **7**, it can be seen that the drill pipe **18** is formed of separate sections **90**, **92**, **94** and **96** that are joined in end-to-end connection so as to form an extended length of the of the pipe **18**. When such pipe arrangements are required, the gripping means **26** of the present invention will have to be adapted so as to accommodate such extended lengths. Fortunately, the structure of the apparatus **10** of the present invention can accommodate such an arrangement. As can be seen in FIG. **7**, the arm **24** is connected to a first gripper assembly **100** and connected by stab frame **102** to a second gripper assembly **104**. The second gripper assembly **104** is located directly below and vertically aligned with the first gripper assembly **100**. The stab frame **102** includes a suitable pin connection for engaging the body **106** of the second gripper assembly **104**. The first gripper assembly **100** has body **108** that is directly connected to the pin connections associated with the arm **24**. The gripping assembly **100** includes grippers **110** and **112** which engage in intermediate position along the length of pipe **18**. The grippers **114** and **116** of the second gripper assembly **104** engage the lower portion of the pipe **18**. The method of moving the pipe **18** from the horizontal position to the vertical position is similar to that described hereinbefore.

It should be noted that the arm **24** can extend at various angles with respect to the gripper assemblies **100** and **104**. In the preferred embodiment, the arm **24** will be generally transverse to the length of the body associated with the gripper assemblies **100** and **104**. However, if needed to accommodate certain drilling rig height and arrangements, the arm **24** can be angled up to 30° from transverse with respect to the body associated with the gripper assemblies **100** and **104**.

In FIG. **8**, it an be seen that the arm **24** has a first stab frame **120** extending upwardly from the top of the arm **24** and a second stab frame **122** extending below the arm **24**. The stab frame **120** includes a gripper assembly **124** affixed thereto. The stab frame **122** includes a gripper assembly **126** connected thereto. The arm **24** will include suitable pin connections located on the top surface thereof and on the bottom surface thereof so as to engage with the stab frames **120** and **122**. The gripper assembly **124** has suitable grippers **128** and **130** for engaging an upper portion of the pipe **132**. The gripper assembly **126** includes grippers **134** and **136** for engaging with a lower portion of the pipe **132**. As illustrated in FIG. **8**, the pipe **132** is a multiple section pipe. However, pipe **132** can be an extended length of a single pipe section.

FIG. **9** shows still another embodiment of the gripper assembly structure of the present invention. In FIG. **9**, the arm **24** is connected to the upper stab frame **150** and to the lower stab frame **152**. Gripping assemblies **154**,**156** and **158** are provided. The gripper assembly **154** is connected to an upper end of the upper stab frame **150**. The gripper assembly **158** is connected to a lower end of the lower stab frame **152**. The gripper assembly **156** is intermediately located directly on the opposite side of the end of the arm **24** and connected to the lower end of the upper stab frame **150** and to the upper end of the lower stab frame **152**. As such, the present invention provides up to three gripper assemblies **154**, **156**, and **158** to be connected. This can be utilized so as to accommodate even longer lengths of pipe, if needed.

The present invention achieves a number of advantages over the prior art. Most importantly, the present invention provides a pipe handling apparatus and method that minimizes the number of control mechanisms, sensors and hydraulic systems associated with the pipe handling system. Since the movement of the pipe is achieved in a purely mechanical way, only a single hydraulic actuator is necessary for the movement of the boom. All of the other movements are achieved by the interrelationship of the various components. As such, the present invention achieves freedom from the errors and deviations that can occur through the use of multiple hydraulic systems. The simplicity of the present invention facilitates the ability of a relatively unskilled worker to operate the pipe handling system. The amount of calibration is relatively minimal. Since the skid **12** associated with the present invention can be transported by a truck, various fine movements and the location of the pipe handling apparatus **10** can be achieved through the simple movement of the vehicle. The pipe handling apparatus **10** of the present invention is independent of the drilling rig. As such, a single pipe handling apparatus that is built in accordance with the teachings of the present invention can be utilized on a number of rigs and can be utilized at any time when required. There is no need to modify the drilling rig, in any way, to accommodate the pipe handling apparatus of the present invention. Since the pipes are loaded beneath the boom, the providing of the pipe to the pipe handling apparatus can be achieved in a very simple manner. There is no need to lift the pipes to a particular elevation or orientation in order to initiate the pipe handling system.

Referring to FIG. **10**, there is shown a side elevational view of the preferred embodiment of the system **210** of the present invention, with the pipe handling apparatus **212** in a first position. The pipe handling apparatus **212** has a boom **214**, a lever assembly **216**, an arm **218**, and a gripper **226**. The boom **214** is pivotally connected the skid **215**. The lever assembly **216** is pivotally connected to the boom **214**. The arm **218** is pivotally connected to the lever assembly **216**. The arm **218** is pivotally connected to the gripper means **226** opposite the lever assembly **216**. The gripper means **226** holds a tubular **244** for transfer from a horizontal orientation to a vertical orientation as the pipe handling apparatus **212** moves from the first position to second position, described below. The tubular **244** can be a pipe, a casing, or any other tubular member. The tubular **244** is shown as in the horizontal orientation. Derrick **234** sits above a wellhead **240**. As used herein, the term 'derrick' refers to derricks, masts, and similar structures associated with oil and gas production. The derrick **234** is centered over the wellhead **240**. Derrick **234** has structural members **236**. The structural members **236** can be of any orientation suitable for a typical derrick of an oil well. Structural members **236** of the derrick **234** are arranged so as to give the derrick **234** rigidity. The structural members **236** of the derrick **234** are arranged so as to form an opening called a window **238**. The window **238** is located on the front **245** of the derrick **234**. A header **228** is mounted in the window **238** on the front **245** of the derrick **234**. More particularly, the header **228** is mounted near the top **239** of the window **238**. As is described below, tubulars **244** are delivered by the pipe handling apparatus **212** to the wellhead **240** through the window **238**.

Referring to FIG. **11**, there is shown a side elevational view of the preferred embodiment of the system **210** of the present invention, with the pipe handling apparatus **212** in a second position. In the second position, the pipe handling apparatus **212** delivers tubular **244** in a vertical orientation to the wellhead **240**. The boom **214** is also in the second position, which is vertically oriented. The lever assembly **216** has pivoted with respect to the boom **214**. End **220** of the arm **218** is pivotally connected to the lever assembly **216**. The arm **218** extends outwardly from the lever assembly **216**. The gripper **226** is affixed to an opposite end **222** of the arm **218**. When the boom **214** is in second position, the header **228** receives a

portion of the arm **218** therein. The header **228** helps guide the arm **218** towards the wellhead **240** so that the tubular **244** can be precisely aligned with the wellhead **240**. Once the tubular **244** is delivered to the wellhead **240** in a vertical orientation, the gripper **226** releases the tubular **244**. Normally, the gripper **226** and arm **218** would spring upwards after releasing the tubular **244**. This "springback" of the gripper **226** and arm **218** can be up to ten inches. However, the header **228** prevents the springback of the gripper **226** and arm **218**. The upward force of the arm **218** compresses the header **228** between the arm **218** and the window **238** of the derrick **234**. The derrick **234** is an oil derrick. The header **228** resists the force created by the upward motion of the arm **218** after the gripper **226** releases the tubular **244**. In other words, the header **228** exerts a downward force on the arm **218**. It can be seen that the header **228** also extends around the sides **217** of the arm **218**. Thus, the header **228** resists any sideways motion of the arm **218** due to springback, wind, or any source of sideways motion. In other words, the header **228** also exerts a horizontal force on the arm **218**.

Referring to FIG. **12**, there is shown a front elevational view of the system **210** of the present invention, with the pipe handling apparatus **212** in the first position. The wellhead **240** can be seen as extending upwardly from the well foundation **241**. In normal operation, the pipe handling apparatus **212** is located below the wellhead **240**. The oil derrick **234** has structural members **236**. As discussed above in FIG. **10**, the structural members **236** are arranged so as to form the window **238**. In the embodiment shown in FIG. **12**, the window **238** is formed of structural members **236** in an inverted V-shape. The V-shape of the structural members **236** is often referred to as the "V-door." At the widest point, the window **238** has a width approximately equal to a width of a bottom **246** of the derrick **234**. The top **239** of the window **238** is located between the top **247** of the derrick **234** and the bottom **246** of the derrick **234**.

The header **228** is mounted to the structural members **236** near the top **239** of the window **238**. In FIG. **12**, the header **228** is mounted near the apex of the inverted V-shape, but the present invention contemplates that the header **228** can be mounted anywhere in the window **238** that is suitable for receiving the arm **218** of the pipe handling apparatus **212**. The header **228** can be made of any material and of any shape that is suitable for placing the header **228** in the window **238** of the derrick **234** and for receiving the arm of the pipe handling apparatus **212** therein. The header **228** has an inside surface **230** and an outside surface **232**. The outside surface **232** is formed so as to suitably fit within the window **238** of the derrick **234**. The inside surface **230** is formed so as to suitably receive the arm **218** of the pipe handling apparatus **212** when the pipe handling apparatus **212** delivers a tubular to the well head **240**.

In FIG. **12**, the header **228** has an A-shape so as to suitably fit near the top **239** of the V-shaped window **238**. The header **228** can be of any other suitable shape depending on the shape of a given window for a given derrick. The header **228** has a body **229**. The body **229** has a head **233** and legs **231** that extend downwardly from the head **233**. The head **233** of the body **229** of the header **228** exerts a downward force when the arm **218** is placed adjacent the header **228**. The legs **231** exert horizontal forces on the arm **218** so as to keep the arm aligned within the head **233** and legs **231** of the body **229** of the header **228**. In the event of strong wind gusts, the legs **231** of the header **228** keep the pipe handling apparatus **212** from swaying side-to-side. That is, the legs **231** of the header **228** resists sideways motion of the arm **218** of the pipe handling apparatus **212**. In the event that the pipe handling apparatus **212** is not aligned with the center of the wellhead **240**, the legs **231** of the header **228** serve the further function of guiding the arm **218** of the pipe handling apparatus **212** to the center of the wellhead **240**. The header **228** thus improves accuracy of the pipe handling apparatus **212**. By guiding the pipe handling apparatus **212** and holding the pipe handling apparatus **212** in place while tubulars are delivered to the wellhead **240**.

The header **228** is unique in that it has no moving parts and can be easily mounted to the window **238** formed by the structural members **236** of the derrick **234**. The header **228** resists both upwardly and sideways motions of the arm of the pipe handling apparatus **212**. The body **229** of the header **228** contacts the arm of the pipe handling apparatus **212** when the tubular is in the vertical orientation. The header **228** is compressed between the arm **218** and the window **238**.

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 present 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 system for resisting upward movement of an arm of a pipe handling apparatus, the system comprising:

a derrick having structural members that form a window therein;

a pipe handling system having an arm that rises into the window of the derrick to deliver or receive a tubular held in a vertical orientation;

a header having an outside surface configured for attachment to the structure of the derrick, and having the outer surface attached to the structure of the derrick;

the header having a slot configured to receive the arm of the pipe handling system when the arm is extended into the derrick to deliver or receive the tubular to a location above a well head located beneath the derrick; and,

whereas when delivering the tubular to the well head, the arm of the pipe handling system engages the slot of the header as the tubular reaches a position over the well head, such that the header resists further upwardly motion of the arm to pretension the pipe handling system.

2. The system of claim **1**, wherein the header includes a body, the body configured to fit within the window of the derrick, the body having the slot formed therein to receive a portion of the arm of the pipe handling system.

3. The system of claim **2**, the body comprising:

a head mounted in the window and receiving a portion of the arm beneath it so as to resist an upward motion of the arm when the pipe handling system is in the second position; and

at least one leg extending downwardly from a side of the head, the leg being mounted in the window and receiving a portion of the arm against it so as to resist a sideways motion of the arm, when the pipe handling system is in the second position.

4. The system of claim **3**, the head and the leg being integrally formed.

5. The system of claim **1**, wherein the window of the derrick includes an inverted V-shape, and the header comprises a body having a V-shape configured to fit within the inverted V-shape of the window of the derrick.

6. A system for resisting upward movement of an arm of a pipe handling apparatus, the system comprising:

a pipe handling apparatus having an arm for lifting a pipe from a horizontal to a vertical orientation;

a derrick having a window configured to receive a pipe there through;

a header within the window having an outside surface configured for attachment to the structure of the derrick, the outer surface attached to the structure of the derrick;

the header having a slot configured to receive the arm of the pipe handling system when the arm is extended into the derrick to deliver or receive the tubular to a location above a well head located beneath the derrick; and,

whereas when delivering the tubular to the well head, the arm of the pipe handling system engages the slot of the header as the tubular reaches a position over the well head, such that the header resists further upwardly motion of the arm to pretension the pipe handling system.

7. The system of claim **6**, wherein the window comprises an inverted V-shape and the header comprises an A-shape and is configured to fit within the window.

8. The system of claim **6**, wherein an upper surface of the portion of the arm abuts against an underside of the header.

9. The system of claim **6**, wherein a side surface of the header restrains the portion of the arm from lateral movement.

10. The system of claim **6**, wherein the slot is configured to receive the portion of the arm and restrain upward and lateral movement of the arm.

11. A system for resisting upward movement of an arm of a pipe handling apparatus, the system comprising:

a pipe handling apparatus for lifting a pipe from a horizontal to a vertical orientation;

a vertical structure comprising elongate structural members;

a window in the vertical structure, the window sized and configured to receive there through a pipe held by grippers at one end of an arm of the pipe handling apparatus; and

a header within the window having an outside surface configured for attachment to the structure of the derrick, the outer surface attached to the structure of the derrick;

the header having a slot configured to receive the arm of the pipe handling system when the arm is extended into the derrick to deliver or receive the tubular to a location above a well head located beneath the derrick; and,

whereas when delivering the tubular to the well head, the arm of the pipe handling system engages the slot of the header as the tubular reaches a position over the well head, such that the header resists further upwardly motion of the arm to pretension the pipe handling system.

12. The system of claim **11**, wherein the window comprises an inverted V-shape and the header comprises a V-shape and is configured to fit within the window.

13. The system of claim **11**, wherein an upper surface of the portion of the arm abuts against an underside of the header.

14. The system of claim **11**, wherein a pair of opposed side surfaces of the header restrains the portion of the arm from lateral movement.

15. The system of claim **11**, wherein the slot is configured to receive the portion of the arm and restrain upward and lateral movement of the arm.

16. The system of claim **11**, wherein an upper surface of the portion of the arm abuts against an underside of the header to restrain upward movement of the arm and a pair of opposed side surfaces of the header restrains the portion of the arm from lateral movement.

17. A system for resisting upward movement of an arm of a pipe handling apparatus, the system comprising:

a derrick having a window formed therein;

a header within the window of the derrick, the header configured to restrain from upward motion a portion of the arm of the pipe handling apparatus when the arm is extended into the derrick holding a pipe in a vertical orientation;

the header including a body, the body configured to fit within the window of the derrick, the body including a slot formed therein to receive a portion of the arm of the pipe handling apparatus;

the body comprising:

a head mounted in the window and receiving a portion of the arm beneath it so as to resist an upward motion of the arm when the pipe handling apparatus is in the second position; and,

at least one leg extending downwardly from a side of the head, the leg being mounted in the window and receiving a portion of the arm against it so as to resist a sideways motion of the arm when the pipe handling apparatus is in the second position.

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