

April 19, 1966

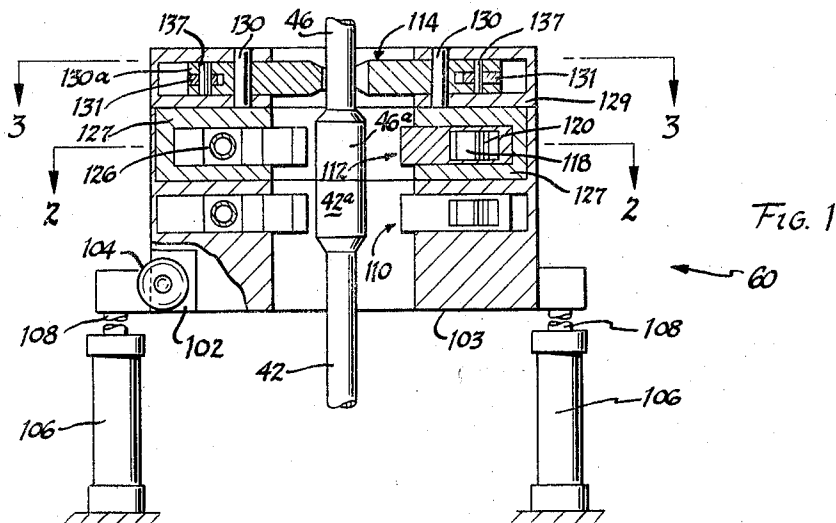
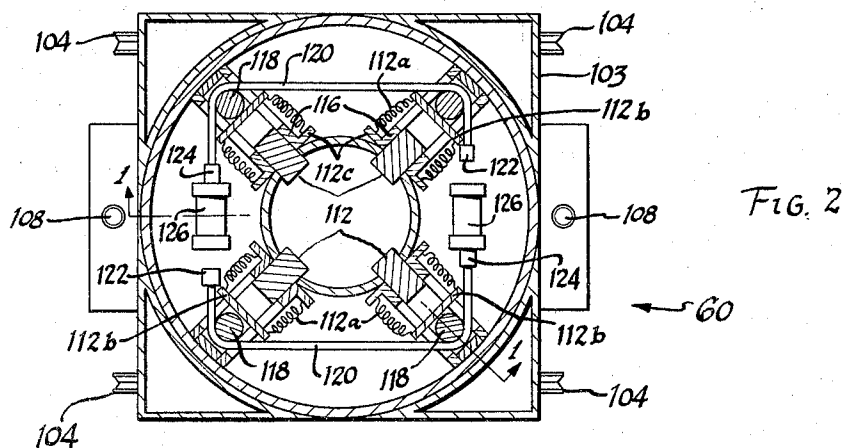
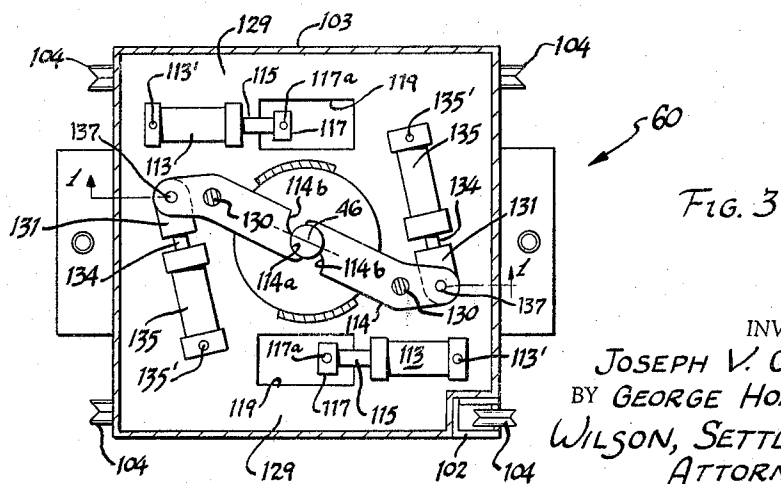
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3,246,547

DRILL STRING SUSPENSION ARRANGEMENT

Filed Aug. 13, 1962

3 Sheets-Sheet 1



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DRILL STRING SUSPENSION ARRANGEMENT

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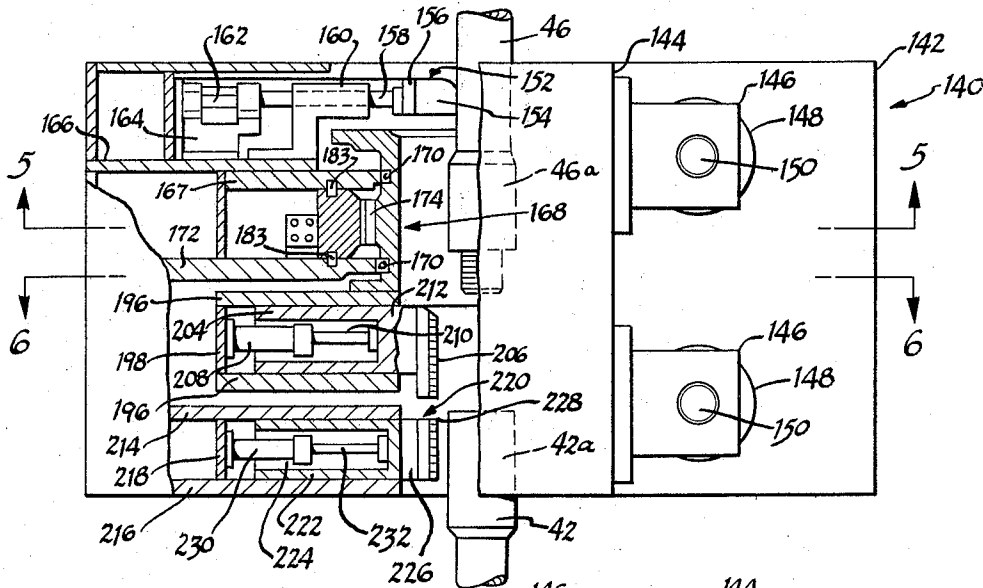


FIG. 4

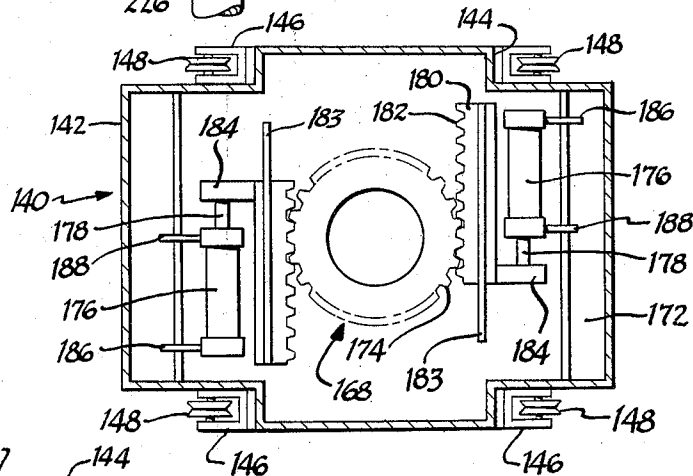


FIG. 5

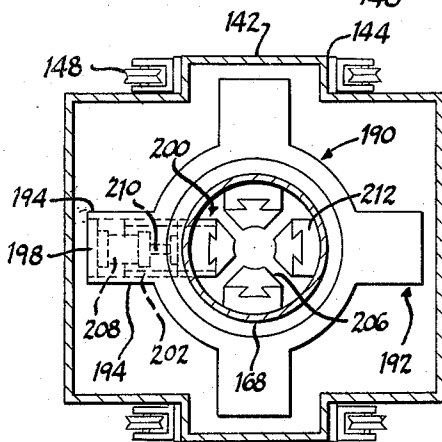


FIG. 6

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DRILL STRING SUSPENSION ARRANGEMENT

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FIG. 9

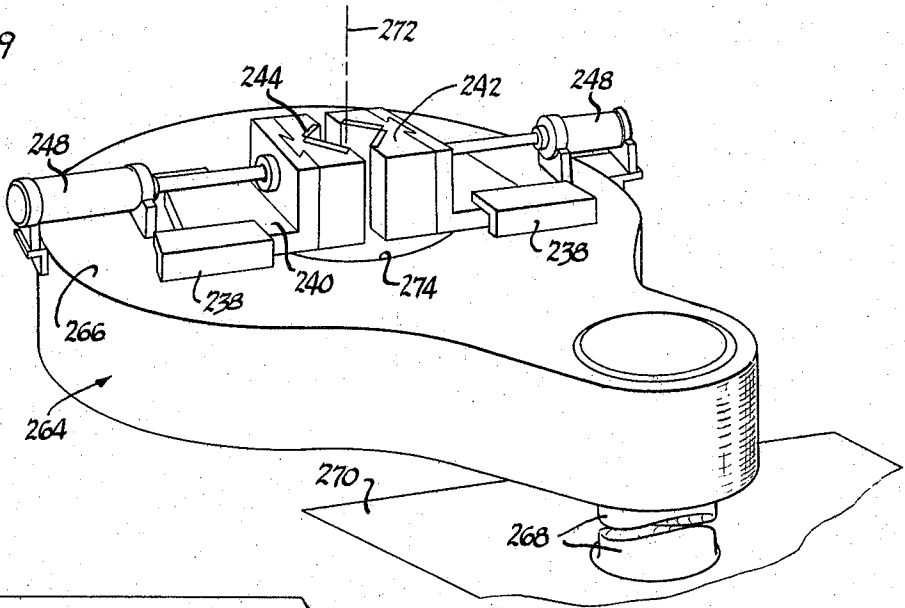
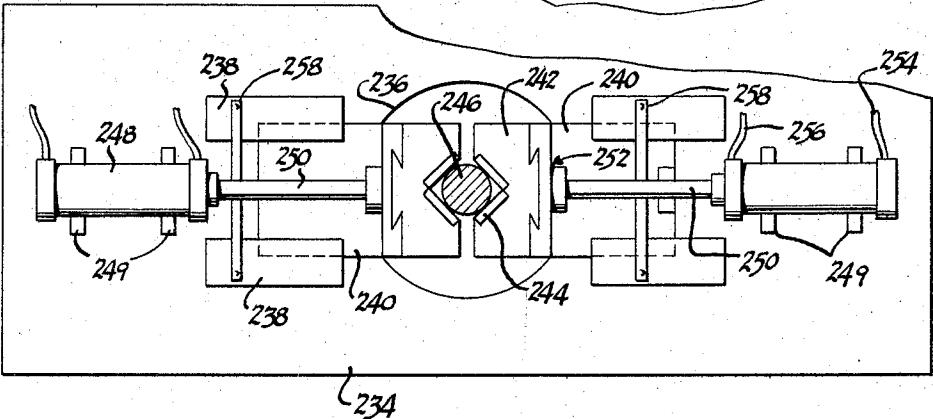


FIG. 7

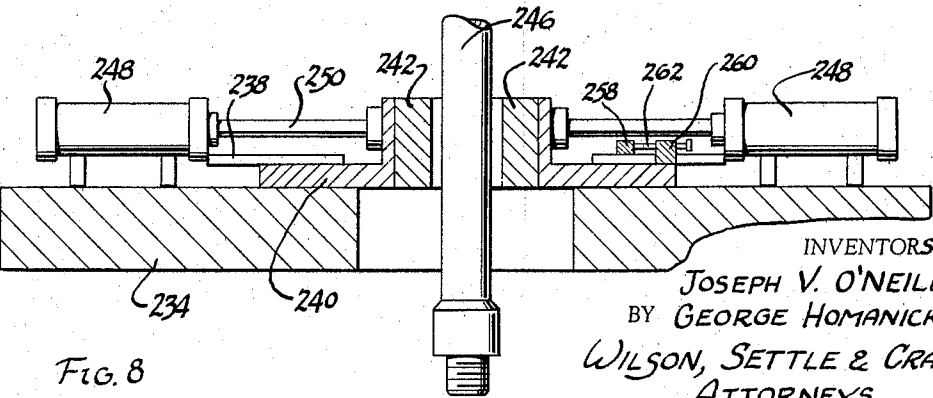


FIG. 8

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DRILL STRING SUSPENSION ARRANGEMENT
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National Bank Building, Cincinnati, Ohio
Filed Aug. 13, 1962, Ser. No. 216,663
6 Claims. (Cl. 81-54)

This is a continuation-in-part of copending application Ser. No. 52,274, filed Aug. 26, 1960, now Patent No. 3,158,213.

This invention relates to well drilling apparatus, and particularly to apparatus which permits the drilling of wells such as oil wells to be carried out automatically, without manual labor, but with human control.

Still further, this invention relates to an improved pipe guide and knocker chuck mechanism making up an integrated component system for the automated drilling of oil wells, characterized by extremely high-speed handling in the making and breaking of pipe joints.

THE PROBLEM

As is well-known, one of the most difficult problems confronting the oil well driller or other person desiring to form bores into or through the crust of the earth, is the handling of long strings of drill pipe in an efficient, accurate and safe manner. Take for instance the situation where an oil well is to be drilled several thousand feet deep into the surface crust of the earth. Presume that by using sufficient sections of drill pipe, the drill bit is at about the two thousand foot level and strikes a hard formation and is broken. This necessitates removal of all of the pipe to expose the bit for repair. Such removal requires that the entire two thousand feet of string be pulled from the hole to expose the drill bit.

For convenience of handling, drill string is conventionally made up into thirty foot lengths, called sections and these are interconnected by means of a box joint at each end. To remove the string it is pulled thirty feet to expose a joint and then power tongs are applied by manual guidance to break the joint. A crew working at top efficiency can remove a section in about two to three minutes under optimum working conditions. Multiplied times several thousand feet, it will be understood that this is a time-consuming operation because both pulling the string and going back into the hole require the repetition of these steps many, many times.

One of the problems associated with the making of joints in a drill string is the bringing together of the threaded ends into alignment to start the threads; this is called "stabbing in." When it is understood that a section of drill pipe weighs as much as 2,500 to 3,000 pounds, it will be understood that it is an unwieldy object when hanging from a block and tackle on a drilling derrick, and men must be very careful to avoid crushed fingers, broken arms and torn flesh when guiding the bottom end of the top section of a string into threaded engagement with the subjacent section. This is extremely hazardous and, representing present conditions, is an extremely antiquated method of operation.

Accordingly, an important step forward in the art would be provided by a mechanized system for making and breaking joints in drill string or casing wherein the pipes are guided into alignment or are stabbed in mechanically without human intervention and wherein the joint is subsequently automatically made by apparatus remotely controlled by an operator to avoid actual manual intervention, and wherein all components are integrated into an automatic system of extremely high speed, accuracy and freedom from danger to human operators.

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OBJECTS OF THE INVENTION

Accordingly an important object of the present invention is to provide well drilling apparatus which can be operated without direct physical human effort, but with human control.

An additional object of the invention is to provide well drilling apparatus which can be operated automatically to add pipe to or remove pipe from a drill string without manual handling of the individual pipe or drill string sections.

A further object of the invention is to provide a drilling apparatus which assumes an improved control over the pipe during the drilling period, string connecting periods and string disconnecting periods.

A further object is to provide a novel drill pipe made-and-break chuck or knocker chuck, incorporating pipe section guide and aligning means.

A still further object is to provide pipe section guiding and aligning means for use in well drilling apparatus.

A further object is to provide a system for making and breaking joints in a string of drill pipe.

A further object is to provide a unitary structural system for making and breaking pipe joints including an automatic guide mechanism in combination with means for gripping a pipe and means for rotating an adjacent pipe.

Other objects of this invention will appear in the following description and appended claims, reference being had to the accompanying drawings forming a part of this specification wherein like reference characters designate corresponding parts in the several views.

FIGURE 1 is a sectional view taken along the lines 1-1 of FIGURES 2 and 3 of a first embodiment of a pipe joint tightening and loosening mechanism of the present invention;

FIGURE 2 is a sectional view taken along the line 2-2 of FIGURE 1;

FIGURE 3 is a sectional view taken along the line 3-3 of FIGURE 1;

FIGURE 4 is an elevational view partly in section illustrating a second embodiment of a knocker chuck of the present invention;

FIGURE 5 is a sectional view taken along the line 5-5 of FIGURE 4;

FIGURE 6 is a sectional view taken along the line 6-6 of FIGURE 4;

FIGURE 7 is a top plan view of pipe guiding mechanism of the present invention;

FIGURE 8 is a side elevational view, partly in section, of FIGURE 7; and

FIGURE 9 is a perspective view showing application of the guiding mechanism of FIGURES 7 and 8.

Before explaining the present invention in detail it is to be understood that the invention is not limited in its application to the details of construction and arrangement of parts illustrated in the accompanying drawings, since the invention is capable of other embodiments and of being practiced or carried out in various ways. Also, it is to be understood that the phraseology or terminology employed herein is for the purpose of description and not of limitation.

PERSPECTIVE VIEW

Briefly, the present invention relates to a novel pipe assembly mechanism for well drilling, typified by oil wells, wherein a set of radially movable guide elements are effective to cradle and guide a pipe section into end threadable relationship with a drill string or adjacent pipe section, and wherein a first set of pipe-gripping jaws is effective to hold a drill string while a second set of pipe-gripping jaws is effective to make or break the joint.

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In one embodiment of the invention, the guiding elements move in a radially-extending arcuate path and in another embodiment of the invention, the guiding elements move in a linear radial path. In both instances the guiding elements can cooperate with make-and-break mechanism or tongs to provide an automatic and fully integrated system for stabbing in, making, and breaking pipe joints at high rates of speed and without manual labor, only human push-button control being utilized.

In view of the foregoing brief introduction, a full and complete description of the various embodiments of the invention will now follow.

THE EMBODIMENT OF FIGURES 1, 2, AND 3

As described in the copending application, Ser. No. 52,274 filed Aug. 26, 1960, of which the present application is a continuation-in-part, one typical embodiment of the present invention comprises a combination guide and make-and-break chuck mechanism adapted for use in an automated oil well drilling system and utilizes guiding jaws which are movable radially but in a slight arcuate path to cradle and guide a pipe section into connecting relationship with a string, and which cooperates with powered jaws to make and break a pipe joint.

Referring now to FIGURES 1, 2 and 3, it will be noted that the first embodiment of the invention is designated as a joint loosening-tightening mechanism 60. Referring to FIGURE 1, the mechanism comprises a housing 103, having brackets 102 carried thereon journalling V-rollers 104, which rollers are adapted to engage vertical tracks not shown but referred to in the parent application Ser. No. 52,274, to mount the mechanism 60 for vertical movement within a well-drilling derrick structure. In order to provide power for moving the mechanism 60 in vertical directions in accordance with the environment of the parent application, fluid cylinders 106 are provided that are equipped with piston rods 108. Of course, it will be understood that in the broad aspects of the invention, other means can be used for transporting the mechanism 60 vertically, horizontally or in other directions, and that the descriptions of the fluid cylinders are not to be considered limiting upon the scope of invention.

PIPE GUIDE JAWS

Referring further to FIGURE 1, it will be noted that there are provided three sets of jaws indicated generally by the differentiating numerals 110, 112 and 114. Jaws 114 serve as retractable guiding devices for guiding an upper pipe or free section into a lower pipe or drill string during pipe-connecting or disconnecting movements, the purpose of the retracting feature of jaws 114 being to permit enlargement of the central space within mechanism 60 as required during certain periods of drilling, such as when casing up the hole.

As further shown in FIGURE 3, each of the jaws 114 is provided with two arcuate pipe-contacting surfaces 114a and 114b. Contact surfaces 114a are operative to guide drill pipe, and contact surfaces 114b are operative to guide larger diameter casing (when piston rod 134 is advanced from cylinder 135). It will be understood that the stroke of each piston rod 134 is regulated so that the surfaces 114a and 114b have a relatively loose, guiding-type engagement with the pipe or casing, whichever is being handled. For this purpose a stop mechanism as described with reference to FIGURES 7 and 8 also can be employed.

Each of the jaws 114 is formed as a lever, fulcrumed on a pin 130, carried in housing 103. The back end of each lever is bifurcated, see FIGURE 1, to form vertically-spaced finger portions 130a for reception of a flange or plate-like connector 131, carried on the end of the piston rod 134 of fluid cylinder 135.

A pivot pin 137 is provided to operatively connect each

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lever 114 with its respective flange and piston rod 131, 134. Also, the cylinders 135 are mounted on pivot pins 135' for pivotal movement.

It will be understood from the foregoing description and illustrated arrangement that suitable introduction of pressurized hydraulic fluid into the cylinders 135 is effective to retract the piston rods 134 so as to cause the lever jaws 114 to pivot in a manner carrying the arcuately-shaped pipe-contacting surfaces 114a and 114b radially inwardly to cradle drill section 46, see FIGURE 1, for guiding the pipe section accurately into the central space between jaws 114 (FIGURE 1). The guiding action is of vertical nature and provides a substantial advance in the art, ensuring that the threads of the male portion 46a on the lower end of pipe section 46 correctly align with and enter into the threads of the female portion 42a on the upper end of the pipe or drill string 42.

It is important to note at this point that conventionally the thread-aligning operation or "stabbing-in" operation, as this is called in the oilfields, is performed manually, and due to the heavy weight of a pipe section, in the range from 2,500 to 3,000 lbs., a swinging or pendulum action is generally imparted to the upper pipe as when it is hanging from the hoisting block. This pendulum action makes alignment and threading of the pipes a very difficult and dangerous operation which leaves much to be desired as regards high speed. However, by the illustrated arrangement of jaws 114 above the joint-tightening jaws 112 as will be described later, the stabbing-in operation may be performed quickly and absolutely without manual assistance or intervention. The only necessity is that the lower end of the section 46 be brought within the relatively large guiding area or zone provided by the jaws 114 in their retracted position. Then, the jaws are actuated to move the pipe to center and hold it there once the arcuate surfaces 114a have taken effect.

THE TOP ROTATABLE TIGHTENING JAWS

As best shown in FIGURE 2, each of the tightening jaws 112, previously referred to, is mounted for movement toward and away from the well hole axis by means of a guide 116. Each jaw 112 carries a pin or roller at 118, and a chain, cable, strap or the like 120 is trained around all four rollers 118. In FIGURE 2, two cables 120 are shown, one for each pair of adjoining jaws 112. One end of each cable 120 is anchored as at 122, and the other end of each cable is connected with a piston rod 124 of a fluid cylinder 126. By this configuration of apparatus, hydraulic fluid can be introduced into the two cylinders 126 to draw the piston rods 124 inwardly to exert a pull on the cables 120, in effect shortening the cables and drawing the pins 118 radially toward the axis of the well hole.

To retract the jaws 112, as shown in FIGURE 2, return springs 112a are employed. Such springs 112a are mounted by means of a plate 112b fastened as by welding to the back of each jaw 112. Slots to accommodate the plates 112b are provided in each side of the guides 116 and the rear end of each spring 112a is connected to a plate 112b as by a small socket. At the front end of each of the sides of the guides 116, there is provided a retainer plate 112c having a socket to receive the front end of the spring 112a. From the foregoing it will be understood that when a jaw 112 moves forward toward the axis of the well hole, the springs 112a will be compressed and will store sufficient energy to return the jaws 112 to retracted position when fluid pressure is released from cylinders 126.

The jaws 112 and the power cylinders 126 are mounted on a rotary platform or subhousing 127, FIGURE 1, carried in the space below a partition wall 129 extending transversely of the main housing 103. Partition wall 129 is provided with slots 119, see FIGURE 3, through which extend connecting lugs or brackets 117,

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Each bracket 117 extends upwardly from a portion of sub-housing 127 and is connected by means of a swivel connection at 117a with a piston rod 115 of a double-acting fluid cylinder 113. It will be noted that the rear fixed end of the cylinder 113 is pivotally mounted on a pin 113', fastened to partition 129. The arrangement is such that suitable introduction of pressurized fluid into each cylinder 113 causes the entire subhousing 127 to be rotated relative to the housing 103 for effecting an initial loosening or final tightening of a joint between the upper pipe section 46 and the lower pipe string 42, see FIGURE 1.

THE STRING GRIPPER JAWS

By reference to FIGURE 1, it will be noted that the drill string 42 is gripped and held against rotation by a set of four radially-movable jaws 110. In the illustrated embodiment, these jaws are powered by cable-fluid cylinder means and retracting springs similar to that shown in FIGURE 2 for jaws 112. However, jaws 110 are mounted on housing 103 and are not rotatable, rather than on a rotary subhousing as in the case of jaws 112.

OPERATION

In summary, it will be understood that jaws 114 function as retractable pipe guides, and that jaws 112 and 110 perform the actual tightening or loosening operations relating to making and breaking a joint in the drill string. The torque for final make-or-break is provided by the powerful hydraulic cylinders 113 shown in FIGURE 3.

It will be appreciated that the stroke of piston rods 115 is insufficient to completely form the threaded connection between the drill string 42 and the pipe section to be added or removed, 46. Thus the cylinders and rods 113, 115 serve to finally make or initially break the joint, and the subsequently spinning-off or the initial spinning-on of the joint is performed by operation of fluid motors of a vertically movable drill head, as described in the parent application, Serial No. 52,274, filed Aug. 26, 1960.

THE SECOND EMBODIMENT OF FIGURES 4, 5 AND 6

Within the broad scope of invention, the present invention can utilize radially-movable guide jaws in combination with radially movable make-and-break jaws. To illustrate this aspect of the invention, reference is now made to FIGURES 4, 5 and 6, where there is shown a unitary make-and-break and guide structure incorporating such features. The knocker chuck of FIGURES 4, 5 and 6 is designated by the reference numeral 140 and includes an outside housing 142 of generally square box-like configuration and optionally having off-sets 144 along opposed sides to accommodate roller support brackets 146. Rollers 148 are journaled on support shafts 150 carried by the brackets 146 and are adapted to cooperate with suitable tracks, not shown, carried by a drilling derrick for lineal vertical movement of the knocker chuck 140. Of course it will be understood that a suitable elevating or lowering mechanism will be provided to raise and lower the knocker chuck 140. Typical moving elements will include hydraulic pistons, line hoists or other apparatus.

THE PIPE GUIDE JAWS

In the upper part of the outer housing 142, as shown in FIGURE 4, are four 90° spaced pipe guide jaws 152. The jaws 152 are mounted to move radially inwardly to engage the lower end of a pipe section 46, above the male box portion 46a. The pipe 46 is thus centered in the chuck 140 to be accurately guided into alignment with the female box portion 42a of the uppermost section 42 of the drill string. Thus, while the pipe 42 and thus the drill string is held stationary and the free section 46

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is rotated by suitable means and moved downwardly, the threads of the male section 46a engage the threads of the female section 42a to spin in the joint. To finally torque up to make the joint, additional power is provided by a set of rotatable pipe-gripping jaws for the male portion 46a of section 46, cooperating with a set of non-rotatable holding jaws for the female portion 42a of the pipe 42. These cooperable sets of jaws will be described later after a finalizing description of the elements of the pipe guide jaws 152 and their actuation.

As shown in FIGURE 4, the pipe guide jaws 152 of the knocker chuck 140 consist of pipe guide blocks 154 carried by heads 156 mounted on piston rods 158 which slidably extend through supports 160. Piston rods 158 terminate in pistons slidably mounted within cylinders 162 carried by pedestals 164 which in turn are carried by a transverse wall 166 of outer housing 142 of the knocker chuck 140.

When the pipe 46 is lowered into the knocker chuck 140, pipe guide jaws 152 are moved radially inwardly by actuation of pistons 162 to slidably engage the pipe after the male end 46a has passed beyond the guide jaws. Because of a slight clearance maintained between the jaws 152 and the exterior of the pipe 46, the pipe is permitted to be spun to make up the tool joint. No serious abrasion of the pipe 46 results from its turning relative to the guide jaws 152 because the blocks 154 are formed of abrasion-resistant material, such for example as a plastic or soft iron.

THE MAKE-AND-BREAK JAWS

As in the previous embodiment of the invention, one bank of make-and-break jaws is characterized by an ability to be slightly rotated to make and break a tool joint, and for such operation must be mounted within a subhousing rotatable relative to the knocker chuck itself.

In FIGURES 4 and 5 the rotatable housing is designated by the reference numeral 168 and is mounted in vertically spaced bearings 170 carried by the upper transverse wall 166, 167 and the lower transverse wall 172. It will be noted that the inside diameter of the housing 168 is substantially larger than the diameter of the drill pipe 46, thus being enabled to accommodate larger diameter casing sections.

It will also be noted by reference to FIGURES 4 and 5 that the periphery of the rotatable housing 168 is provided with gear teeth 174, adapted to be engaged with an actuating rack to be hereinafter described.

A better understanding of the actuating mechanism can be had by reference to FIGURES 4 and 5 together. Thus, as shown, two cylinders 176 are secured to the top side of wall 172 with piston rods 178 extending therefrom. Geared racks 180, having gear teeth 182 of a configuration to mate with the gear teeth 174 of rotatable housing 168, are mounted on guideways for lineal movement alongside the cylinders 176. The slidable mounting is provided by upper and lower keys 183, carried by the upper transverse wall 167 and the lower transverse wall 172, being positioned in vertically spaced parallel alignment.

Connection between the racks 180 and the piston rods 178 of cylinders 176 is provided by an outwardly-extending bracket arm 184 and connection to the piston rod is effected as by welding or equivalent.

It should be pointed out that hydraulic lines 186 and 188 are connected to each end of cylinders 176 for appropriate flow of hydraulic fluid from a source not shown.

It will be understood from the foregoing that appropriate application of hydraulic fluid to the cylinders 186 is effective to impart right or left rotation to the housing 168.

THE PIPE-GRIPPING JAWS OF THE ROTATABLE HOUSING

By reference to FIGURES 4 and 6, the mounting of the pipe-gripping and rotating jaws will now be described.

The housing 168, as shown in FIGURE 6, carries a subjacent cylinder and jaw-carrier 190 of circular configuration and including four 90° spaced box guides 192 extended radially. Box guides 192 include side walls 194, FIGURE 6, and top and bottom walls 196, FIGURE 4. The back end of each box guide 192 includes a transverse closing wall 198.

Within each of the box guides 192 there is fitted a mating box section slidable gripper jaw carrier, designated by the reference numeral 200, FIGURE 6, and including side walls 202, FIGURE 6, and top and bottom walls 204, FIGURE 4. The exterior dimension of the gripper jaw carrier is of a size slidably mating to the interior of the box guide 192.

As shown in FIGURE 6, a chuck or jaw 206 is keyed to the end of each of the gripper jaw carriers 200 and provided with a concavity to mate with the exterior of a drill pipe section.

Movement of the gripper jaw carrier 200 and jaws 206 is effected by means of a hydraulic cylinder 208 fastened at its back end to the closing wall 198. The piston rod 210 extends forwardly from the cylinder 208 and is connected to the head 212 of the gripper jaw carrier 200.

Although not shown, for greatest drawing clarity it will be understood that appropriate hydraulic lines are connected into the cylinders 208 for operation thereof.

From the foregoing it will be understood that application of hydraulic fluid to the cylinders 208 will be effective to move the chucks or jaws 206 into gripping relation with the male portion 46a of the pipe 46, FIGURE 4. Thereafter, application of hydraulic fluid to the cylinders 176, FIGURE 5, will be effective to rotate the housing 168 to make or break a joint as desired.

Cooperating with the jaws 206 is a lower set of hydraulically-actuated holding jaws that will now be described.

THE DRILL STRING-HOLDING JAWS

By reference to FIGURE 4, it will be noted that a transverse wall 214 is mounted within the outer housing 142 of the knocker chuck 140. Also, a bottom wall is provided at 216. Between the walls 214 and 216 are provided vertically disposed cylinder support walls 218 and a suitable embodiment of the invention would include four such walls spaced at a 90° relationship around the drill string axis within the housing 142. Between the walls 214 and 216 there are provided vertically-extending side walls of box guides similar to the box guides 192 described with reference to FIGURE 6. Within these box guides are slidably mounted gripper jaw carriers 220, having top and bottom walls 222 and side walls 224 forming a box guide having a head 226 carrying a jaw 228. A cylinder 230 has its back end connected to the cylinder support wall 218 in abutting relation and the piston rod 232 thereof extends forwardly to be connected to the back end of the head 226 for actuating the gripper jaw carrier 220.

From the foregoing it will be understood that when four such units are spaced in 90° array around the female portion 42a of the drill string pipe 42, with the cylinders 230 actuated to drive the piston rods 232 forwardly, the jaws 228 will grip the female portion 42a. Since the jaws 228 are non-rotatable, the drill string 42 will thereby be held against rotation so that when torque is applied to the superjacent jaws 206, a joint 42a, 46a can be either made or broken as desired.

SUMMATION

From the foregoing, it will be noted that a combination of three elements make up an important combination in accordance with the present invention. Thus, the bottom holding jaws 228 cooperate with the top holding and rotatable break-out or make jaws 206 to make or break a pipe joint. Working in connection with these elements,

the pipe guide jaws 152 guide the pipe 46 into alignment with the pipe or drill string 42, thereby removing the heretofore dangerous manual operation of guiding a drill section into alignment with the drill string to make a joint. To those skilled in the art, the dangers inherent in this prior operation will clearly bring forth the advance provided in the art by the present invention.

THE GUIDE APPARATUS OF INVENTION

As shown in FIGURES 7 and 8, an important aspect of the present invention resides in the automated pipe guiding element, used in conjunction with the subjacent make-and-break jaw combination.

Although shown in the prior embodiment as incorporated in a unitary housing with make-and-break jaws, it is to be included within the broad scope of invention that the guiding concept of the present invention can be utilized with commercially available make-and-break apparatus wherein the axis of the make-and-break chuck is made to operate coincident with the drilling axis, to provide a substantial advance in the art over the manual guiding systems now and heretofore employed.

With the foregoing in mind, a complete and full description of FIGURES 7 and 8 will now be provided.

As shown in FIGURES 7 and 8, the guiding apparatus is mounted upon a base 234 having an opening 236 of substantial size to accommodate drill string, casing pipe or the like. Although not shown, it is to be understood that the base 234 is movable, as by means of hydraulic cylinders or suitable pivoting apparatus.

On the top surface of the base 234 there are provided guide blocks 238 which are positioned in spaced parallel alignment on each side of the hole 236, in pairs to accommodate opposed slide plates 240, each of the slide plates 240 terminating at its forward end in a keyed-on head 242, carrying two guide jaws 244 positioned in 90° spaced array to form a V adapted to rotatably cradle a drill pipe as at 246. Heads 242 are replaceable for different diameter pipes.

Hydraulic cylinders 248 are connected to the top side of the base plate 234 by means of supports 249 in axial alignment to the guide blocks 238 and the slide plates 240, and the piston rods 250 thereof are connected as at 252 to the back side of the head 242. Hydraulic lines 254 and 256 are provided for cylinders 248 to drive piston rods 250 in a reciprocating fashion.

It will be understood from the foregoing that actuation of cylinders 248 is effective to drive the guide jaws 244 toward each other to cradle the pipe 246.

Appropriate clearance of the jaws 244 relative to the pipe 246 is provided by stop mechanism now to be described, which limits the travel of the heads 242 toward the drilling axis, thus providing rotational clearance between the jaws 244 and the pipe 246.

To provide the adjustable stop mechanism, it will be noted from FIGURES 7 and 8 that a cross member 258 is provided between each of the pairs of guide blocks 238. On the back of each of the slide plates 240 there is provided a vertically-extending stop member 260, having a threaded member 262 thereon to abut the cross member 258. By suitable adjustment and setting of the bolt 262, it will be evident that proper clearance of jaws 244 relative to the drilling axis or exterior of pipe 246 can be provided.

With the above stop mechanism, it will be understood that when cylinders 248 are actuated, the jaws 244 are moved toward each other and stopped at appropriate clearance to rotatably receive the pipe 246.

Other stop configurations of course fall within the scope of invention.

It is to be considered within the extended scope of invention that one set of jaws 244 can be elevated slightly above the other set of jaws and extended in length to form overlapping V's or a scissor-type action. Thus, when a pipe 246 is within the perimeter of the hole 236 of plate

234, the jaws can be moved forward and will center the pipe 246 to the drilling axis positively and accurately. This will allow the catching of more wildly swinging pipe.

It will be understood from the foregoing that when the guiding embodiment of FIGURES 7 and 8 is applied to substantially any drilling equipment, including that of the foregoing two embodiments of the invention, the manual effort of guiding or stabbing a pipe section into mating relationship with a drill string is obviated in favor of a more positive and danger-free set of mechanical hands that not only guide the pipe but hold the pipe during the threading operation in a manner which has not heretofore been possible. An important advantage of the guiding aspect of the present invention is that the positive guiding provided reduces the tendency of thread abrasion as the box joints of the pipe are brought together in the threading up operation.

EXTENDED SCOPE OF INVENTION

As shown in FIGURE 9, the broad scope of the present invention resides in the use of the guide mechanism shown in FIGURES 7 and 8 with a torquing chuck of presently available commercial utility. Thus, such an embodiment comprises a housing 264 having a top 266, with the housing 264 supported upon a column 268 mounted upon a drilling table or similar support 270. Within the housing 264 there is provided a known pipe joint torquing mechanism comprising a set of rotatable pipe-gripping jaws. In connection with this known apparatus, the present invention comprises the mounting of the hydraulic cylinders 248 on the top wall 266, by means of blocks 249 with the heads 242 movable radially to the drilling axis 272. It will be understood from the foregoing that when the heads 242 are retracted, a drill pipe can be swung into position above the opening 274, the heads 242 quickly actuated to position or center the pipe, which is thereafter lowered in slidable relationship through the jaws 244 as above described, to make a pipe joint.

When a pipe joint is being broken, the jaws 244 and heads 242 are retracted at the appropriate instant.

In FIGURE 9 the guide mechanism 242, 244, etc. is shown mounted directly on top of the surface 266 of housing 264. However, it is to be understood that the distance of the unit above housing 264 can be varied, commensurate with necessary clearance for the box ends of the pipe being handled.

Also, as regards FIGURE 9, it is to be understood that stop mechanism similar to 258, 260 of FIGURES 7 and 8 will be utilized, but have not repeated for purposes of drawing clarity.

While the foregoing embodiments have been defined and described with respect to the use of hydraulic cylinders, and terminology is to include fluid cylinders, including both liquid and gas-operated cylinders.

As regards the embodiments of FIGURES 1-3, the retraction springs 112a can be replaced by return hydraulic cylinders if desired. The springs however provide a very simple and effective structure, and of course as will be understood, the retracting cylinders would add some complexity in the form of additional hydraulic circuitry. However, such is to be included within the scope of invention.

While the various embodiments of the invention, namely the FIGURES 1-3 and FIGURES 4-6 embodiments, have included housings having guide rollers 104 and 148 respectively, for movement along vertically disposed trackways carried by a drilling derrick, it is of course to be understood that other forms of vertical guides can be provided within the broad scope of the invention. Also, cable lifts, hydraulic cylinders and the like can be included for vertical movement of the make-and-break mechanism for appropriate positioning with

respect to a box joint, for either making or removing drill string.

In a further extended scope of invention, the structure of FIGURES 7 and 8 can comprise two or more separately pivoted units, i.e. visualize the support base 234 split at the center and pivotally mounted at the back edge to swing relatively to the drill axis. When so operating, appropriate mechanism will be provided to position the heads 242 in alignment for operation. This could comprise an abutment in combination with a swing cylinder, connected between a base section 234 and a fixed joint.

CONCISE SUMMARY

From the foregoing it will be understood that the broad concept of the present invention resides in the following features:

(A) A set of guide jaws which are actuatable radially either in linear or arcuate manner to within a given clearance of the drilling axis to accommodate a drill pipe in relatively rotatable relation to the drill pipe. Note that in FIGURES 7-8 only two jaws have been shown. It will thus be understood that the broad scope of invention includes a plurality of at least two jaws movable to a controlled clearance relative to the drilling axis.

(B) An upper set of relatively rotatable pipe-gripping jaws, cooperating with a lower set of radially fired but non-rotatable gripping jaws to be mounted on a unitary housing with the guiding elements of A above to make or break a pipe joint.

(C) The radially fired guide jaws of A cooperating with the two sets of jaws of B to guide a pendulum swinging drill stem section into accurate alignment with a drill string to make or break a joint in the string.

ADVANTAGES

From the foregoing it will be understood that improved mechanism is provided in accordance with the present invention to align a section of drill pipe with a drill string to make or break a pipe joint. It will be understood that all manual operations except push-button control are removed and the hazards associated with the prior methods of making and breaking string are avoided.

Further, the addition of a section of pipe or casing is accurately guided while a pipe joint is being made or broken, thereby reducing the abrasion and damage caused by the prior art swinging of the pipes relative to one another. Thus, it is an inherent advantage of the present invention that extended service life of the drill pipe is provided.

An important feature of the invention is the removal of the danger of broken arms and crushed fingers and hands by a two-ton dangling pendulum swinging section of drill pipe, without the cumbersome use of ropes in accordance with the prior art. Thus the invention provides an advance in the making and breaking of string in a high-speed, more accurate, and safe fashion.

Another important advantage of the present invention is the provision of an integrated system of mechanism for making and breaking pipe joint for high-speed drilling operations.

We claim:

1. In combination for stabbing in drill pipe, a housing defining an opening having an axis and encircled by a continuous wall,
 - a first set of a plurality of pipe gripper jaws carried by said housing for transverse movement relative to said axis,
 - power means in said housing for moving said first gripper jaws, said first gripper jaws being adapted for radial movement only of said axis,
 - a rotatable carrier positioned coaxially within said housing,
 - power means in said housing for rotating said carrier,

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a second set of pipe gripper jaws on said rotatable carrier for movement radially of said axis,
 power means on said carrier for moving said second gripper jaws in said radial fashion,
 a plurality of guide jaws positioned adjacent said second pipe gripper jaws and movable radially relative to said axis to guide a pipe with joint-stabbing accuracy, power means carried by said housing for moving said guide jaws,
 and means on said housing limiting the degree of movement of said guide jaws toward said axis.

2. In a make-and-break chuck for pipe stabbing, a housing defining an opening having an axis, a plurality of pipe guide arms pivotally mounted intermediate the ends on said housing in a common plane and having free pipe guide ends movable toward and away from said axis to guide a pipe for stabbing, hydraulic cylinders operatively connected to the other ends of each said guide arm to move said guide arm pivotally,
 an annular carriage rotatably mounted in said housing coaxial to said opening,
 a plurality of pipe-gripper jaws mounted on said carriage for radial movement relative to said opening, means on said carriage and operatively connected to said jaws to move the same,
 a plurality of pipe-holding jaws carried by said housing for radial movement only relative to said axis, and means on said housing and operatively connected to said holding jaws to move the same.

3. In a make-and-brake chuck for pipe stabbing, a housing defining an opening having an axis, a plurality of pipe guide jaws slidably mounted in said housing in a common plane for radial movement relative to said opening to guide a pipe for stabbing, means limiting movement of said guide jaws toward said axis,
 a hydraulic cylinder connected to each said guide jaw to effect said radial movement thereof,
 a subhousing rotatably mounted in said housing coaxial to said opening,
 a plurality of pipe-gripper jaws slidably mounted on said subhousing for radial movement relative to said opening,
 hydraulic cylinder means on said subhousing and operatively connected to each said gripper jaw to move the same in said radial fashion,
 a plurality of pipe-holding jaws mounted in a common plane adjacent said gripper jaws and mounted for slidable radial movement only toward and away from the axis of said opening,
 and hydraulic cylinder means connected between said housing and each said gripper jaw to move the same in said radial manner.

4. In pipe joint loosening-tightening mechanism for stabbing joints, including a housing defining an opening having an axis,
 a set of pipe guide jaws pivotally mounted in the top part of said housing and powered into guiding relation to a first pipe section positioned along said axis to stab in a joint,
 a lower set of pipe-gripping jaws radially movable into gripping engagement with a second pipe section positioned along said axis,
 a rotatable carrier mounted in said housing intermediate said guide jaws, and said lower pipe-gripping jaws,
 an upper set of pipe-gripping jaws mounted on said

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carrier and radially movable into gripping engagement with the first pipe section,
 and means for rotating said carrier
 whereby said lower jaws are adapted to grip the top of the second section and said guide jaws guide the bottom end of the first section into accurate stabbing engagement therewith, and said carrier jaws thereafter partially rotate said first section into final connecting engagement with said second section.

5. In a pipe joint loosening-tightening mechanism for stabbing in pipe joints including a housing defining an opening having an axis,
 a set of pipe guide jaws pivotally mounted in the top part of said housing and powered into guiding relation to a first pipe section positioned along said axis to stab in the joint,
 a lower set of pipe-gripping jaws radially movable into gripping engagement with a second pipe section positioned along said axis,
 a circumferentially movable carrier mounted on said housing intermediate said guide jaws and lower gripping jaws,
 means for moving said carrier,
 and an upper set of gripping jaws on said carrier and movable into gripping engagement with the first pipe section whereby said lower jaws grip the top of the second pipe section and said guide jaws guide the bottom end of the first section into connecting engagement therewith, and said carrier jaws thereafter grip and slightly turn said first section into final connecting engagement with said second section.

6. In a make-and-break chuck for stabbing in pipe joints,
 an annular support housing defining an opening having an axis to accommodate a drill pipe section having box ends,
 radially movable pipe guide arms pivotally mounted at one end within said housing to swing to and from guiding positions relative to said axis to guide a pipe with joint-stabbing accuracy,
 fluid power means carried within said housing and operably connected to said guide arms for moving said arms toward and away from said axis,
 and means within said housing operably associated with said guide means for torquing and untorquing a pipe joint.

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