HYDRAULIC PIPE TONG APPARATUS

Inventor: Charles E. Carberg, Houston, Tex.
Assignee: Byron Jackson, Inc., Long Beach, Calif.

Filed: Feb. 17, 1972
Appl. No.: 227,522

U.S. Cl.......... 269/26, 81/57.19, 269/157
Int. Cl........ B23q 3/08
Field of Search 269/25, 26, 157, 81/57.16, 81/57.34, 57.19, 57.21

References Cited
UNITED STATES PATENTS
2,708,382 5/1955 Olson 269/157 X
2,174,550 10/1939 Chapman 269/25 X
3,540,326 11/1970 Dickmann et al. 81/57.18
3,246,547 4/1966 O'Neill et al. 81/57.34
2,705,614 4/1955 McKibben et al. 269/25 X
963,345 7/1910 Wood 269/157 X
2,230,288 2/1941 Dindl 269/25 X
2,567,039 9/1951 Stone 269/25
3,302,496 2/1967 Mitchell et al. 81/53 R

FOREIGN PATENTS OR APPLICATIONS
3,420,148 1/1969 Doerfer et al. 269/26 U X
3,548,692 12/1970 Dickmann 81/57.21 X
831,292 3/1960 Great Britain 269/25

Primary Examiner—Harold D. Whitehead
Assistant Examiner—J. T. Zatarga
Attorney, Agent, or Firm—William S. McCurry; James M. Peppers

ABSTRACT
Pipe gripping apparatus carried by a support frame including a hydraulic piston radially supported in fixed relation within the frame through a piston rod. A movable combination blind cylinder and pipe jaw is fitted around the piston for radial movement toward and away from gripping relation with pipe. The piston and cylinder defines a fluid pressure chamber connected to pressuring means for introducing fluid under pressure into the chamber to move the cylinder and pipe jaw into gripping engagement with pipe. A retraction arrangement is provided to move the cylinder and pipe jaw away from the pipe.

6 Claims, 3 Drawing Figures
HYDRAULIC PIPE TONG APPARATUS

BACKGROUND OF THE INVENTION

The present invention relates to pipe tongs, and more particularly to an improved hydraulic pipe gripping back-up tong adapted to be employed in combination with a power driven tong so that the parts of a well pipe may be connected or disconnected, the pipe gripping means of the back-up tong having application as well to other pipe tongs. The pipe gripping means employs a fixed piston unit cooperating with a movable combination cylinder and jaw carrying unit equipped with pipe gripping jaws.

The present invention pertains to improvements in back-up tongs such as disclosed in U.S. Pats. No. 3,246,547, No. 3,302,496 and No. 3,507,174, and which may be utilized with pipe handling apparatus such as disclosed in U.S. Pats. No. 3,505,913, No. 3,516,308 and No. 3,540,326, for example.

SUMMARY OF THE INVENTION

The present invention provides pipe gripping apparatus wherein the pipe gripping force may be varied independently of torque applied to connect or disconnect pipe.

The present invention also provides pipe gripping apparatus of relatively simple and inexpensive construction.

The present invention further provides pipe gripping apparatus wherein the size and number of pipe gripping units employed in the apparatus may be readily varied within specified dimensional limits to accommodate different torque requirements.

The foregoing and other provisions and advantages reside in pipe tong apparatus of the present invention comprising a support frame having a center adapted to receive pipe and pipe gripping means carried by the support frame including a hydraulic piston disposed radially toward said center and supported in fixed relation within the frame through a piston rod. A movable combination cylinder and pipe jaw is fitted around the piston for radial movement toward and away from gripping relation with the pipe. The piston and cylinder defines a fluid pressure chamber communicating with pressurizing means for introducing fluid under pressure into said chamber to move said cylinder and pipe jaw into gripping engagement with said pipe. Retraction means is provided to move the cylinder and pipe jaw away from the pipe.

BRIEF DESCRIPTION OF THE DRAWING

FIG. 1 is an elevational view showing a power tong and a back-up tong adapted to be utilized with pipe being inserted and withdrawn from a well bore;

FIG. 2 is a partially sectional and fragmentary plan view of the back-up tong as taken along the line 2--2 of FIG. 1, and

FIG. 3 is a fragmentary sectional view taken along the line 3--3 of FIG. 2.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring first to FIG. 1, there is generally illustrated a back-up tong assembly 10 and a power tong assembly 12 adapted to be supported above the floor (not shown) of the usual well drilling unit mounted above a well bore. Pipe, such as drill pipe or casing, is adapted to be run into and pulled from the well bore. Such a pipe is illustrated in FIG. 1 as including an upper stand of pipe 14 in the illustrative form of a stand of drill pipe having a tool joint pin end 18 thereon adapted to be threadedly connected by the tong 12 to the box end 20 of a length or stand of the pipe 16 disposed in the well bore. In order to support the tong assembly 12 in an operative position above the well bore so that the stand of pipe 14 may be lowered therethrough for engagement with the pipe 16, a suitable crane 22 is provided, including a boom 24 projecting from a vertically disposed post 26. A cable 28 extends over sheaves 30 and is connected to a pressure operated cylinder mechanism 32 disposed within the post 26 whereby the tong assembly 12 may be raised and lowered relative to the post 26 and thereby relative to the well bore into which or from which pipe is being removed. Also forming a part of the crane 22 is a counterweight 34 slidably vertically along the post 26, there being a second cable 36 also connected to the upper end of cylinder 32, extending over a sheave 38, and connected also to the counterweight 34 so that the mass of the tong assembly may be properly supported. This crane assembly may be of any desired type such as herein shown and in accordance with the disclosure in U.S. letters Pat. No. 3,505,913, for example.

The tong assembly, as is typical of tongs of the type here involved, includes a head section generally denoted at 40 and a supporting and power transmission section generally denoted at 42. The power transmission section in the illustrative embodiment has a hydraulic motor 44 adapted to be connected to a suitable source of motive fluid under pressure (not shown) so as to drive the transmission mechanism of the tong assembly, which may be of any desired type, but which may be constructed in accordance with the disclosure in the U.S. letters Pat. No. 3,516,308, for example. The head section 40 of the tong assembly 12 may be of any desired type of tong head mechanism adapted to grip and effect rotation of the pin end 18 of the pipe while the box end 20 of the pipe 16 is held against rotation either in the usual rotary table slips or by the back-up tong assembly generally denoted at 10, made in accordance with the invention and hereinafter to be more fully described. The tong head 40 may be made in accordance with the disclosure in U.S. letters Pat. No. 3,540,326, for example.

The back-up tong assembly 10, as best illustrated in FIGS. 1 and 2, includes a support structure 46 comprising an elongated hollow case 48 supported at its rear end 50 by a post 52 depending from the power tong assembly 12. If desired, as will be appreciated by those skilled in the art, the post 52 may be connected to a torque indicating mechanism (not shown) including a gauge which will show the angular force applied to the back-up tong 10 tending to cause angular movement of the support structure 46, as an indication of the connecting torque applied to pipe joints held by the back-up tong, by rotation of the power tong assembly 12.

At the forward end of the support structure 46 is a back-up tong head assembly generally denoted at 54, the support structure 46 including brackets 56 connected to ears 58 formed as part of the head assembly 54 by bolts 60. The head end of the back-up tong assembly is also, in the illustrative embodiment, supported beneath the power tong assembly 12 by means
of ears 62 projecting from the sides of the tong assembly 12 and supporting bolts 64 which extend through outwardly extended gussets 66 carried by the support structure. Coiled springs 68 are provided between the gussets 66 and the ears 62, and the gussets 66 and the bolts 64, to cushion relative vertical movement between the head 40 of the power tong assembly 12 and the head 54 of the back-up tong assembly 10.

Referring more particularly to FIGS. 2 and 3, back-up tong head assembly 54 is seen to include hydraulic pipe gripping units 70, each having a jaw unit 72 disposed to converge toward a common point which ordinarily would be the center of the pipe 16 when box end 20 is moved into head assembly 54. Each jaw unit carries one or more mortise and tenon mounted pipe dies 73, as shown, for ready removal and replacement. In the illustrated embodiment, three of such gripping units are preferably provided. It will be understood, however, that as few as two jaw units 72 may be employed with one of such jaws being movable through a gripping unit 70 and the other of such jaws being fixed within head 54. The provision of two to several movable jaw units 70 are preferred, however, so that all the jaws may be retracted to give optimum clearance for movement of the well pipe through head 54.

Each gripping unit 70 includes a cylinder guide 74 with the three provided cylinder guides being joined as by welding through gusset members 76 to form the main body or frame of head 54 as shown. The head assembly ears 58 are mounted from two of the gusset members 76 as shown to mount head 54 with support structure 46 as previously mentioned. It is to be noted that head unit 54 may be of welded construction as shown or integrally formed as a casting or forging, depending on production and service factors.

As shown in FIG. 3, the cylinder guide 74 may be of generally rectangular shape in section. Reciprocably mounted within cylinder guides 74 is a movable jaw carrying cylinder 78 which mounts the jaw unit 72 through a mortise and tenon structure 80 including a lock screw 82 as shown. Each jaw unit 72 includes one or more pipe gripping dies 73 also mounted through a mortise and tenon arrangement as shown. The exterior of cylinder 78 is of rectangular configuration to register within guide 74 in a manner preventing rotation of the cylinder within the guide.

A cylindrical piston 84 is mounted and retained on the distal end of a piston rod 86 by means of a snap ring 88 as shown and mounted within a cylindrical blind bore 90 defined within cylinder 78. The blind end of bore 90, the piston 84 and the piston rod 86 define a pressure chamber 92 which is rendered fluid tight by a seal ring 94 mounted between the piston rod and the piston and seal rings 96 mounted between the piston and the cylindrical wall of bore 90 as shown.

The supporting end of piston rod 86 is joined by threaded connection through a support member or plate 98 and retained by a threaded nut 100. Support member 98 is connected to cylinder guide 74 and head assembly 54 by means of fasteners such as cap screws 102. As can be seen, the piston 84 and piston rod 86 are fixed and immovable with respect to the head assembly 54.

A flanged bushing 104 is mounted within the bore 90 of cylinder 78 and about piston rod 86 to align the piston and piston rod within the cylinder and also to retain the piston within the bore. The bushing 104 is retained in position by means of fasteners such as cap screws 106 extending through an outer flange of the bushing and into threaded connection within the wall of cylinder 78. A cylinder return spring 108 is disposed around piston rod 86 and confined in compression between a flange formed within bushing 104 and the rear of piston 84 to urge the bushing 104 and attached cylinder 78 into retracted position against support member 98.

A passage 110 is longitudinally defined through piston rod 86 to provide fluid communication through the piston rod into chamber 92.

When fluid under pressure, oil for example, is introduced through passage 110 into chamber 92, cylinder 78 and jaw unit 72 for each of the pipe gripping units 70 is displaced inwardly to concurrently converge into gripping contact with pipe box end 20. The gripping force corresponds to the fluid pressure introduced into chamber 92. In the embodiment of FIGS. 2 and 3, the operating pressures may be in the range of 500–2,500 p.s.i. (35–175 kilograms/sq. centimeter), for example.

When the pressure is released from chamber 92, the resilience of spring 108 imposed against the bushing 104 displaces the fluid out of chamber 92 through passage 110 and returns cylinder 78 into retracted position with bushing 104 abutting support member 98. Thus, each cylinder 78 and jaw unit 72 is moved from retracted position to gripping position and return by periodic admission of fluid under pressure into chamber 90.

A source of fluid under pressure 112 is connected through a manual or remotely operated switching valve 114 through conduits 116 and fluid fittings 118 into respective communication with each of passages 110. Valve 114 is also connected to a return sump as shown. With valve 114 in a first position, fluid under pressure is admitted into each of the chambers 92, causing each of the cylinders 78 and jaw units 72 to extend and converge into gripping relation with pipe box end 20. When valve 114 is switched to a second position the pressurized fluid is blocked off and the fluid in chambers 92 is free to flow into the return sump. Thus periodic switching of valve 114 causes periodic gripping and release of pipe gripping units 70 as desired.

In operation of the back-up tong assembly 10 in combination with a power tong assembly 12, the assembly 12 will be operated to grip and rotate a joint of pipe in either a righthand or lefthand direction respectively, when a pipe joint is to be connected or disconnected. During the initial or final stages of rotation, as applicable, the back-up tong unit may remain idle. However, when the tool joints 18 and 20 shoulder together, as when connecting, or need to be broken apart as when disconnecting, the back-up tong unit 10 is employed to apply high torque resistant forces to the tool joint box end 20 in either direction, as necessary, while torque is applied to pipe pin end 18 by power tong 12.

Following the above described jaw engaging operations, the back-up jaw units 72 will remain retracted in response to the springs 108.

The foregoing description and drawing will suggest other embodiments and variations to those skilled in the art, all of which are intended to be included in the spirit of the invention as herein set forth.

That being claimed is:

1. Pipe tong apparatus comprising a horizontal support frame providing a central opening adapted to receive a vertically disposed length of pipe; pipe gripping
means carried by said support frame, said pipe gripping means including a plurality of horizontally and radially disposed pipe gripping units arcuately arranged about said central opening, each of said pipe gripping units having a cylinder guide carried by said support frame and providing a radially extending guideway therein, said guideway being rectangular in cross-section normal to its radial dimension, a blind cylinder disposed in said guideway and having a rectangular cross-section complemental to the cross-section of said guideway for preventing rotation of said cylinder within said guideway, the blind end of said cylinder facing said central opening, pipe engaging jaw means mounted on said blind end, said cylinder being slidable in said guideway to move said jaw means into and out of engagement with a length of pipe in said opening, a piston fitted within said cylinder, a piston rod having one end fixed to said piston and the other end fixed to said frame, said piston and said cylinder defining a fluid pressure chamber at said blind end of said cylinder, fluid pressure manifold means for simultaneously introducing fluid under pressure into the fluid pressure chambers of all of said pipe gripping units to slide their respective cylinders towards a pipe disposed in said central opening, thereby to move their respective jaw means into gripping engagement with the pipe, and retraction means associated with each of said units for sliding their respective cylinders away from the pipe, thereby to move their respective jaw means out of engagement with the pipe.

2. The apparatus of claim 1 wherein said retraction means comprises a coil spring mounted in compression between the rear of said piston and the rear of said cylinder.

3. The apparatus of claim 1, wherein said manifold means includes a fluid passage defined through said piston rod to the exterior of said frame.

4. The apparatus of claim 3 including a fluid switching valve connected through conduit means and said passage into communication with said chamber and adapted for connection with a fluid pressure source to switch fluid under pressure into and out of said chamber.

5. The apparatus of claim 1 wherein said support frame includes gusset means connecting said pipe gripping units together.

6. The apparatus of claim 1 wherein said jaw means is removable from said cylinder and at least one pipe die is removably mounted in said jaw means.