Nov. 24, 1970 H. D. HORTON 3,541,897

POWER TUBING TONGS

Filed June 7, 1968 2 Sheets-Sheet 1

FIG. 1

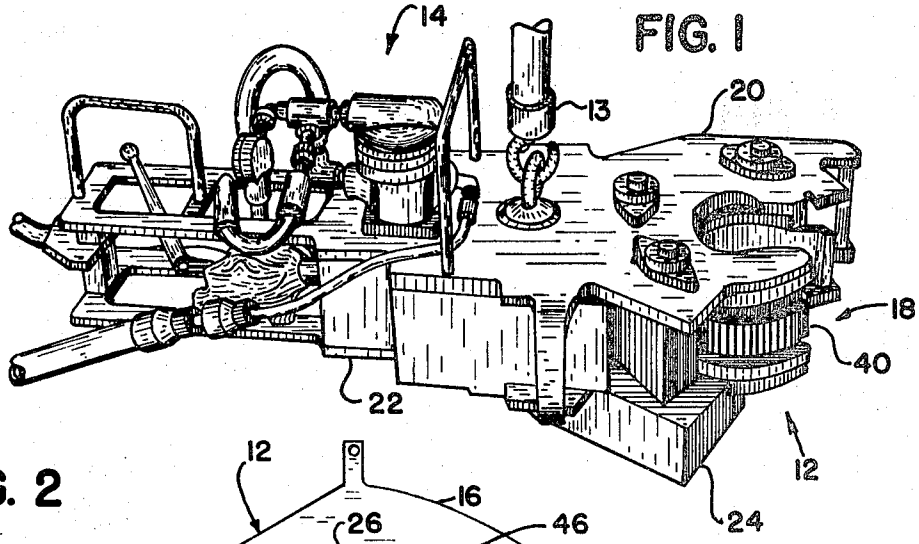


FIG. 2

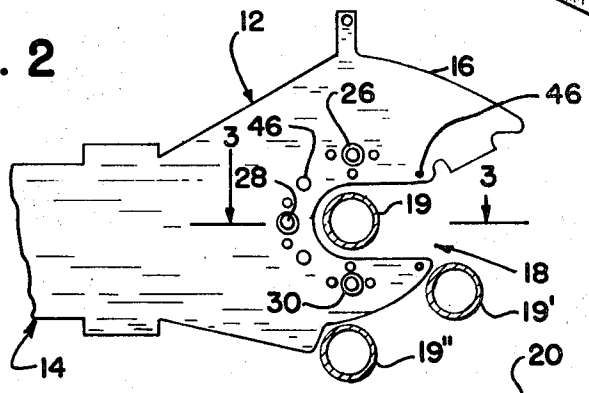


FIG. 3

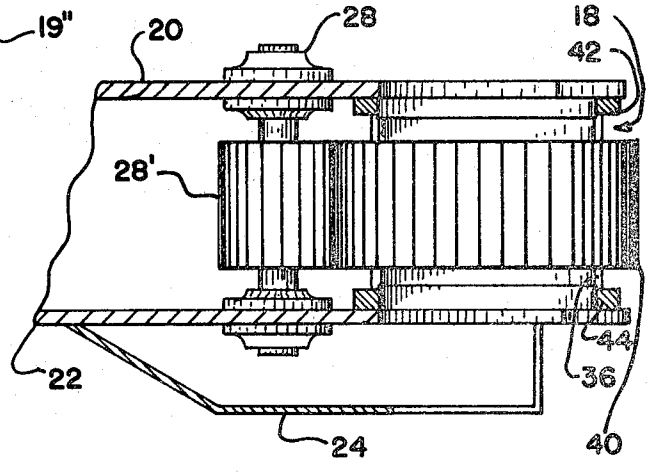


FIG. 4

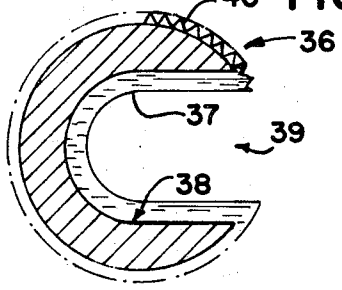


FIG. 5

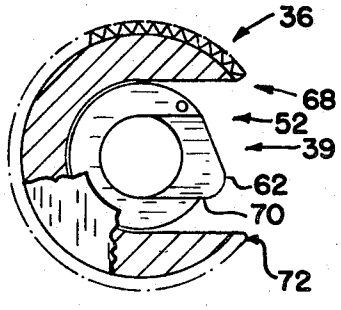
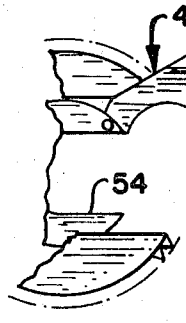


FIG. 6



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Nov. 24, 1970 H. D. HORTON 3,541,897

POWER TUBING TONGS

Filed June 7, 1968 2 Sheets-Sheet 2

FIG. 7

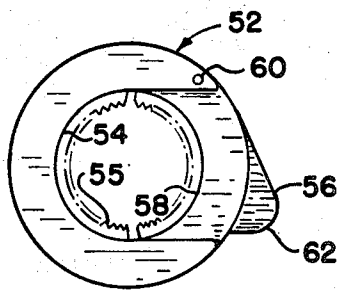


FIG. 8

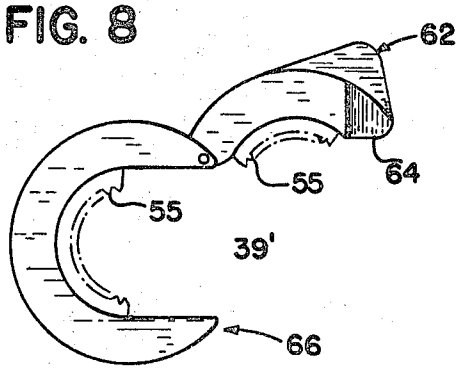


FIG. 9

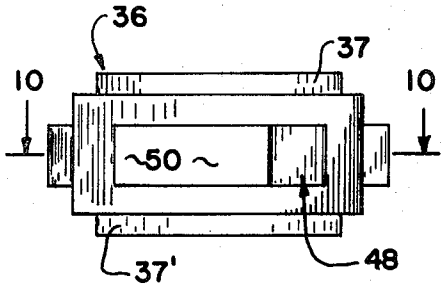


FIG. 10

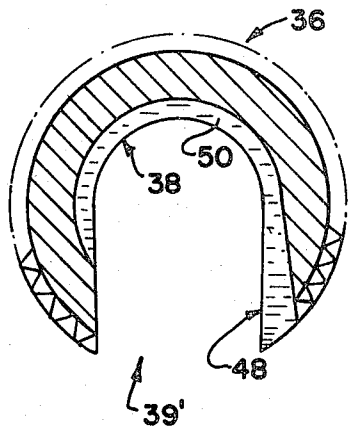
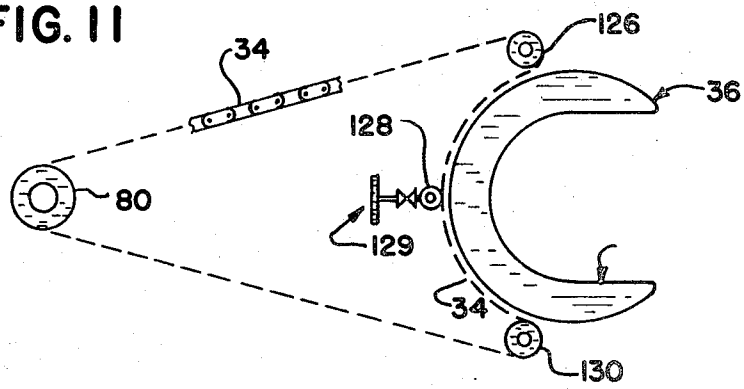


FIG. 11



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United States Patent Office 3,541,897 Patented Nov. 24, 1970

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POWER TUBING TONGS

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Filed June 7, 1968, Ser. No. 735,450
Int. Cl. B25b 17/00
U.S. Cl. 81—57.18 7 Claims

ABSTRACT OF THE DISCLOSURE

Improved power tubing tongs for multiple string operations which enables threads on the tubing joints to be individually made up on multiple production wells. The power tongs include an external housing having a bull gear assembly disposed for the major circumferential distance thereabout with the external housing being adapted to receive a removable internal jaw section therein. The internal jaw section includes a tubing die circumferentially disposed for the major circumferential distance about the inside peripheral wall surface thereof. The internal jaw section includes a segment which pivotally swings open to permit the insertion of a tubing therein and an abutment which cooperates with an edge portion of the external housing in a manner whereby rotation of the bull gear assembly imparts rotational motion into the internal jaw section which in turn causes the removable dies to firmly grasp the tubing when the tubing is to be made up. Upon disassembly of the joints of tubing, the internal jaw section is inverted within the external housing to permit joints of tubing to be unscrewed. The configuration of the external housing and the drive train assembly permits the power tubing tongs to cooperate with each string of tubing in a triple completed well without the necessity of springing each of the tubes apart from one another.

BACKGROUND OF THE INVENTION

In the art of oil production it is necessary to run and pull long strings of piping, including tubing and other tubular-like goods into the bore hole. This operation must be carried out many times when initially drilling the bore hole. After the bore hole has been cased, it is sometimes provided with more than one string of tubing through which oil is produced. This type of oil well is referred to as a multiple completed well and sometime as many as three different production tubings are arranged within the casing with each tubing leading to a different oil producing zone. From time to time it is necessary to remove the tubing from the bore hole in order to service the well. Removing three strings of tubing from a bore hole is a laborious and time consuming operation. Furthermore, the removal and replacement of the tubing is costly, especially where expensive workover units are required to remain in the standby condition while such an operation is being carried out. Power tubing tongs of the prior art have been used with limited success in removing tubing from multiple completed wells. This operation entails the construction of scaffolding in order to permit "Rough-necks" to be vertically disposed at three different levels as they engage the tubing with the power tongs. In carrying out this operation it is necessary that the tubing be sprung or forced apart from one another in order to provide sufficient room within which the power tongs can be placed into close proximity of each tubing string. The sprung apart or bowed tubing misaligns the threads thereof and when the joints of tubing are again made up, the misaligned threads cause much difficulty with damage often occurring to the individual threads of the joints which make up the tubing string.

SUMMARY OF THE INVENTION

This invention sets forth the construction of improved power tongs having a main body which rotatably receives an external housing thereon. Means associated with the main body imparts rotational motion into the external housing. The external housing slidably receives an internal jaw section within a cavity provided therein. The internal jaw section is provided with a hinged segment with the inside peripheral wall surface of the jaw section being provided with removable tubing dies. The hinged segment of the jaw section has an abutment thereon which cooperates with the entrance to the external housing in a manner to maintain the dies in gripping realtionship with respect to tubing when the external housing is rotated in one direction, and which releases the dies from the tubing when rotated in the opposite direction. This action enables the vertical center line of the pipe dies to be placed closely adjacent to an edge portion of the main body which in turn enables the fabrication of a power tubing tong which can be brought into close proximity with respect to a multiplicity of vertically depending production tubing strings.

It is therefore an object of the present invention to provide improved power tubing tongs which can be used to fasten and unfasten joints of tubing.

Another object of the present invention is the provision of power tubing tongs having an improved rotatable pipe die holding means associated therewith which enables one marginal edge portion of the tongs to be greatly reduced in size.

A further object of the present invention is the provision of an improved pipe gripping means for power tubing tongs.

A still further object of the present invention is the provision of an improved pipe gripping mechanism comprised of an internal jaw section having a movable segment associated therewith which is received within a cavity of an external housing wherein the housing imparts rotational motion into the internal jaw section.

Still another object of the present invention is the provision of improved power tubing tongs adapted to be used on multicompleted wells.

The above objects are attained in accordance with the present invention by the provision of power tubing tongs which are fabricated in a manner substantially as described in the above abstract.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a perspective view illustrating one form of the present invention;

FIG. 2 is a fragmentary more or less schematical top plan view showing the device of FIG. 1 operatively disposed with respect to a multiplicity of vertically depending production tubings;

FIG. 3 is an enlarged fragmentary partly cross-sectional view taken along line 3—3 of FIG. 2;

FIG. 4 is a cross-sectional view of part of the device seen in the foregoing figures;

FIG. 5 is a partly cross-sectional view of the device seen in FIG. 4, with additional parts being included therein;

FIG. 6 is a fragmentary representation of the device seen in FIG. 5, but shown in a different operative configuration;

FIG. 7 is a top plan view of part of the apparatus seen in FIGS. 1, 5, and 6;

FIG. 8 is similar to FIG. 7 but with the apparatus seen in a different operative configuration;

FIG. 9 illustrates a modification of FIG. 4;

FIG. 10 is a cross-sectional view taken along line 10—10 of FIG. 9; and

FIG. 11 is a schematical representation of one form

of the present invention showing the power train associated therewith.

DETAILED DESCRIPTION OF THE DRAWINGS

Looking now to the details of FIG. 1 in conjunction with FIGS. 2, 3, and 4, there is seen indicated by the arrow at numeral **12** a set of power tubing tongs made in accordance with the present invention and including a control end **14** having the necessary motor, fluid flow conduits, and controls for the proper operation of the apparatus. The tubing tongs are preferably suspended as seen at **13** from the center of gravity of the apparatus. One side **16** of the tongs is enlarged to provide reinforcement for the apparatus, while the remaining opposite side includes a contoured edge portion which is substantially smaller in width as compared to the enlarged reinforced side. Tubing, piping, or other tubular like goods are received through entrance **18** and where a multiplicity of tubing strings must each be tightened or loosened, they are preferably positioned as seen at **19**, **19'**, and **19''**.

Upper and lower spaced apart plate members **20** and **22** form the main body of the tongs and suitably maintain the various gears journaled thereto. Lower reinforcing plate member **24** underlies plate member **22** and forms a boxed-in construction which greatly adds rigidity to the entire main body assembly. Gears **26**, **28**, and **30** are equally spaced apart from one another and are journaled to the upper and lower plate members with each of the gears being driven by a suitable power means, as for example, a hydraulic motor.

An external housing **36** includes a U-shaped cavity **37** formed therein with the cavity extending outwardly as indicated by the arrow at numeral **38** so as to form the entrance **39** into the cavity. A bull gear **40** circumferentially extends a limited distance about the external housing with the bull gear being discontinued across the entrance to the cavity. The bull gear is engaged by gears **26**, **28**, and **30**.

Spaced apart bearing members **42** and **44** may be in any form which will maintain the upper and lower ends of the external housing suitably journaled to the upper and lower spaced apart plates.

Looking more specifically now to the details of FIG. **5** in conjunction with FIGS. **6**, **7**, and **8**, there is seen the before mentioned external housing **36** having an internal jaw section **52** operatively positioned therewithin. It will be noted that the outside diameter of the jaw section is slidably received in close tolerance relationship by the cavity with the outer marginal edge portion of the jaw being enclosed by edge portion **37** which forms the innermost edge portion of the cavity. The internal jaw section includes an abutment **62** which is adapted to contact edge portion **68** of the external housing when the bull gear is rotated in a first direction, or alternatively, edge portion **72** when rotated in another direction.

The abutment is an integral part of a segment which is pivotally attached to the remainder of the jaw section by a pivot pin **60**. The inside peripheral wall surface of the internal jaw section includes removable dies **55** which extend approximately 300° of the circumference thereof. The removable dies are attached both to the segment and to the remainder of the external section.

Looking now to the details of FIGS. 9 and 10, there is seen a modification of the foregoing external housing. The housing has a cavity **50** therein with the cavity being larger at **48** as compared to its marginal progressively reducing edge portion **38**. The cavity is provided with an entrance **39'** and a bull gear. Upper and lower marginal edge portions of the external housing are received by journal means as in the previous embodiment.

Looking now to the details as illustrated in FIG. 11 there is seen a chain **34** suitably driven by power means **80** with the chain driving spaced apart sprockets **126**, **130**. The bull gear is positioned between the spaced apart

sprockets and provided with an idler **128** which is adjusted by adjustment means **129**.

OPERATION

In operation the power tubing tongs of the present invention are suspended from a suitable support means **13** and vertically positioned tubing string is received within the pipe engaging and **18** in a manner as seen at **19** in FIG. 2.

In order for the tubing **19** to enter into the illustrated position of FIG. 2, it is necessary for the swinging segment **62** of the internal jaw section to be in the relative position illustrated in FIGS. 6 and 8 with respect to the external housing, and with the external housing being aligned with its entrance facing the tubing. This places both the external housing and the internal jaw section in alignment with the pipe engaging end of the tongs, so that all three entrances are aligned with each other. This relative position of the recited elements enables the tongs to be moved into a position which encloses the tubing string. Upon energization of the motor, the drive train rotates the external housing. It is preferred that at least two of the three spaced apart gears **28'** engage the bull gear **40** at all times so as to allow for the absence of the portion of the bull gear which forms the entrance **39**.

As the external housing is rotated by the bull gear assembly the abutment **62** of the external jaw section contacts edge portion **68** of the external housing (assuming the pipe is being unscrewed) whereupon the abutment forces the segment into the closed position by the action of the edge portion upon the contoured portion **51** of the abutment means. As the bull gear continues to rotate the internal jaw section, the removable pipe die firmly grasps the tubing with the pressure being uniformly exerted against the tubing with a force which is proportional to the torque exerted upon the bull gear. When the tubing has been satisfactorily made up, the direction of rotation of the motor which moves the drive train is reversed whereupon the bull gear turns the external housing in an opposite rotational direction. This action relaxes the gripping action of the die upon the tubing and upon the edge portion **72** of the external housing contacting or approaching the pivoted end of the pivotal segment, the segment can be forced into the open position as the tongs are moved away from the tubing as seen in FIGS. 6 and 8. The power tongs are then swung away from the tubing string and back into engagement with another tubing joint which is to be tightened.

Where it is desired to break-down joints of the tubing string, the internal jaw section **52** is removed from the external housing and turned upsidedown so as to enable the dies to be forced into gripping action with respect to the tubing upon counterclockwise rotation of the external housing. The action of the internal jaw section with respect to the external housing is essentially as described above, with the exception that portion **56** of the abutment now contacts edge portion **72** of the external housing when tightening the tubing. In order to remove the tongs from proximity of the tubing, it is necessary to "trigger" the motor until the segment is aligned with the entrance to the main body and to the external housing, whereupon rearward movement of the tongs with respect to the tubing opens the segment and releases the tubing therefrom.

In a multi-completed well, as for example the before mentioned triple completed well, each of the three tubing strings may be individually manipulated in a sequential manner by the power tongs by engaging each string in the illustrated manner of FIG. 2. The particular configuration of the contoured edge portion of the power tongs nearest adjacent string **19'** and **19''** enables two of the strings to be maintained closely adjacent to the smaller side of the tongs, all in the manner of FIG. 2. This construction of the tubing tongs eliminates the necessity of building scaffolding so as to vertically sepa-

rate three different "roughneck" crews as well as eliminating the necessity of springing the tubing apart horizontally in order to enable engagement thereof with the tongs.

An important feature of the present invention resides in the cooperative action between the internal jaw section and the external housing. As set forth in the various drawings, the pivotal segment swings away from the internal jaw section, through both the entrance to the external housing and to the main housing. This cooperative action between the main housing, the external housing, and the internal jaw section enables the construction of a power tong which is greatly reduced in size at the tubing engaging end thereof.

As particularly seen in FIG. 6, the pivotal segment is received within a portion of the external housing so as to enable the segment to be pivoted a sufficient amount to allow tubing to be freely received within the die. The particular embodiment of FIG. 10 includes a cavity having the largest recessed opening located at **48** which serves the dual function of slidably receiving the internal jaw section therethrough, while at the same time enabling the segment to be pivoted clear of the tubing which is received therethrough.

As seen in the embodiment of FIGS. 7 and 8, the pivotal segment disclosed therein includes a portion **64** of reduced thickness which is received within a slot (not shown) near edge potrion **66** so as to bridge the segment to the remainder of the internal jaw section. The abutment **62** is seen to be further reduced in thickness as compared to portion **64**.

In the embodiment of FIGS. 9 and 10, the cavity **50** is reduced in depth from the entrance at **48** towards the end portion at **38**. The internal jaw section is slidably received through the entrance in close fitting relationship therewith.

The preesnt invention eliminates crushed tubing since the dies contact 300° of the tubing circumference. The bull gear reinforces the external housing and cooperates with the internal jaw section in a manner which eliminates broken castings. When the improved tongs are used on tubing sizes two and one-sixteenth inch through three and one-half inch, the power requirements are only twenty gallons per minute at two thousand pounds per square inch, using speeds of fifty to seventy-eight revolutions per minute to provide a torque of 1600 to 2400 foot pounds. The improved power tubing tongs are light weight, rugged, simple in design, and low in cost.

While I have illustrated and described a preferred embodiment of my invention it is to be understood that such is merely illustrative and not restrictive and that variations and modifications may be made without departing from the spirit and scope of the invention. I therefore do not wish to be limited to the precise details set forth but desire to avail myself of such changes as fall within the purview of my invention.

What I claim is:

1. Power tubing tongs including a main body within which there is rotatably received an external housing, an internal jaw received within said external housing, means connected to said main body for rotatng sad external housing; said main body, said external housing, and said internal jaw having means forming a tubing receiving entrance through which tubing may pass to a coaxial position;

said internal jaw being freely received within said external housing when the external housing entrance is aligned with the main body entrance; said internal jaw including an inwardly directed tubing gripping means disposed thereon for imparting rotational motion into tubing received therewithin; means for moving a portion of said internal jaw towards and away from the remaining portion of the internal jaw to thereby form said tubing receiving entrance;

abutment means on the movable portion of said internal jaw arranged to engage said external housing for increasing the gripping action of said tubing gripping means when the external housing is rotated in one direction, sad abutment means also being arranged to engage another portion of said external housing for releasing said gripping means from the tubing when the external housing is rotated in an opposite direction.

2. The power tubing tongs of claim **1** wherein said means for rotating said external housing includes a bull gear means forming a drive train having at least two spaced apart gears meshed with said bull gear, said bull gear extending more than 270° about and forming a part of an outer peripheral surface of said external housing.

3. The power tubing tongs of claim **1** wherein said external housing includes means forming a cavity therewithin, said internal jaw being received within said cavity, with said abutment means being formed on said portion which is movable away from said remaining jaw section, and with said abutment means being urged towards said remaining jaw section by a wall which forms said cavity.

4. The power tubing tongs of claim **1** wherein said portion of said internal jaw section which is movable includes at least 20° of a circumference thereof, hinge means at one extremity of the movable section, said abutment means being located on the outer periphery of said internal jaw section.

5. The improvement of claim **1** wherein said means of rotating said external housing includes a bull gear, a chain, spaced apart sprockets, means for moving said chain, said bull gear being meshed with said chain at a location between said spaced apart sprockets; whereby:

movement of said chain imparts rotational motion into said external housing.

6. The improvement of claim **1** wherein removable tubing gripping dies are affixed to the inside of said internal jaw section to thereby enable selection of the size of said dies, said movable portion of said internal jaw section including a segment of the internal jaw section, one end of said segment including pivot means for pivoting said segment into and away from the remaining internal jaw section.

7. The improvement of claim **1** wherein said main body includes an enlarged reinforced side and a pipe accommodating side having a contoured edge portion which is spaced apart from said external housing a limited distance to thereby enable said pipe accommodating side to be received between two of three spaced apart tubing strings of a triple zone well to thereby avoid misalignment of the tubing joints as they are made up by the power tongs.

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