July 21, 1964 S. TAMNY ETAL 3,141,362

JAW OPERATING STRUCTURE FOR A POWER-OPERATED WRENCH

Filed May 12, 1960 6 Sheets-Sheet 1

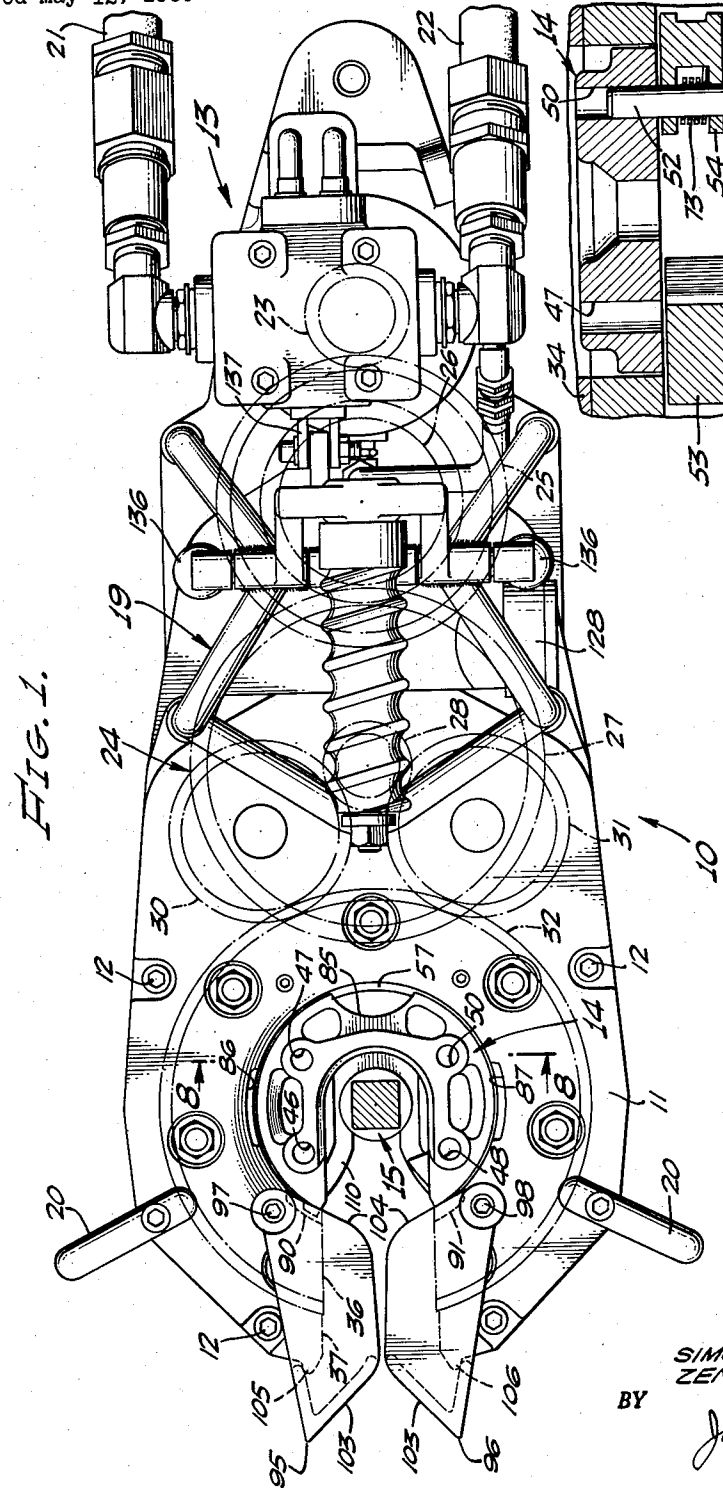


FIG. 1.

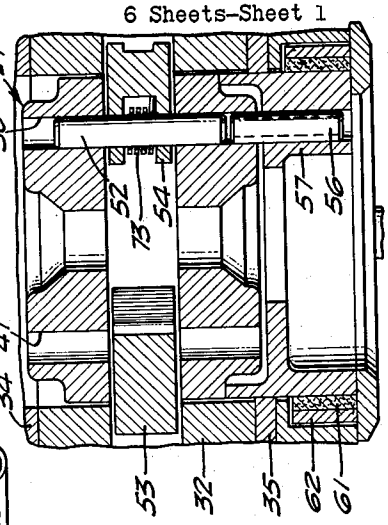


FIG. 8.

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JAW OPERATING STRUCTURE FOR A POWER-OPERATED WRENCH

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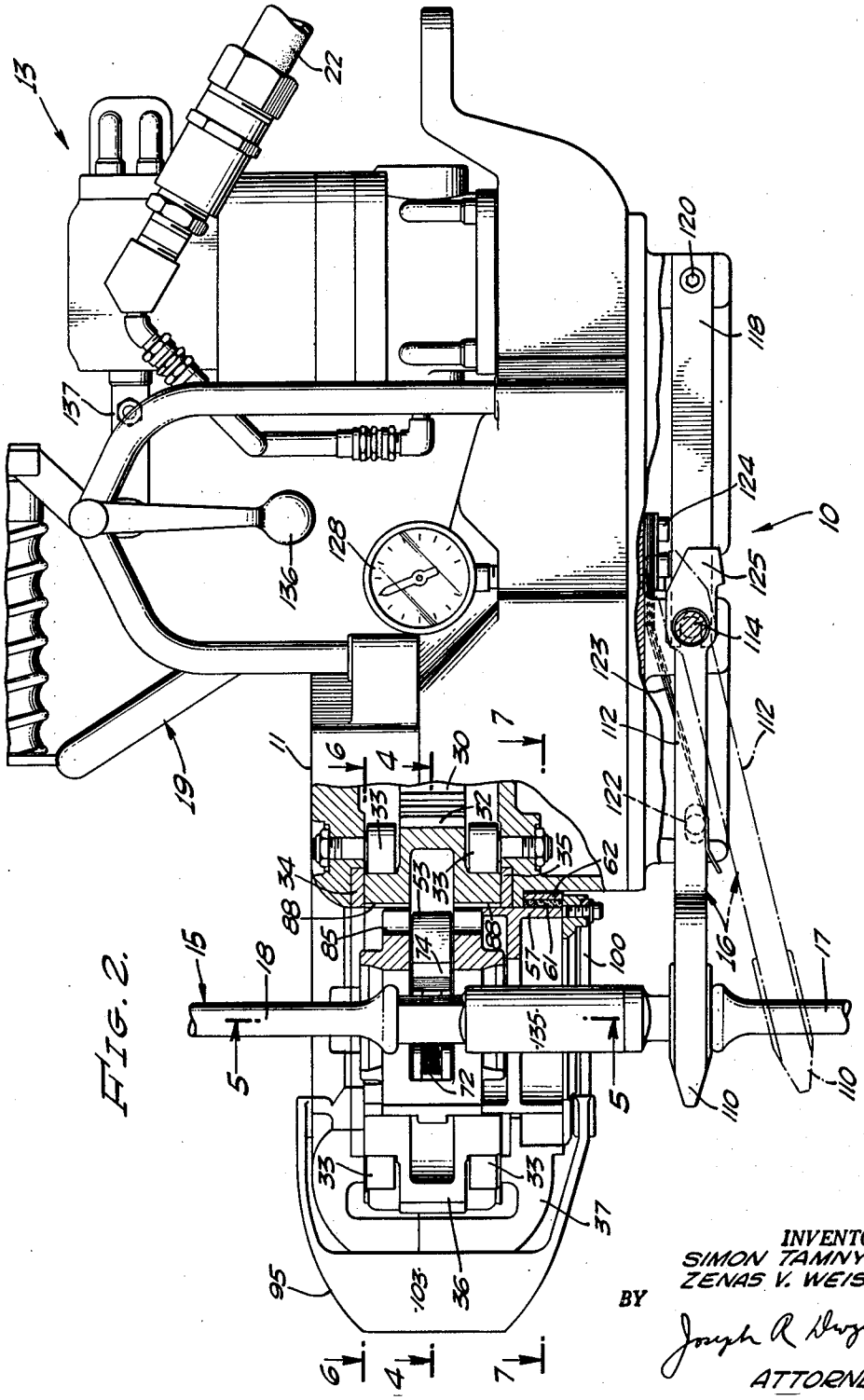


FIG. 2.

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JAW OPERATING STRUCTURE FOR A POWER-OPERATED WRENCH

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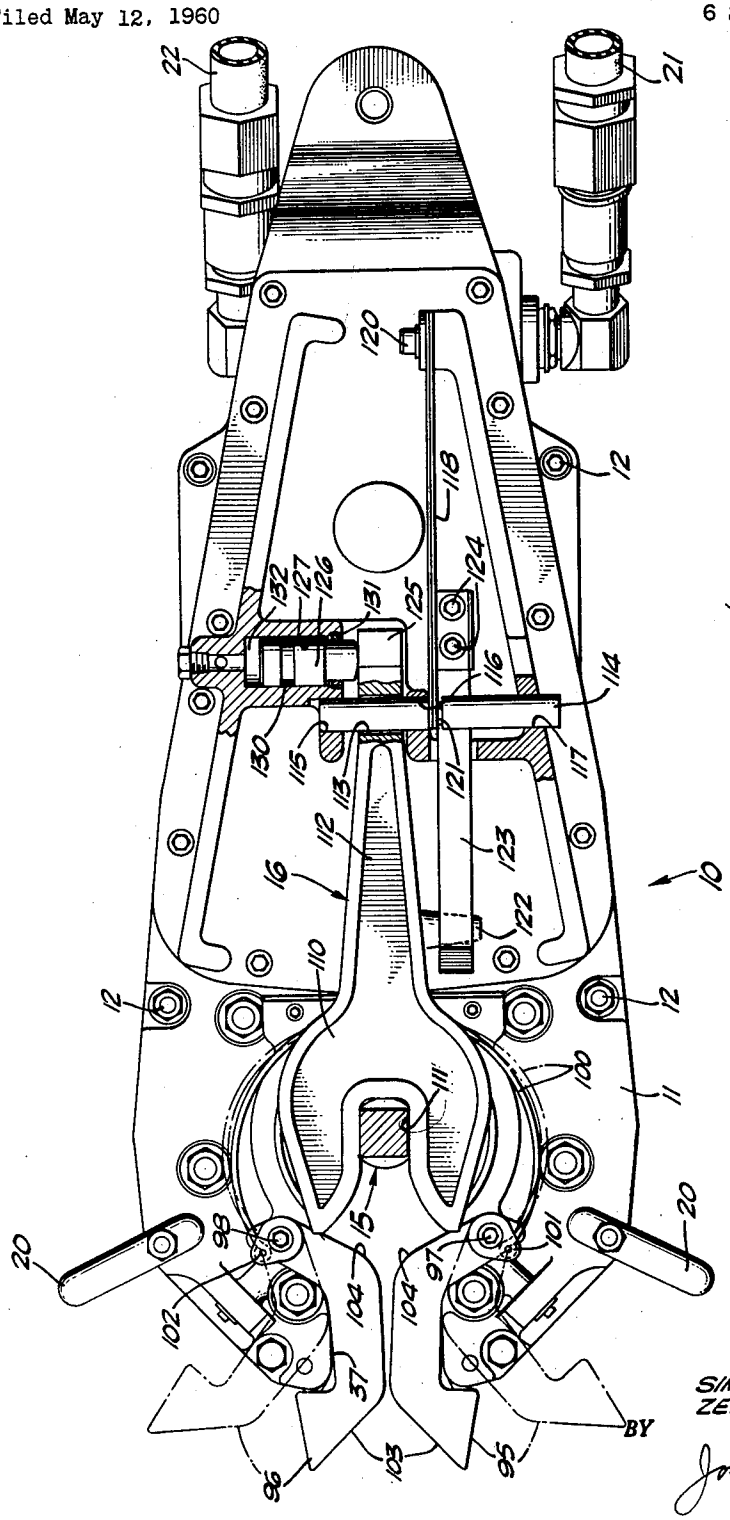


FIG. 3.

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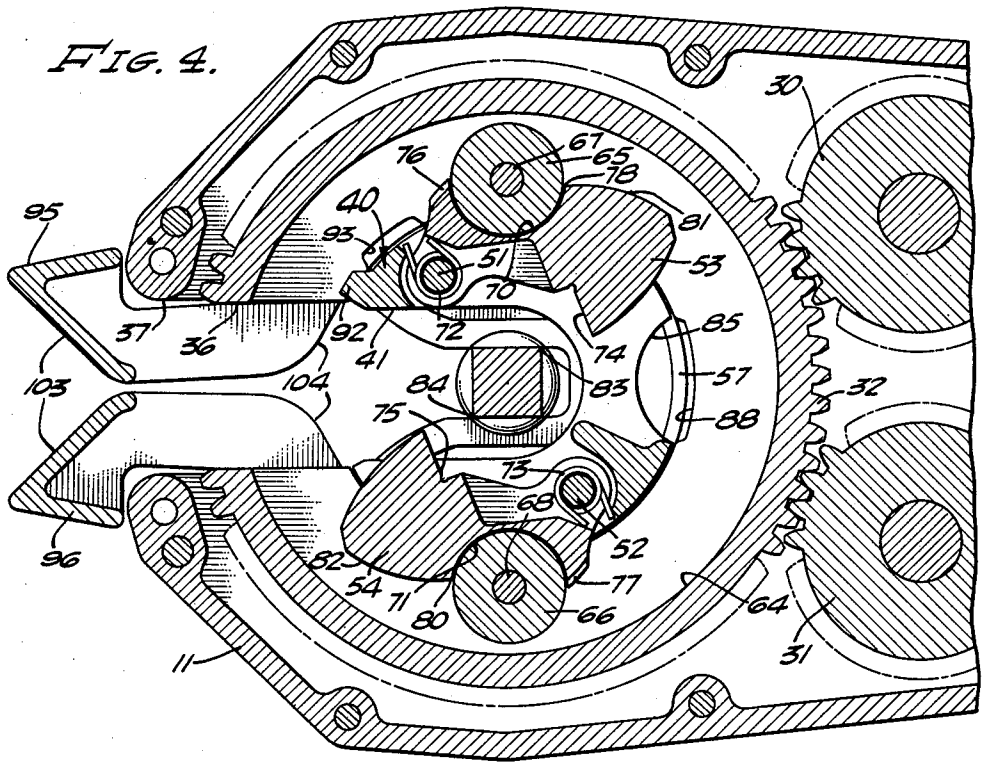
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JAW OPERATING STRUCTURE FOR A POWER-OPERATED WRENCH

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FIG. 4.



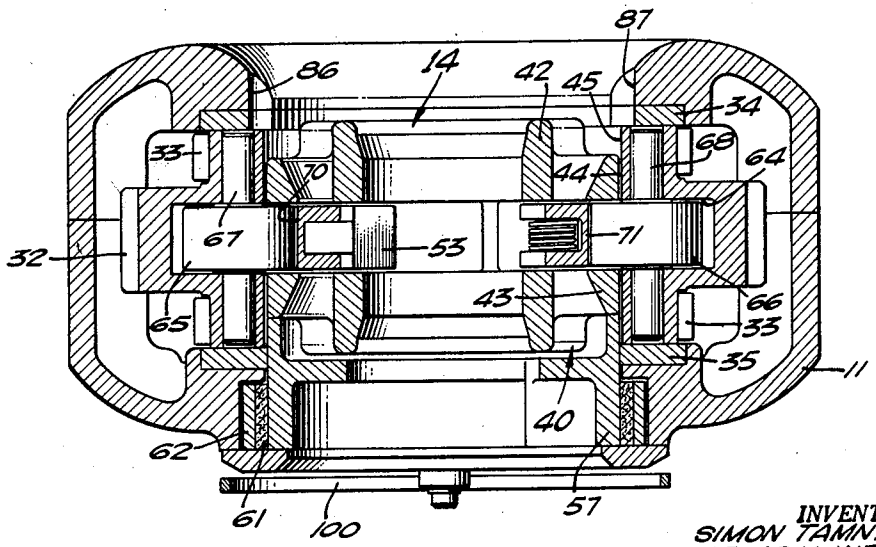


FIG. 5.

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JAW OPERATING STRUCTURE FOR A POWER-OPERATED WRENCH

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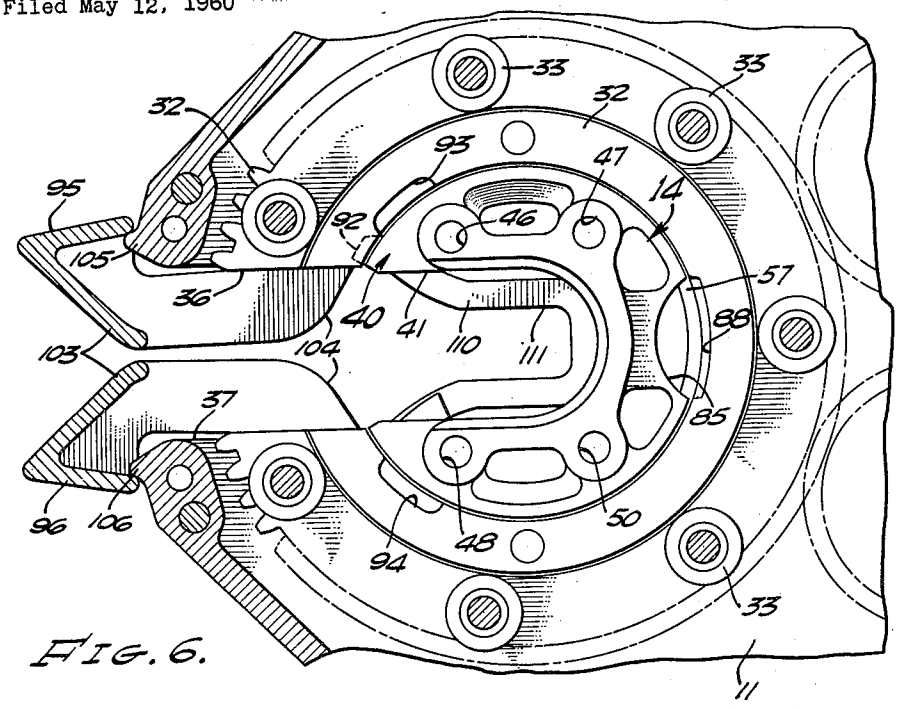


FIG. 6.

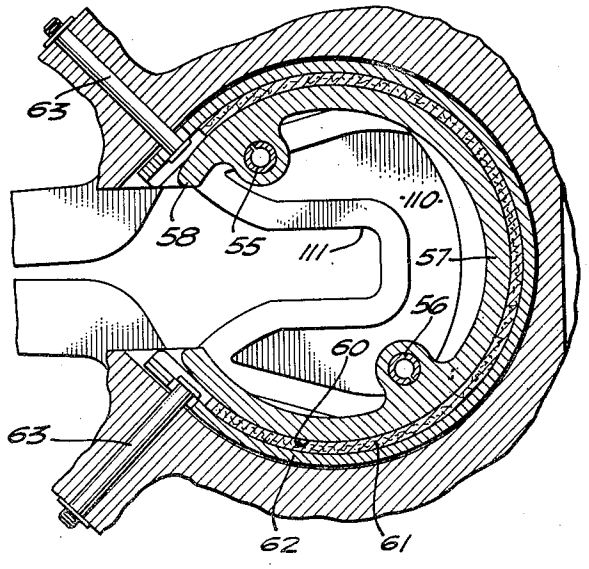


FIG. 7.

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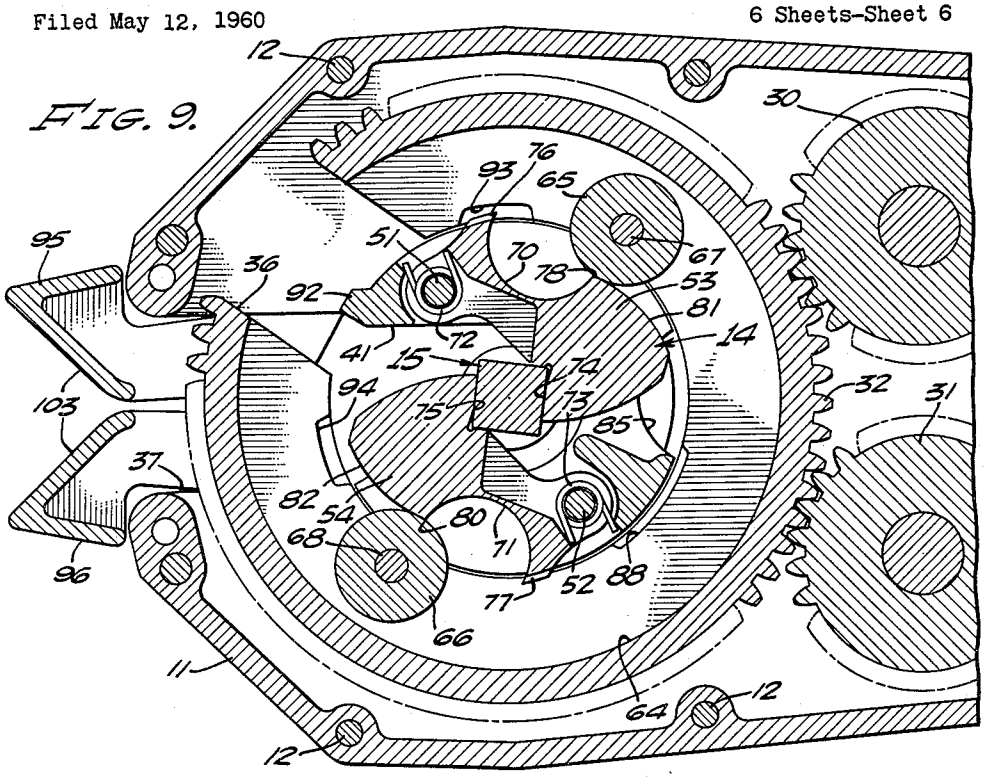
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FIG. 9.



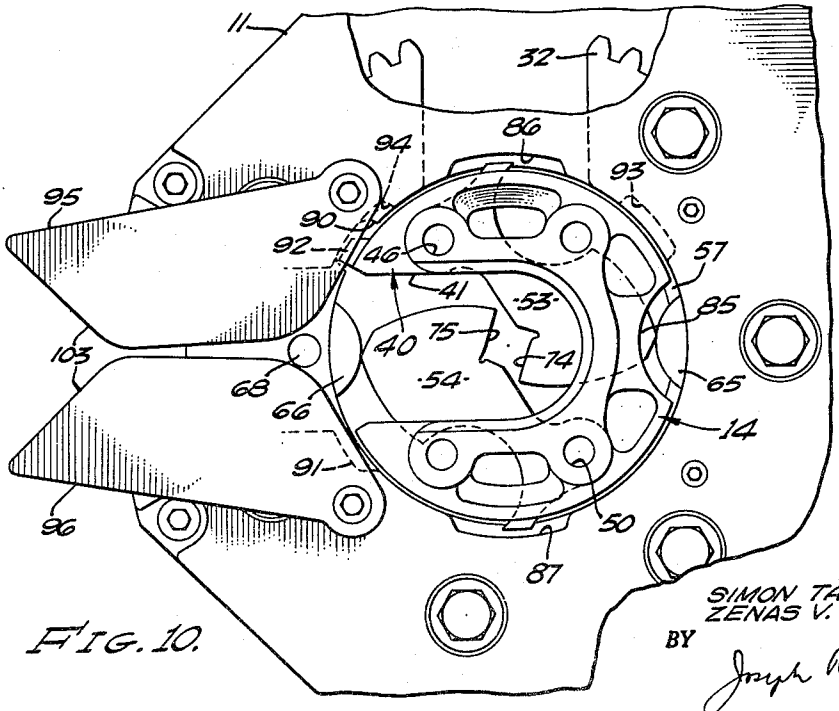


FIG. 10.

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United States Patent Office 3,141,362 Patented July 21, 1964

3,141,362

JAW OPERATING STRUCTURE FOR A POWER-OPERATED WRENCH

Simon Tammy and Zenas V. Weisel, Los Angeles, Calif., assignors, by mesne assignments, to Byron Jackson Inc., Long Beach, Calif., a corporation of Delaware

Filed May 12, 1960, Ser. No. 28,746
18 Claims. (Cl. 81—57)

This invention relates, in general, to oil well tools and, in particular, to a new and improved power tong for assembling or disassembling threaded sections such as sucker or pump rods used in pumping oil out of a well or threaded sections of piping and the like.

In raising oil from a well to ground level, a submersible pump, normally located at or near the bottom of the well, is actuated from the ground level by means of a sucker or pump rod made up of a number of rod sections threaded together. Each rod section is threaded at its opposite ends and two adjacent rod sections are joined by a threaded coupling. For ease of assembly and disassembly the sucker rod sections are each formed with flat sides near each threaded end to define a substantially square cross-sectional configuration, normally referred to as the "square" of the rod section. Suitable manual or power operated tongs grip these squares in their jaw means and rotate one of the rod sections while holding the other adjacent rod section stationary to thread or unthread the rod sections from the coupling means and from each other.

Often, when adjacent sections are so joined and it is desired to disassemble them, the flat portions of the squares are not in planar alignment. This consequently poses a problem particularly for power actuated tongs. It is presently conventional to maneuver the power tong until both the rotatable jaws in the power tong and the backup jaws are in proper orientation with the misaligned squares so that they will both grip the squares of the rod. If backup jaws are part of a separate tong or wrench, this must also be maneuvered to properly grip the rod. It is therefore seen that in conventional operation two independent positioning functions must be performed in order to grip both rod squares.

It is, therefore, one principal object of this invention to provide a new and improved power actuated tong having rotatable jaws and means for automatically adjusting the jaws so that they will forcibly grip the rod only at the flats to thus save the square of the rod from destruction, and to provide a tong with only one positioning operation.

Still another object of this invention is to provide a power tong having jaws which will automatically adjust for gripping the flats of a sucker rod without necessitating the movement of the tong itself.

Still another deficiency in conventional power tongs is the fact that the rotatable power actuated jaws have not been able to accommodate rods of different sizes.

Accordingly, still another principal object of this invention is to provide an improved power tong means which overcomes the deficiencies of the conventional tongs by providing power actuated jaw means which will accommodate rod squares of different sizes without requiring substitution of jaw means.

Still another feature of the present invention is the provision of a means for indicating the amount of torque actually imposed upon a sucker rod joint by the power actuated jaw means during assembly of the sucker rod.

Still another object of this invention is to provide a power tong which is extremely rigid, dependable in operation and simple to operate.

Other objectives and advantages of the invention will be hereinafter described or will become apparent to those

skilled in the art, and the novel features of the invention will be defined in the appended claims.

In the accompanying drawings:

FIG. 1 is a top plan view of a power actuated tong constructed in accordance with the teachings of this invention and illustrating a sucker rod joint with the upper section thereof disposed within its power actuated jaws;

FIG. 2 is a side elevational view, partially broken away, to illustrate to advantage some of the working parts of the tong and showing the sucker rod disposed within the jaws of the fixed and rotatable power jaws;

FIG. 3 is a bottom plan view, partially broken away, illustrating to advantage the fixed or stationary back-up wrench with the lower square of the rod joint gripped within its jaws and showing a portion of the torque indicating means;

FIG. 4 is an enlarged sectional plan view, taken along line 4—4 of FIG. 2 and looking in the direction of the arrows;

FIG. 5 is an enlarged sectional elevational view taken along line 5—5 of FIG. 2 and looking in the direction of the arrows, but with the rod joint omitted to more clearly illustrate the power jaw mechanism;

FIG. 6 is an enlarged sectional plan view, taken along line 6—6 of FIG. 2 and looking in the direction of the arrows, but with the sucker rod omitted;

FIG. 7 is an enlarged sectional plan view, taken along line 7—7 of FIG. 2 and looking in the direction of the arrows, but with the sucker rod joint removed;

FIG. 8 is an elevational sectional view, taken along line 8—8 of FIG. 1 and looking in the direction of the arrows;

FIG. 9 is an enlarged sectional plan view, similar to the plan view of FIG. 4, but showing the jaws in actual engagement with the square of the sucker rod, and

FIG. 10 is a top plan view illustrating the rotatable power jaw mechanism in collapsed form ready for removal from the tong frame for reversal and/or replacement.

Turning now to the drawings, and in particular to FIGS. 1, 2 and 3, it can be seen that there is illustrated a power tong, indicated in its entirety as **10**, which comprises a hollow frame **11** formed of two halves suitably fixed together by any suitable means such as bolts **12** and on which is mounted a hydraulic motor, indicated in its entirety as **13**, for rotating and actuating a power jaw rod gripping means or subassembly, indicated in its entirety as **14**, and incorporated in the frame **11**.

As can be more clearly seen in FIG. 2, a sucker rod, indicated in its entirety as **15**, is disposed in the power jaw subassembly **14** for assembly or disassembly. A relatively fixed back-up wrench, indicated in its entirety as **16**, is operatively attached to the frame **11** for the purpose of holding the lower section **17** of the sucker rod **15**, while the power jaw subassembly **14** rotates the upper section **18** to assemble or disassemble the sucker rod, as will be appreciated from a more detailed description hereinafter.

The entire tong may be conveniently and is normally suspended horizontally by a supporting hanger, indicated in its entirety as **19**, which is, in turn, suspended by a cable (not shown) and the tong is raised or lowered to suit the convenience of the operator. The frame **11** is also provided with a pair of handles **20** to move and control the movement of the tong.

The fluid motor **13** may be of any conventional type having an inlet **21** and an outlet **22** for the flow of driving fluid therethrough. A power take-off gear **23** rotatable in either direction, is connected to the drive shaft (not shown) of the motor **13** and forms part of a power train indicated in its entirety as **24**, for ultimately rotating the

jaw gripping subassembly 14. This gear train comprises driving gear 23, large gear 25, small gear 26, large gear 27, a pinion 28 which in turn drives a pair of larger gears 30 and 31. Gears 30 and 31 serve to rotate an outer partial ring gear or driving means 32, sometimes referred to as a carrier ring, for opening and closing and rotating the jaws of the power jaw subassembly 14 previously mentioned. Outer partial carrier ring or driving means 32 is fixed laterally but permitted to rotate by means of a plurality of rollers 33 fixed to the frame 11 as shown in FIG. 2 and the frame is also provided with suitable bearing plates such as 34 and 35 to prevent wear.

Turning now in particular to FIGS. 4–8 illustrating the power jaw subassembly and outer partial ring gear in more detail, it can be seen that the outer partial ring gear 32 meshing with the gears 30 and 31 serves to position a cutaway or throat portion 36 in alignment with an opening or throat 37 in the frame 11 for the purpose of receiving the sucker rod in the position shown. Throat portion 36 and the throat 37 are large enough to accommodate the square of the sucker rod regardless of its position with respect to the throats. Rotation of the gears 30 and 31 in one direction, such as counter-clockwise, will serve to rotate the partial outer ring 32 so that the throat 36 is in a position such as shown in FIG. 9 where the rod is gripped and then rotated, as will now be explained. The two gears 30 and 31 are used to bridge the gap in the gear teeth because of the throat 36, for full rotation of the ring gear.

Power jaw subassembly 14 comprises an inner partial driven ring 40 having an opening or throat 41 for alignment with the throats 36 and 37 in the outer partial ring and in the frame for the purpose of receiving the sucker rod. Inner driven ring 40 is provided with a substantially cylindrical sidewall 42 of a width or height substantially equal to the width of the outer partial ring 32 and a reduced radially outwardly extending flange or boss 43, the outer periphery 44 of which mates with the inner periphery 45 of the partial outer ring gear 32 to rotate therein to a limited extent and be guided thereby. The driven ring 40 is also provided with a plurality of apertures 46, 47, 48 and 50 (FIG. 6). Apertures 46 and 50 respectively receive pins 51 and 52 (FIGS. 4 and 8) about which jaw means or gripping elements 53 and 54 pivot or cam inward and outward for the purpose of gripping the rod section and to be described in more detail hereinafter. The apertures 46 and 50 also serve to receive a pair of pins 55 and 56 (FIGS. 7 and 8) which removably connect the inner partial driven ring means 40 with a brake drum 57.

The brake drum 57, as more clearly shown in FIGS. 7 and 8, is formed with an opening 58 to accommodate the sucker rod and has a cylindrical outer periphery 60 in braking contact with a brake lining 61, which in turn is attached to a brake cover plate 62 by means of a pair of pins 63. Brake cover 62 is in turn immovably attached to the frame 11, and serves to impede movement of the drum 57 and the inner partial driven ring 40 until the torque on the ring 40 is sufficient to overcome the friction between the drum and the brake lining.

Turning again to FIGS. 4 and 5, and also now to FIG. 9, it can be seen that the outer partial ring gear 32 is provided with a groove or slot 64 opening radially inwardly and of a width less than the thickness of the boss 43 and is also provided with camming means in the form of a pair of rollers 65 and 66 rotating about a pair of pins 67 and 68, respectively, which, in turn, attach the rollers 65 and 66 to the outer partial or carrier ring 32 so that the camming means rotate therewith. Camming means 65 and 66 are each received in, and cooperate with, semi-circular notches 70 and 71 formed in the outer side of the gripping elements 53 and 54. Upon rotation of the outer partial or carrier ring 32, that is, clockwise as shown in the drawing, camming means 65 and 66 will

tend to leave or roll out of the notches 70 and 71 while the latter are being held against rotation with respect to outer ring 32 by the operation of the inner partial ring 40 and the brake drum 57 and brake band 61. Continued rotation of the outer partial ring 32 will thus serve to cause camming means 65 and 66 to urge the gripping elements 53 and 54 radially inwardly about pivot pins 51 and 52, i.e. clockwise. Helically wound springs 72 and 73 disposed about pins 51 and 52 serve to urge the gripping elements radially inwardly, that is, clockwise, for a purpose to be described.

Each gripping element 53, 54 is provided with a notch or jaw 74 and 75, respectively, on its radially inner side to provide the jaws for the power tong, and is formed right angular to conform to the flats of the squares of the rod section disposed or to be disposed and gripped therebetween. Obviously, the square of the particular rod section being gripped will be held in a manner shown in FIG. 9 by these jaws for continued rotation to thread or unthread a rod section. Obviously also, reversal of the outer carrier ring 32, that is, counter-clockwise, will serve to move the camming means 65 and 66 into the notches 70 and 71 releasing the force acting on the rod and overcoming the springs 72 and 73 permitting the latter to be moved, that is, to a position shown in FIG. 4; the friction of the brake and barke drum serving to hold the inner partial ring 40 so that the camming means will roll into their respective notches. Jaw projections 76 and 77 formed in the gripping elements at the extreme outer end of the notches 70 and 71 prevent camming means 65 and 66 from rolling out of the notches 70, 71 and function on continued clock-wise rotation of outer ring 32 to swing jaws 74 and 75 outward.

As previously mentioned, one of the important features of the present invention is the automatic adjustment of the power jaws so that the edges of sides of the notches 74 and 75 will not grip the squares of the rod sections at the corners thereof thus damaging the rod. This feature will now be described.

In FIGS. 4 and 9 it can be seen that the notches 70 and 71 terminate at corners 78 and 80 formed between the notches 70 and 71 and cam follower surfaces 81 and 82 on the outer sides of the gripping elements. Corners 78 and 80 are so arranged and spaced from the sides of the notches 74 and 75, that if the corners of the squares of the rod section, as for example at 83 and 84, were to be engaged by these surfaces, the reaction force of the corners 78 and 80 against the camming means 65 and 66 would be directed, not radially inwardly, but tangentially so as to impart rotational movement to the entire jaw gripping subassembly 14, overcoming the friction between the brake lining and the brake drum enough so that there is a slight movement of the entire subassembly relative to the rod section. Thus the radial forces will only be slight so as not to damage the corners of the square. This slight movement will allow the surfaces of the jaws 74 and 75 to be correctly aligned or oriented with respect to the flats of the squares of the rod section, at which time the camming means 65 and 66 can ride up on to the cam follower surfaces 81 and 82 and cause the jaws to grip the rod square tightly.

The cam follower surfaces 81 and 82 and the relationship with the camming means 65 and 66 direct radial force towards the rod square imparting power sufficient to forcibly grip the square in the manner desired. Thus the power jaw subassembly is automatically adjustable, regardless of the relative position of the square to the flat surfaces of the notches in the jaws when the sucker rod is placed in the power tong, and movement of the entire tong to accommodate this misalignment of a jaw in a power tong, is not necessary.

Also as previously mentioned, another feature of this invention is the fact that the power jaw subassembly 14 is removable and reversible. Not only will the gripping elements accommodate various sizes opposing notch sur-

faces move inwardly in parallel but various ranges of square sizes may be accommodated simply by the interchange or replacement of power jaw subassemblies having different jaw sizes and/or different lengths of movement of the gripping elements. Also, any particular selected subassembly may be used to thread or unthread the rod section without turning over the entire power tong or by disassembly and transposition of individual gripping elements. This feature is accomplished as follows:

As previously explained, the carrier ring 32 may be rotated in either direction by the reversible fluid motor 13. In FIGS. 4 and 9 rotation of the carrier clockwise will serve to urge the jaws 74 and 75 into gripping relationship with the square of the rod section therein, and continued movement will rotate the rod in a clockwise direction to thread the rod section into a rod coupling. When it is desired to remove the rod from the well and to separate the joined sections, a reverse operation of the jaws is desirable. This is accomplished in the embodiment illustrated, as mentioned before, by the removal of the power jaw subassembly 14 and reversing or transposing the same, that is, turning it upside down and replacing it in the carrier ring. This removal is conveniently accomplished by reason of the fact that continued clockwise rotational movement of the carrier ring 32 and the reaction of the camming means 65 and 66 on cam follower surfaces 81 and 82 will serve to urge the gripping elements radially inwardly such as to a position shown in FIG. 10, at which position the outer peripheries of the gripping elements 53 and 54 are substantially totally within the outer periphery 44 of the inner partial ring 40. Means are provided in the form of a notch 85 in the outer periphery of the inner partial ring to permit the inner partial ring to be removed from the carrier ring free of one of the camming means 65 or 66 normally extending within the inner partial ring, as more clearly seen in FIGS. 5 and 10. Throat 36 allows the other camming means 65 or 66 (depending upon the position of the outer carrier ring) to be removed free of interference. Means are also provided in the form of pairs of notches 86, 87 in the frame 11 and pairs of notches 88 (one shown in FIGS. 4 and 9) opposite throat 36 to allow clearance of the jaw projections 76 and 77 as will be apparent. It is noted, however, that for purposes of indexing the subassembly within the frame, the frame is provided with pairs of indexing notches 90 and 91 adjacent the throat 37 which are matched when the inner ring 40 is in the position shown in FIG. 10 with an indexing projection or lug 92 on the inner ring adjacent its throat 41 but extending radially outwardly, as shown more clearly in FIGS. 4, 6 and 10. The outer ring is also provided with a pair of indexing notches 93 and 94, as more clearly shown in FIG. 9 and located near its throat 36, to match the notches 90, 91 in the frame and the indexing lug 92 when the inner and outer rings are properly positioned such as in FIG. 10 for removal. In the position shown in FIG. 10, the throat 36 of the outer ring is located at 90 degrees to the right of the frame throat 37, or upwardly as shown in FIG. 10, and the throat 41 is aligned with the frame throat 37, and in this position the indexing projection 92 and indexing notches 90 and 94 will permit the entire subassembly to be removed.

To transpose and/or reverse the subassembly 14 for reverse operation, the outer ring 32 is rotated a half turn with its throat 90 degrees to the left of the frame throat 37, and in this position its indexing notch 93 will align with the frame indexing notch 91 so that the projection 92 may be free and clear. In this position the subassembly 14 will be properly inserted in the outer ring without interference. In this transposed position, of course, pins 55 and 56 would then be disposed in apertures 47 and 48 rather than in apertures 46 and 50 to attach the brake drum 57 to the inner partial ring 40. Otherwise the function of the pins 55 and 56 will be the same. In this reverse position, the function of the camming means 65 and 66 with respect to the notches 70 and 71, jaw projections 76 and 77, corners 78, 80 and cam follower surfaces 81, 82, is identical, except that the rotation of the gripping elements 53 and 54 would then be counter-clockwise to impart counter-clockwise rotation to the rod square.

Thus the power jaw subassembly 14 is, in effect, a cartridge which may be removed and replaced as a unit, and it is also apparent that the size and disposition of the notches 74 and 75, as well as the relative distance that the gripper elements travel in any individual subassembly, provide a means for accommodating ranges of sizes of squares. Also, while the jaws 74 and 75 are shown cut into the gripper elements themselves, these jaws could be formed by removable or replaceable dies or liners.

Thus a selected subassembly may be disposed or placed in the opening in the carrier ring 32 by the proper positioning of the indexing notches and indexing projection, and in this position the camming means 65 and 66 and the jaw projections 76 and 77 will be properly disposed. Once inserted, rotation of the carrier ring will serve to move the camming means 65, 66 to overcome springs 72, 73 which urge the gripper elements 53, 54 radially inwardly. Throats 36, 37 and 41 may be then aligned to receive the sucker rod. It can also be seen from this description that the springs 72, 73 serve to hold the gripper elements in their inward position when the subassembly is removed from the tong.

As a safety feature for the power tong, safety means in the form of a pair of gates 95 and 96 are hingedly connected to the frame 11 adjacent its throat 37 by pairs of threaded pivot pins 97, 98 located on the upper and lower halves of the frame 11, as more clearly seen in FIGS. 2 and 3. These gates are spring-actuated towards a closed position by a semi-circular leaf spring 100 attached to the gates, as at 101 and 102, to cammingly bias the gates closed. In operation, the sucker rod, manually forced through the throat 37 of frame 11 will automatically open gates 95, 96 overcoming the resistance of spring 100; the inner and outer ends of the gates being formed with entrance and exit surfaces 104, 104 to facilitate opening and closing of the gates. Once the rod section is within the gates they will automatically close again by the operation of the biasing spring 100. Stop means in the form of projections 105 and 106 (FIG. 1) may be provided to limit the inward movement of the gates.

Turning now in particular to FIG. 3 where the relatively fixed back-up wrench 16 is shown in more detail, it can be seen that this wrench comprises a head 110 with a jaw 111 to receive the square of lower section 17 of a sucker rod and to firmly hold the same against rotation. This wrench is also provided with a horizontally extending arm 112 which is apertured as at 113 to receive a horizontally extending locating pin 114. This locating pin is fixed in the frame 11 by apertures 115, 116 and 117 with lateral movement permitted. A leaf spring 118 is suitably attached at one end to the frame 11 as by bolt means 120, while the other end engages and cooperates with a reduced portion 121 of the pin to bias the pin to the left as shown in the drawings, that is, through the apertures 113, 115 and 116. Movement of the pin by hand or otherwise to the right by grasping the spring 118 sufficient to remove the pin from apertures 113 and 115 will serve to release the arm 112 from the frame.

Intermediate the ends of the wrench but near the head 110 there is provided a lateral projection 122 engageable by a holding spring 123 suitably attached to the frame 11 as by bolt means 124. Spring 123 serves to bias the wrench upwardly towards the frame to accommodate the square of a lower rod section, such as 17, when the rods are joined and it is desired to separate them, as can be more clearly seen in FIG. 2. The resiliency of the spring 123 will be overcome by the unthreading of the sections and the wrench will lower, but upon removal of

the sections from the tong the spring will return the wrench to its higher position.

When the operator desires to join rod sections, the wrench is reversed. By grasping the spring 118 and moving the end operatively attached to the locating pin 114 to the right, as shown in FIG. 3 and as previously explained, the locating pin will be removed from the apertures 115 and 113 to release the arm 112, whereupon the wrench may be transposed and positioned by releasing the spring 118. In this position, the wrench is free to hang in a lower position so that the head 110 may accommodate the square of a lower section, such as 17. Complete downward movement of the wrench, pivotal about the pin 114 is prevented by the extreme end 125 of the arm abutting the bottom of the frame. In actual practice, the wrench in its lowermost position is approximately that shown in the dotted lines in FIG. 2.

Also, as mentioned, another feature of this invention is a means incorporated therein for measuring the torque actually imposed upon rod sections being joined. This is accomplished in the embodiment illustrated by the reaction of the jaw 111 and the arm 112 which imparts a force on a hydraulic piston 126 due to the torque imposed upon the arm 112. The hydraulic piston 126 is engageable at the extreme end of arm 112 as shown, and the aperture 113 is sufficiently large to accommodate slight relative movement of the arm. The piston 126 is disposed in a bore 127 in the frame 11 and is in open communication with a hydraulic pressure gauge 128 (FIG. 2). Suitable sealing means, such as seals 130, 131 are provided where necessary. As shown in FIG. 3, movement of the arm 112 to the left will increase the fluid in piston chamber 132 which will be shown and calibrated in the gauge 128. This provides an accurate and convenient means of indicating the amount of torque imposed when two rod sections are joined.

In operation to join two rod sections together, the power tong is normally suspended by the hanger 19 from a cable and the back-up wrench 16 is in the lowermost of its two positions to readily receive and grip the square of a lower section, such as 17, and the throats of the frame 11, the outer partial ring gear 32, and inner partial ring gear 40, are aligned by operation of the hydraulic motor to receive a rod section. A coupling, such as 135, may be partially or completely threaded thereon or upon the uppermost of a rod section, such as 18. The upper section being normally suspended from a cable (not shown) is manually forced past the safety gates 95 and 96 which open and close in a manner above described into the throats of the power jaw subassembly 14 in a position such as is shown in FIGS. 2 and 4. In this position, a valve handle, such as 136, shown pivotally disposed on the hanger 19 will operate a valving mechanism (not shown) in the motor 13, operatively connected to this handle in any suitable manner, such as by links 137 (FIG. 1), to cause rotation of the partial carrier ring 32 through the operation of the gear train 24. As heretofore explained, rotation of carrier ring 32 causes a closing of the jaws upon the upper square and further and continued rotation threads the two rod sections 17 and 18 into the coupling. The amount of torque imposed upon the rod sections will be registered in the torque gauge 128 by operation of the hydraulic piston 126 and back-up wrench 16 as above described. It is to be noted that the operation of the wrench jaws may be carried out without regard to orientation of the jaws 74 and 75 with respect to the square of the rod section.

When the two rod sections are properly joined the operator will reverse the operation by reversing the movement of the valve handle 136 and the valving mechanism which will ultimately rotate the carrier ring gear 32 in the opposite direction. Due to the operation of the brake drum and brake lining and to the jaw projections 76, 77 the gripping elements 53 and 54 will move radially outwardly as the camming means 65 and 66 return to the notches 70 and 71, thus freeing the jaws 74 and 75 of the square of the upper rod. The carrier ring 32 is then positioned to again align the throats for the reception of another rod section, all in one controlled operation.

When it is desired to remove the sucker rod from the well and to disassemble the various sections of rod, the power tong may be operated substantially as follows. The jaw gripping subassembly or cartridge 14 is first collapsed in a manner previously described by rotation of the ring gear in a direction to thread rod sections, but without a rod section therein, so that the gripping elements will be substantially completely disposed within the inner partial ring and the indexing notches in the frame, and carrier ring aligned with the indexing projection 92 of the inner partial ring are positioned so that the inner partial ring may be removed. The subassembly 14 is then transposed and reinserted upon rotation of the carrier ring a half turn. With the throats all aligned, the cartridge or subassembly is then made ready to uncouple rod sections in a manner previously described. With the power tong horizontally suspended from a cable it is brought towards the vertically disposed sucker rod at a lever so that the fixed back-up wrench 16, then in its uppermost position, will engage the square of a lower section, such as 17. The tong is rotated bodily to line up jaw 111 with the flats of the square of the lower rod section. Concurrently, the upper section will, of course, open the safety gates, enter the throats of the carrier ring and power jaw subassembly then aligned with the throat of the frame. As understood from the description above, whether or not the squares of the upper and lower sections are aligned with one another is immaterial, since upon operation of the gripping elements by rotation of the ring 32, the gripping elements will automatically orient themselves to grip the flats of the squares of the upper rod. The automatic adjustment and gripping of the squares is but part of a continued rotation of the ring and the gripping subassembly to release or uncouple the two sections. A reversal of the ring 32 will first open the jaws releasing the square of the upper rod section, and further rotation of the ring 32 will align the throats of the frame, outer partial ring and inner partial ring to receive another rod section.

Obviously, in either operation, threading or unthreading of sections, the lower rod section is removed completely free of the tong by horizontal movement of the tong.

While in the above description of the operation of this device mention is made of the power tong being moved to and from the rod sections and the same being suspended on the cable and the like, such description is intended to be illustrative of a typical operation and variations in this operation would no doubt ensue depending upon the conditions existing in the field.

While the above description of the operation of the power tong comprising this invention has been in connection with rod sections having squares, obviously the tong could be used for any work elements having flats of any description imposed thereon such as, for example, rod sections with hexagonal sides, by the selection of proper notches to mate therewith. Also, this power tong could be used to uncouple or couple tubing of various sizes by the selection of appropriate notches and/or liners for the gripping elements.

While the specific details of the invention have been herein shown and described, changes and alterations may be resorted to without departing from the spirit thereof as defined in the appended claims.

What is claimed is:

1. In a power tong for gripping an object formed with side faces, the combination of, a rotatable power means formed with a central opening and having camming means

rotatable therewith, driven means positioned in said power means for relative rotation thereby and provided with an opening for receiving said object, gripping means movably connected to said driven means and formed with jaw surfaces for fitting said side faces, said gripping means further having means cooperable with said camming means so that upon rotation of said power means with respect to said driven means said jaw surfaces are moved into fitting engagement with said side faces, and means for adjusting said jaw surfaces by minimizing forces for gripping said object and maximizing forces for orienting said jaw surfaces with said side faces so that said jaw surfaces are oriented with said side faces prior to maximum force engagement of said jaw surfaces with said side faces.

2. In a power tong for gripping an object formed with side faces, the combination of, a rotatable power means formed with a central opening and having camming means rotatable therewith, driven means positioned in said power means for relative rotation thereby and provided with an opening for receiving said object, gripping means movably connected to said driven means and formed with jaw surfaces for fitting said side faces, said gripping means further having means cooperable with said camming means so that upon rotation of said power means with respect to said driven means said jaw surfaces are moved into fitting engagement with said side faces, and means for adjusting said jaw surfaces by minimizing forces for gripping said object and maximizing forces for orienting said jaw surfaces with said side faces so that said jaw surfaces are oriented with said side faces prior to maximum force engagement of said jaw surfaces with said side faces comprising means on said gripping means for cooperating with said camming means whereby said camming means will partially rotate said driven means.

3. In a power tong for gripping an object formed with side faces, the combination of, a rotatable power means formed with a central opening and having camming means rotatable therewith, driven means positioned in said power means for relative rotation thereby and provided with an opening for receiving said object, gripping means movably connected to said driven means and formed with jaw surfaces for fitting said side faces, said gripping means further having cam follower surfaces cooperable with said camming means so that upon rotation of said power means with respect to said driven means said jaw surfaces are moved radially inwardly into fitting engagement with said side faces, and means for adjusting said jaw surfaces by minimizing forces for gripping said object and maximizing forces for orienting said jaw surfaces with said side faces so that said jaw surfaces are oriented with said side faces prior to maximum force engagement of said jaw surfaces with said side faces comprising means operative to cooperate with said camming means to move said driven means prior to the operation of the cam follower surfaces.

4. In a power tong for gripping an object formed with side faces, the combination of, a rotatable power means formed with a central opening and having camming means rotatable therewith, driven means positioned in said power means for relative rotation thereby and provided with an opening for receiving said object, gripping means movably connected to said driven means and formed with jaw surfaces for fitting said side faces, said gripping means further having cam follower surfaces cooperable with said camming means so that upon rotation of said power means with respect to said driven means said jaw surfaces are moved radially inwardly into fitting engagement with said side faces, means for adjusting said jaw surfaces by minimizing forces for gripping said object and maximizing forces for orienting said jaw surfaces with said side faces so that said jaw surfaces are oriented with said side faces and prior to maximum force engagement of said jaw surfaces with said side faces and fixed jaw means cooperating with said

movable jaw means for holding one of two separable objects while the power means and gripping means rotate the other object.

5. In a power tong for gripping an object formed with side faces, the combination of, a rotatable power means formed with a central opening and having camming means rotatable therewith, driven means positioned in said power means for relative rotation thereby and provided with an opening for receiving said object, gripping means movably connected to said driven means and formed with jaw surfaces for fitting said side faces, said gripping means further having cam follower surfaces cooperable with said camming means so that upon rotation of said power means with respect to said driven means said jaw surfaces are moved radially inwardly into fitting engagement with said side faces, and means for adjusting said jaw surfaces so that said jaw surfaces are oriented parallel with said side faces comprising means operative to cooperate with said camming means to partially rotate said driven means prior to the operation of said cam follower surfaces so that maximum forces for gripping said object are delayed until said jaw surfaces are oriented.

6. In a power tong for gripping an object formed with side faces, the combination of, a rotatable power ring formed with a central opening and having camming means rotatable therewith, a driven ring positioned in said power ring for relative rotation thereby and provided with an opening for receiving said object, gripping means movably connected to said driven ring and formed with jaw surfaces for fitting said side faces, said gripping means further having cam follower surfaces cooperable with said camming means so that upon rotation of said power ring with respect to said driven ring said jaw surfaces are moved radially into fitting engagement with said side faces, and means to orient said jaw surfaces with said side faces so that said jaw surfaces are parallel with said side faces comprising means operative to move said driven ring partially prior to engagement of said camming means with said cam follower surfaces so that maximum forces for gripping said object are delayed until said jaw surfaces are oriented.

7. In a power tong for gripping an object, rotatable power means having camming means rotatable therewith, driven means including gripping elements rotatable in said power means, said gripping elements cooperable with said camming means to grip said object upon rotation of said power means in one direction and to release said object when rotated in the opposite direction, said driven means being arranged to be removable as a unit from said power means for reverse operation, and means to index said driven means with said power means for proper removal and insertion in said tong.

8. A power tong for coupling and decoupling sucker rods provided with flat wrench-engagable surfaces, comprising, a frame having a throat for the reception of said rod, a partial ring rotatably mounted on said frame and having a side opening therein which may be brought into alignment with said throat so that said rod may be disposed within said ring, means for rotating said ring about its central axis, said ring being provided with camming means movable therewith, gripping means having flat gripping surfaces movable toward and away from a rod disposed within said ring upon rotation of said ring so as to cause said gripping means to grip said rod, and means for orienting said gripping surfaces by minimizing forces for gripping said flat surfaces and maximizing forces for orienting so that said gripping surfaces are aligned with said flat surfaces upon gripping of said rod.

9. The power tong claimed in claim 8 wherein said orienting means comprises means operative to cooperate with said camming means to partially rotate said gripping means upon initial engagement of said gripping surfaces with said flat surfaces.

10. The power tong claimed in claim 8 further includ-

ing fixed gripping means cooperating with said movable gripping means for holding one of two separable sucker rods while the gripping means rotate the other sucker rod.

11. The combination claimed in claim 9 further including means for measuring the torque imposed upon said rod by said gripping means.

12. The combination claimed in claim 9 further including means whereby said gripping means may be removed as a unit from said tong without removal of any other part of said tong;

13. The combination claimed in claim 9 further including means to index said gripping means with said tong for proper removal of said gripping means and insertion thereof in said tong.

14. In a power tong for gripping an object, rotatable power means provided with a pair of camming means having their axes lying in a plane passing through the longitudinal axis of the object to be gripped and rotatable with said power means, and driven means including gripping elements rotatable in said power means and mounted for relative pivotal movement in diametrically opposite arcuate paths, said camming means being cooperable with said gripping elements to grip said object upon rotation of said power means, said driven means being arranged to be removable as a unit from said power means without removal or displacement of any other part of said tong.

15. In a power tong for gripping an object having flat faces, rotatable power means provided with a pair of camming means having their axes lying in a plane passing through the longitudinal axis of the object to be gripped and rotatable with said power means, and driven means including gripping elements rotatable in said power means and mounted for relative pivotal movement in diametrically opposite arcuate paths, said camming means being cooperable with said gripping elements to grip said flat faces upon rotation of said power means in one direction and to release said object when rotated in another direction, said driven means being arranged to be removable as a unit from said power means without removal or displacement of any other part of said tong.

16. In a power tong for gripping an object having flat faces, rotatable power means provided with a pair of camming means having their axes lying in a plane passing through the longitudinal axis of the object to be gripped and rotatable with said power means, and driven means including gripping elements having flat jaw surfaces rotatable in said power means and mounted for relative pivotal movement in diametrically opposite arcuate paths, said camming means being cooperable with said gripping elements to grip said object upon rotation of said power means in one direction and to release said object when rotated in the opposite direction, and means to orient said jaw faces parallel with said flat faces prior to gripping, said driven means being arranged to be removable as a unit from said power means without removal or displacement of any other part of said tong.

17. In a power tong for gripping an object having flat faces, a rotatable power ring provided with a pair of camming means having their axes lying in a plane passing through the longitudinal axis of the object to be gripped and rotatable with said power means, and driven means including gripping elements with flat jaw surfaces rotatable in said power means and mounted for relative pivotal movement in diametrically opposite arcuate paths, said camming means being cooperable with said gripping elements to urge said jaw surfaces radially of said ring to grip said flat faces upon rotation of said power means in one direction and to release said object when rotated in the opposite direction, said driven means being arranged to be removable as a unit from said power means without removal or displacement of any other part of said tong.

18. In a power tong for gripping an object, a rotatable power ring provided with a pair of camming means having their axes lying in a plane passing through the longitudinal axis of the object to be gripped and rotatable with said power means, and driven means including gripping elements with flat jaw surfaces rotatable in said power means and mounted for relative pivotal movement in diametrically opposite arcuate paths, said camming means being cooperable with said gripping elements to urge said jaw surfaces radially of said ring to grip said flat faces upon rotation of said power means in one direction and to release said object when rotated in the opposite direction, and means on said gripping elements operative to orient said jaw surfaces parallel to said flat faces prior to gripping, said driven means being arranged to be removable as a unit from said power means without removal or displacement of any other part of said tong.

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