

Aug. 18, 1964

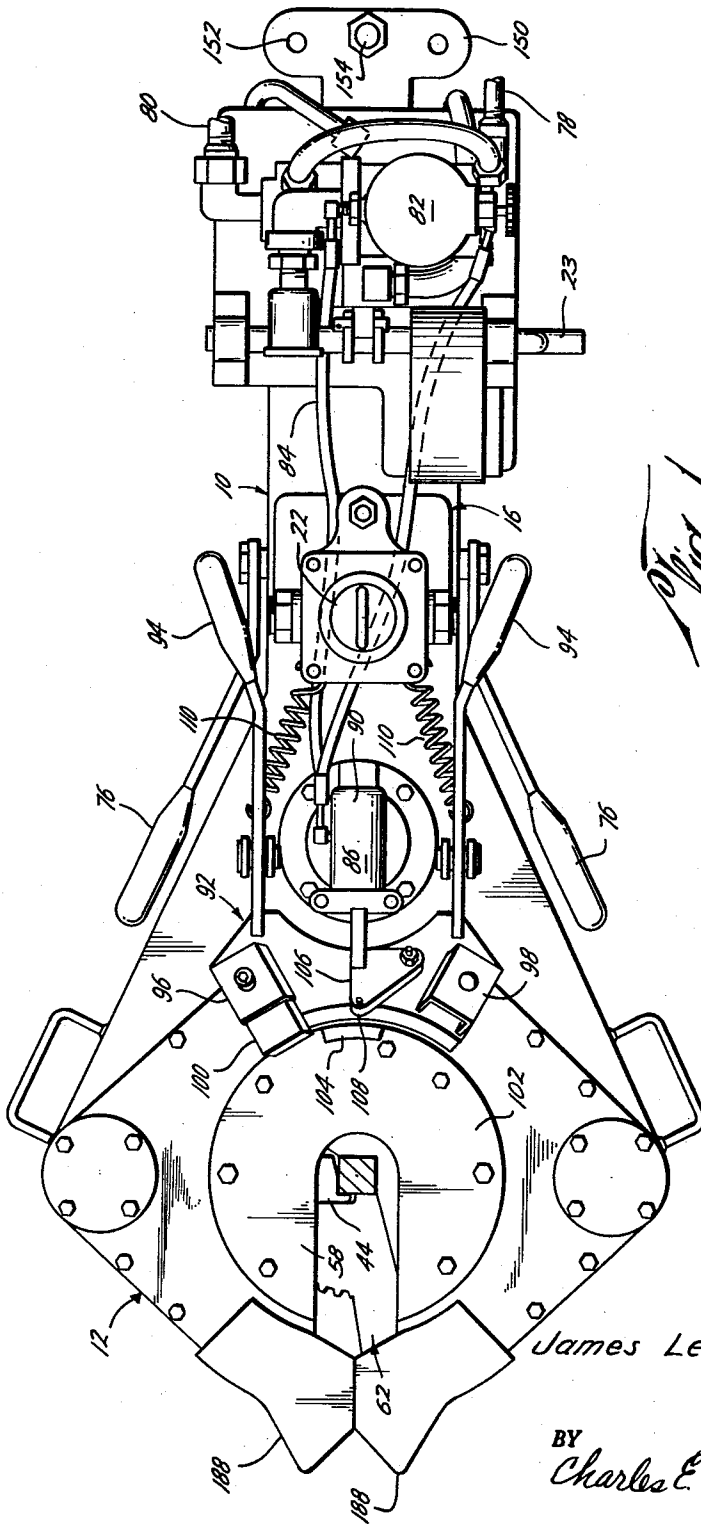
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3,144,794

POWER DRIVEN SUCKER ROD WRENCH

Filed June 26, 1961

6 Sheets-Sheet 1



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POWER DRIVEN SUCKER ROD WRENCH

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6 Sheets-Sheet 2

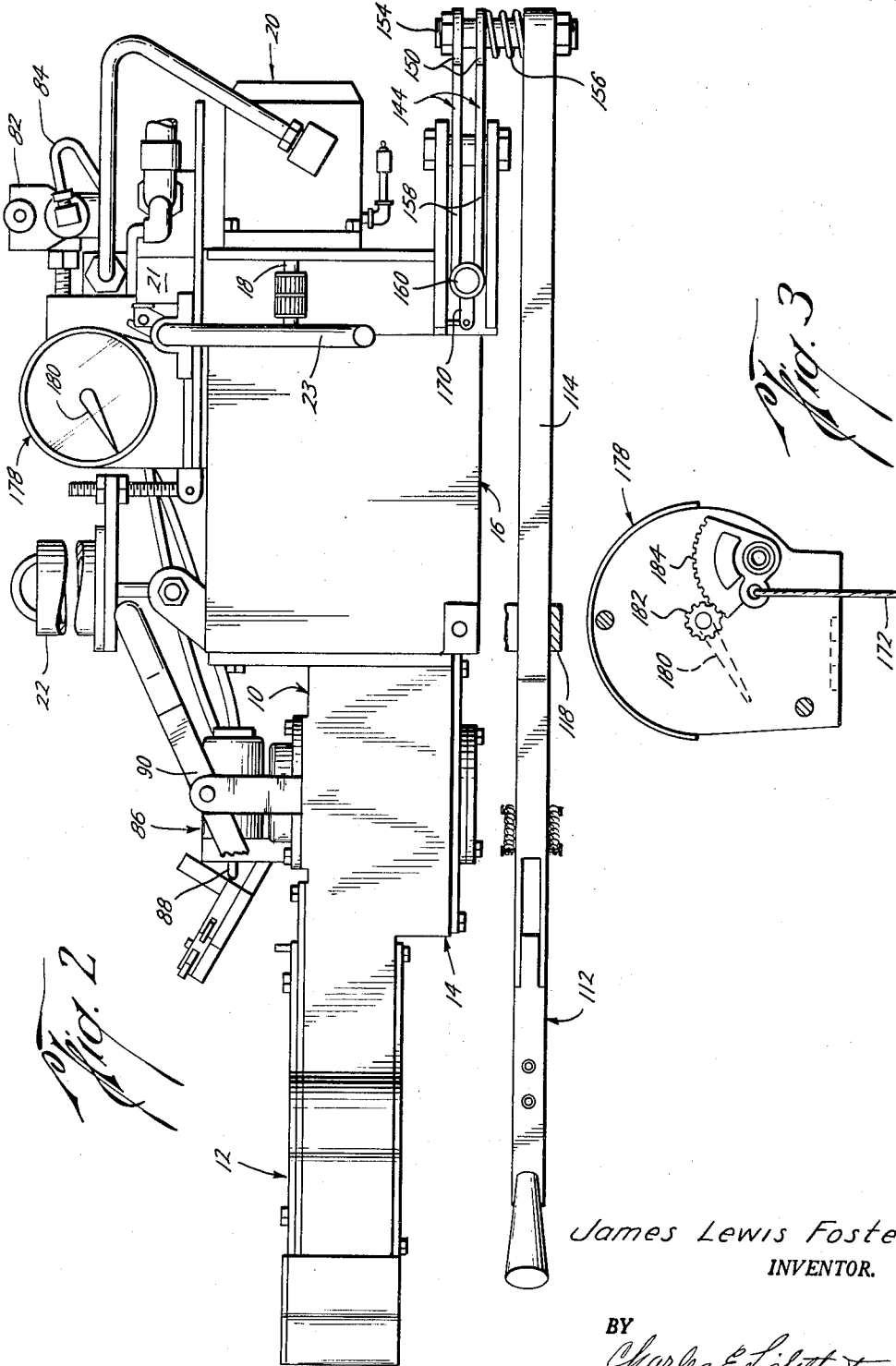


Fig. 2

Fig. 3

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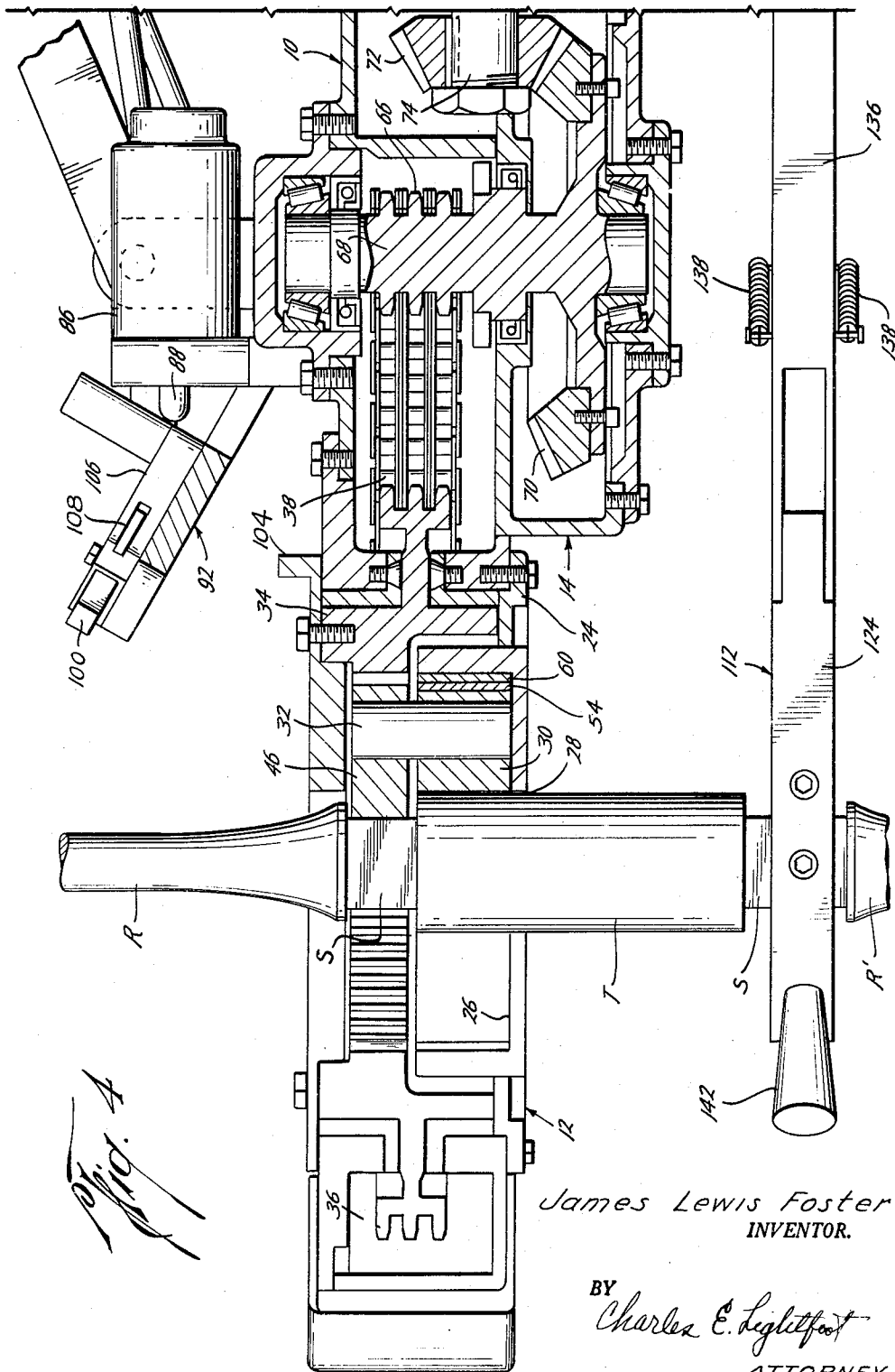
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POWER DRIVEN SUCKER ROD WRENCH

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6 Sheets-Sheet 3



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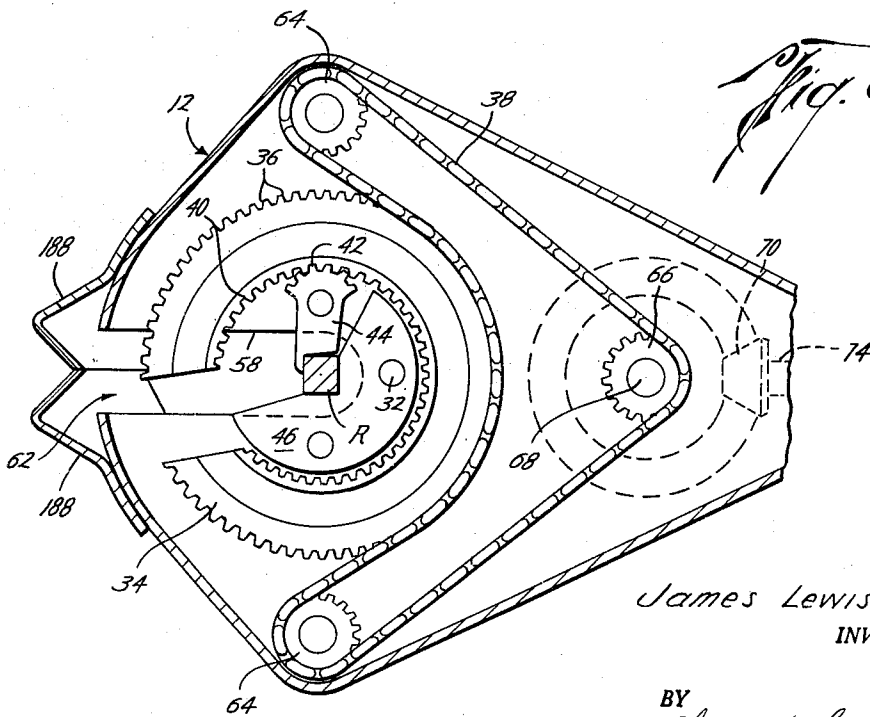
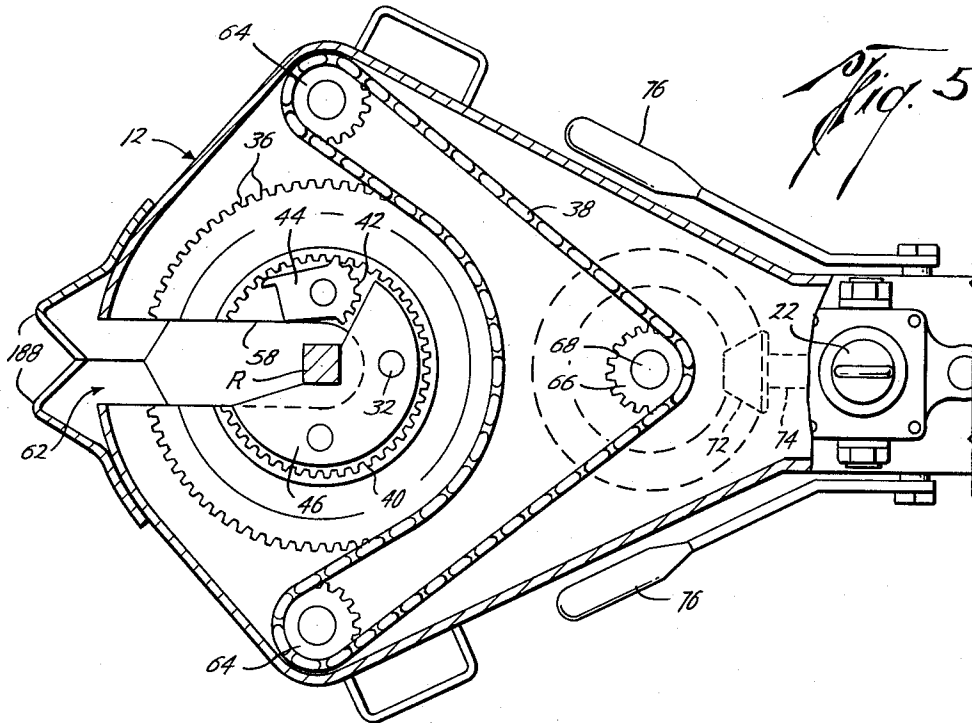
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POWER DRIVEN SUCKER ROD WRENCH

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6 Sheets-Sheet 4



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POWER DRIVEN SUCKER ROD WRENCH

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6 Sheets-Sheet 5

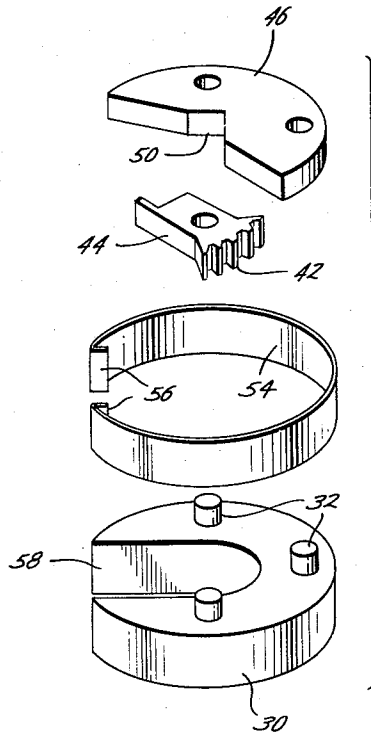
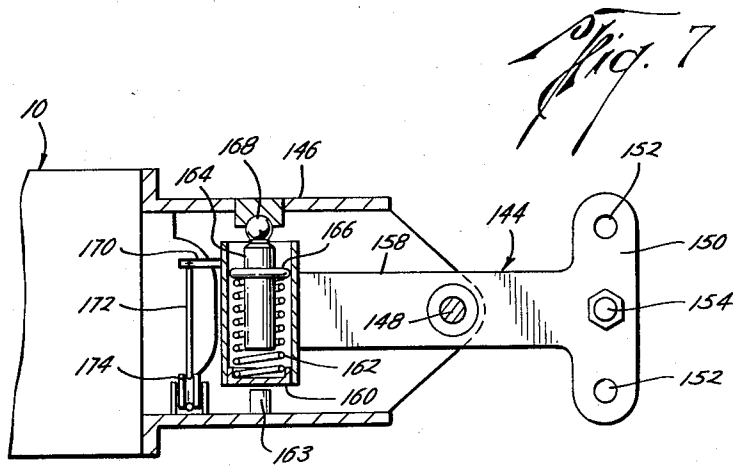


Fig. 8

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3,144,794

POWER DRIVEN SUCKER ROD WRENCH

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4 Claims. (Cl. 81-56)

This invention relates to a power actuated sucker rod tong or wrench, and more particularly to wrench mechanism for connecting and disconnecting the screw threaded joints of pump rods.

In the operation of oil wells, it is usual to employ pumps which are operated from the surface by sucker rods made in sections, which are screwed together, each such section being provided with portions which are of square or other polygonal shape in cross-section for engagement with wrenches by which the sections may be rotated to connect or disconnect the same.

Heretofore, in assembling or disassembling such sucker rod strings when inserting the same in or removing the same from a well, it has been customary to rotate the sections manually by means of wrenches. This method of operation is slow and wasteful of time and labor, and also uncertain in that no means is usually provided for assuring that the joints will be tightly and uniformly made up.

Various power driven wrench mechanisms have been proposed which could be applied to the sections of sucker rods to hold one section against rotation while the other section is rotated to make up or break the joints of the string, but as heretofore commonly constructed, such devices are not designed to be easily and quickly applied to and removed from rod sections and no means is usually provided for accurately indicating the rotative force which is applied whereby the joints can be uniformly made up.

The present invention has for an important object the provision of power driven wrench mechanism for sucker rods, or the like, by which rod joints may be easily and quickly made up or taken apart and by which the rotative force applied to the joints in assembling the string may be uniformly regulated.

Another object of the invention is to provide wrench mechanism for sucker rods embodying means for holding one section of the rod against rotation and power driven means for rotating another section thereof to assemble or disassemble the sections.

A further object of the invention is the provision of power driven wrench mechanism having a frame and a rotatable head carried thereby, the head and frame each having a rod receiving opening or throat, said mechanism also having means for automatically arresting the rotation of the head with said openings positioned in registration to permit the insertion or removal of the sucker rod.

Another object of the invention is to provide wrench mechanism of the type referred to having a rotatably mounted head and releasable means on the head positioned for engagement with a sucker rod to cause the rod to rotate with the head, there being also means for actuating said releasable means to move the same to holding position upon rotation of the head in one direction and to releasing position upon rotation of the head in the other direction.

A further object of the invention is the provision in wrench mechanism of the kind mentioned of a holding wrench having a stationary and a movable element which latter element is movable to one position for coaction

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with the stationary element to hold a rod section against rotation and to another position to release the rod section and also having means for releasably holding the movable element against movement from either of said positions to the other of said positions.

Another object of the invention is to provide wrench mechanism of the type referred to having manually operable means for controlling the rotation of the rotary head to allow the head to be moved into a position in which the rod receiving openings of the frame and head are brought into accurate registration and also having means which functions automatically to arrest rotational movement of the head when said openings are in registration.

A further object of the invention is the provision wrench mechanism of the kind mentioned of means for indicating the rotative force or torque which is applied to the rod joint during operation of the mechanism.

Another object of the invention is to provide wrench mechanism of the type referred to having rod engaging mechanism for causing a sucker rod section to rotate in one direction with the rotary head for use in assembling the sections of a rod string and which may be reversed to permit the rod section to be rotated with the head in the other direction for use in disassembling the string.

A still further object of the invention is the provision of a power driven sucker rod wrench which is of strong and rugged construction, in which the parts are easily replaced for purposes of maintenance and repair, and by which sections of sucker rod may be easily and quickly assembled or disassembled.

The above and other important objects and advantages of the invention may best be understood from the following detailed description of a preferred embodiment of the same, when considered in conjunction with the annexed drawings, wherein—

FIGURE 1 is a top plan view of the invention, showing the same with the sucker rod in position in the rotary head preparatory to making up a rod joint;

FIGURE 2 is a side elevational view of the invention;

FIGURE 3 is a detail view of the indicator mechanism of the torque indicator of the invention;

FIGURE 4 is a fragmentary, side elevational view, partly in cross-section, and on a somewhat enlarged scale, showing internal structure of the invention with the upper and lower members of a sucker rod joint positioned therein for rotation, the joint being shown in its made up condition;

FIGURE 5 is a fragmentary, top plan view on a somewhat enlarged scale of the rotary head and a portion of the mechanism for rotating the same in the rotary head housing, the top of the housing being removed and the rod clamping mechanism of the head being shown in released position;

FIGURE 6 is a view similar to that of FIGURE 5, showing the rod clamping mechanism of the rotary head in clamping position preparatory to rotation of the upper member of the rod joint;

FIGURE 7 is a fragmentary, top plan view, partly in cross-section, of a portion of the lever arm of the tong of the invention as illustrated in FIGURE 2, showing details of construction of the torque indicating mechanism;

FIGURE 8 is an exploded, perspective view of the parts of the rod holding or clamping mechanism of the rotary head assembly of the invention in disassembled relation;

FIGURE 9 is a fragmentary, top plan view on a greatly enlarged scale of the stationary tong of the invention, showing the same in releasing position;

FIGURE 10 is a view similar to that of FIGURE 9 showing the stationary tong in rod clamping or holding position; and

FIGURE 11 is a schematic view illustrating the pressure fluid system by which the invention is operated.

Referring now to the drawings in greater detail, the tong mechanism of the invention includes a frame, generally indicated at 10, formed at one end with hollow housing 12, within which rotary head mechanism is rotatably mounted, to be driven through the intermediation of gear mechanism enclosed in a casing 14 forming a part of the frame and which is in turn operated by an enclosed transmission mechanism 16 through a drive shaft 18 which is connected to a motor 20 operable by pressure fluid from any convenient source of supply under the control of a directional valve 21. The frame is connected to the lower end of a hanger bar 22, at a location to support the frame in a substantially horizontal position when the upper end of the hanger bar is connected to a cable, not shown, by which the device may be suspended over a well head.

The hollow housing 12 has a bottom plate 24 removably attached thereto, and which is formed with an upwardly opening annular socket portion 26 within which the rotary head mechanism is rotatably seated, and which bottom plate has a central opening 28 therethrough.

The rotary head mechanism includes a circular base plate 30 rotatably disposed in the socket 26 and having peripherally spaced upwardly extending pins 32 extending above its upper surface. The rotary head mechanism also includes an annular gear member 34 having external teeth 36 for engagement with the drive chain 38, and internal teeth 40 which are positioned for coaction with the external teeth 42 of a pivotal latch or holding member 44, which is pivotally mounted on one of the pins 32. A holding plate 46 is removably seated on the base plate 30 and is provided with holes 48 into which the pins 32 extend to cause the holding plate to rotate with the base plate. The holding plate 46 is cut away, as best seen in FIGURES 5, 6 and 8, and is provided at its center with an angular notch 50, which is shaped for coaction with an annular cut away portion 52 on the free end of the latch member 44 to form a square opening into which the squared portion of a sucker rod may be positioned, whereby the sucker rod may be securely held against rotation relative to the rotary head, when the latch member is in holding position, as clearly shown in FIGURE 6. A friction element 54 is positioned on the base plate 30 extending peripherally about the same and having inturred end portions 56 positioned to extend into a radial slot 58 formed in the base plate whereby the friction element is secured in place. The friction element 54 takes the form of a flat spring which rotates with the base plate and whose outer face is in engagement with a brake lining 60, shown in FIGURE 4, positioned in the socket 26 to frictionally resist rotation of the rotary head in the housing.

The housing 12 has a radially disposed opening 62 which is positioned to permit the slot 58 of the base plate 30 to be moved into and out of alignment therewith upon rotation of the rotary head, whereby this opening may form with the slot 58, a throat into and out of which a sucker rod may be moved to position the sucker rod in the notch 50 of the holding plate 46 in position to be engaged by the latch member 44 to hold the rod in the head for rotation therewith.

It will be readily apparent that by positioning the latch member 44 and holding plate on the pins 32 in the manner shown in FIGURES 5 and 6, the teeth 42 of the latch member in intermeshing engagement with the internal teeth 40 of the gear member 34, will rotate the latch 44 into latching position, shown in FIGURE 6, so that the

sucker rod R will be rotated counterclockwise with the rotary head. By removing the latch member 42, and the holding plate 46 and turning the holding plate over and repositioning the holding plate on two of the pins 32 and reversing the latch member and positioning the same on the remaining pin, the mechanism may be easily and quickly adjusted to turn a sucker rod clockwise with the rotary head. Upon rotation of the rotary head in a clockwise direction from the position illustrated in FIGURE 6 to that shown in FIGURE 5, the latching member 44 will be moved to the releasing position shown in FIGURE 5, to allow the wrench mechanism to be removed from the sucker rod string.

The driving mechanism for rotating the rotary head includes the endless chain 38 which operates about the idler sprockets 64, 64 rotatably mounted in the housing, which chain also passes about a driving sprocket 66 carried by a rotatably mounted vertical shaft 68 forming a part of the transmission mechanism. The shaft 68 carries a gear 70 which is in intermeshing engagement with a gear 72 carried by a drive shaft 74 which is in turn rotated under the control of suitable clutch mechanism, not shown, by which the drive shaft may be connected to and disconnected from speed selector gears, not shown, by which the speed of rotation of the drive shaft may be changed from high to low gear. The clutch mechanism includes operating levers 76 disposed on opposite sides of the transmission casing or enclosure 16, and which may be moved to different positions to connect the drive shaft 72 to the motor 20 to be rotated thereby in either high or low gear, or to disconnect the drive shaft when it is desired to stop the rotary head.

The motor 20 is of conventional design and powered from any suitable source of fluid under pressure, such fluid being conducted to the motor and from the same through pipes 78 and 80 in the usual manner under the control of the directional control valve 21. The directional control valve is provided with a by-pass valve 82, which is normally closed and through which fluid may flow through by-pass lines, such as those shown at 83 and 84 in FIG. 11, to by-pass the motor when the valve is open. The valve 82 is of conventional construction and is provided with pressure relief mechanism which is actuated by the fluid pressure overcoming an internal spring mechanism or by the release of pilot pressure by an external valve 86 suitably connected to the by-pass valve. The external valve 86 is of conventional construction having a valve stem 88 which is slidably extended from the valve casing 90 in position to be actuated by automatic mechanism associated with the rotary head to open the pilot valve when it is desired to automatically stop the rotation of the head with the opening 62 of the housing 10 in registration with the radial slot 58 of the base plate 30 to open the throat of the head to allow a sucker rod to be positioned in or removed from the head.

The directional control valve 21 is of conventional design, known to the trade as a four way valve, having four ports with means of directing the fluid from the pressure port to the opposite fluid ports of the motor in such a manner that fluid will introduce pressure to the one port of the motor to cause clockwise rotation and permit return flow through the opposite port and out the return port to the return line with means of reversing this flow through the motor to cause counterclockwise rotation and means to direct the fluid directly to the return line without passing through the motor.

The motor may be operated by compressed air in which case no return line is provided and the air is exhausted to the atmosphere.

The directional control valve may have a lever 23 for operating the same by which the valve may be moved to one position to cause the motor to rotate in one direction, to another position to cause the motor to rotate in the other direction or to a position to stop the motor.

The automatic mechanism of the invention by which

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the head is stopped at a predetermined location with the throat of the head in open condition comprises a frame 92 attached to pivotally mounted levers 94 for vertical swinging movement, and having spaced apart sockets 96 and 98, in one of which a stop pin 100 is removably disposed to project radially over the rotary head. The upper cover plate 102 of the rotary head has an upstanding stop lug 104 thereon, which is positioned to engage the outer end portion of the pin 100 when the frame 92 is in its downmost position to arrest rotation of the head with the throat of the head open.

It will be apparent that the pin 100 may be removed from the socket 96 and placed in socket 98 in position for engagement with the lug 104 to arrest rotation of the head in the other direction when desired.

The frame 92 also carries a pivotally mounted plate or bell crank 106 pivotally attached to the frame and having an upstanding projection positioned for movement into engagement with the valve stem 88 when the frame 92 is horizontal, the crank also having a roller 108 thereon, positioned to be engaged by the lug 104 to rotate the bell crank in a direction to actuate the stem to open the pilot valve when the rotary head reaches a position with the throat thereof open. The levers 94 are provided with coil springs 110 connected thereto at locations to yieldingly hold the frame 92 in its elevated position. By actuating either of the levers 94, the stop mechanism may be positioned to stop rotation of the head and to open the pilot valve to shut off the power from the transmission when the head reaches a position with the throat open.

The wrench mechanism also includes a stationary holding wrench, generally designated 112 and whose structural details are best illustrated in FIGURES 9 and 10. The holding wrench comprises an elongated shaft 14 disposed beneath the frame 10 and having a rod clamping head portion disposed vertically beneath the rod clamping mechanism of the rotary head. The holding wrench is pivotally attached at its rear end, as indicated at 116, to torque indicator mechanism carried on the frame 10, and is supported beneath the frame by a stirrup 118 connected to the sides of the frame. The head of the holding wrench includes a widened rod engaging portion 120 on the shaft 114 having a notch 122 shaped to engage two adjacent angularly disposed faces of a squared portion of a sucker rod, and a movable part 124 pivotally attached to the stationary portion and provided with a notch 126 shaped similarly to the notch 122 and positioned to be moved into engagement with the two other adjacent faces of the squared portion of the sucker rod to clamp the rod between the portion 120 and part 122 to hold the rod against rotation. The part 122 has a rearwardly extending portion 128 positioned to engage the adjacent face of the portion 120 rearwardly of the notch 122 therein when the part 124 is in rod releasing position. A cam member 130 of angular shape is pivotally secured to the rear end of the part 124 for movement to one position, shown in FIGURE 10, with the end face 132 of one arm 134 thereof in engagement with the adjacent face of the portion 120 to hold the movable part in rod clamping position, and to another position, shown in FIGURE 9, with said end face 132 positioned to be out of engagement with said adjacent face when the part 124 is in rod releasing position. The other arm 136 of the cam member 130 is connected to the shaft 114 by a coil spring 138 at a location to yieldingly hold the cam in the locking position of FIGURE 10 when the part 124 is in rod clamping position, and in the releasing position of FIGURE 9, when the part 124 is in rod releasing position. The arm 136 has a handle portion 140 on its outer end which may be used to move the cam member to either of its positions, and the part 124 also has a handle 142 located for use in opening and closing the stationary wrench.

It will be apparent that the stationary wrench may be opened, as seen in FIGURE 9, when the rotary head is

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stopped with the throat of the head open to permit the upper and lower rod sections R and R' to be placed with the square sections S in the rotary head and in the stationary wrench, whereupon the head may be rotated to engage the latch 44 with the square of the upper section and the part 124 may be closed to clamp the square of the lower section in the stationary wrench. With the rod sections thus held, the rotary head may then be rotated to screw the rod sections into the coupling element T to assemble the sections.

The wrench mechanism of the invention includes torque indicator mechanism, best illustrated in FIGURES 2, 3 and 7, by which the rotative force exerted on the rod sections may be determined.

The torque indicator mechanism includes a pair of levers 144 pivotally attached mediate their ends to an extension 146 of the frame 10, as by means of the pin 148, for horizontal swinging movement, and each having an outwardly extending cross arm 150 of T-shape provided with openings 152 for the attachment thereto of suitable means, by which the arm may be anchored to a stationary object. The cross-arms 150 are connected centrally to the rear end of the stationary wrench shaft 114, as by means of a bolt 154, about which a spacer spring 156 is disposed between the shaft 114 and the lower one of the levers 144. Each of the levers 144 also has an inner arm 158 to which a spring housing or retainer 160 is attached, within which a coil spring 162 is mounted. A pin 164 extends into the spring 162 and is provided with an external annular spring seat 166 against which one end of the spring is seated, the other end of the spring being seated against the bottom of the spring housing. The pin 164 extends longitudinally beyond the open end of the spring housing and is provided with a ball shaped end portion 168 which seats on the extension 146. By this arrangement torque applied by the rotary head and stationary wrench will be transmitted to the levers 144 to turn the levers about the pivot 148 thereby allowing the spring 162 to be extended or to compress the spring. The housing 160 has an external lug 170 thereon to which a cable 172 is connected which operates about a pulley 174 mounted on the extension 146. Cable 172 is extended to an indicator, generally designated 178 in FIGURES 2 and 3, of conventional design, mounted on the frame 10 and which has a pointer 180 operated by a pinion 182 which is in turn rotated by a toothed quadrant 184 to which the cable 172 is attached. The indicator 178 is suitably provided with spring means, not shown, which yieldingly resists the pull of the cable exerted on the quadrant 184 and by which the indicator is calibrated in the usual manner to show the torque exerted.

It will be apparent that the coil spring 162 tends to hold the levers 144 in a fixed position with the spring housing in contact with a stop 163 on the frame 10. The rotative force exerted by the rotation of the rotary head in a clockwise direction will then result in a counterclockwise reaction of the frame 10, which will compress the spring 162 to exert a pull on cable 172 which will be indicated by the indicator mechanism.

The housing 12 may be provided with slidably movable guard element 188 mounted thereon for sliding movement toward and away from each other in position to close and open the rod receiving throat. These guard elements are provided with yieldable means, such as springs, not shown, positioned for coaction with the elements and housing to urge the elements toward throat closing position and to allow the elements to move to open position when a sucker rod is pressed between them, whereby the sucker rod may be readily inserted into and withdrawn from the throat. These guard elements are provided for the safety of the operator.

In making use of the wrench mechanism of the invention, constructed as described above, the device is suspended above a well with the housing 12 substan-

tially centered relative to the well bore, the rotary head being positioned with the slot 58 in radial alignment with the opening 62 of the housing, as seen in FIGURE 5. The torque arm, made up of the levers 144, is anchored to a suitable stationary object. The rotary head is engaged with the squared portion S of the rod section R above the coupling T, by inserting the rod into the throat of the head and housing, and the stationary wrench is opened and closed about the squared portion S of the rod section R' beneath the coupling T, as seen in FIGURE 4. With the rod sections thus held in the mechanism the motor 20 may then be operated by circulating fluid under pressure therethrough through the connections 78 and 80, whereupon the levers 76 may be operated to operate the clutch mechanism, not shown, to select the proper speed, and the directional control valve may be operated to cause the motor to rotate the rotary head. Upon initial rotational movement of the head in a counterclockwise direction, the head will be rotated in the housing from the position shown in FIGURE 5 to that shown in FIGURE 6, so that the latch or holding element 44 will be moved from releasing position to rod holding position by the interaction of the gear teeth 40 with the teeth 42 of the latch, and thereafter, with the latch in rod holding position the section R of the rod will be rotated with the head, while the section R' will be held stationary by the stationary wrench 112.

During the application of a rotative force on the sucker rod by the rotary head the force applied will be transmitted through the levers 144 to actuate the cable 172 whereby the torque exerted on the rod will be indicated by the indicator mechanism 178.

When it is desired to stop the rotation of the rotary head, this may be accomplished by actuation of the directional control valve to a central position by the lever 23 to stop the motor. In the event that the rotation of the head is stopped with the slot 58 out of radial alignment with the opening 62, the head may be rotated by manual actuation of the directional control valve to bring the slot into proper alignment with the opening. Should it be desired to automatically stop the head with the slot 58 in radial alignment with the opening 62, this may be done by operating either of the levers 94 to lower the frame 92 to position the pin 100 in the path of the stop lug 104 of the head, the bell crank 106 being at the same time moved into position to be engaged by the stop lug. With the automatic stop mechanism thus in operating position the directional control valve is operated to cause the head to rotate and when the lug engages the bell crank the pilot valve will be opened to shut off power from the motor 20 as the lug approaches the stop pin to allow the rotational movement of the head to decrease before the lug engages the pin, whereby damage to the equipment may be prevented. As soon as the power to the motor is shut off the friction band 54 carried by the base plate 30 in engagement with the brake lining 60 will slow down the rotational movement of the head.

In restarting the equipment, the frame 92 is re-elevated to allow valve 86 to close, whereupon the motor may be operated by use of the control valve 21.

Should it be desired to reverse the direction of rotation of the head, the plate 46 may be lifted off of the pins 32 and turned over, the latch 44 being also removed and reversed and the plate and latch replaced on the pins in their reversed positions, whereupon the latch will be moved into rod holding position upon initial clockwise rotation of the head on the rod thereafter rotated clockwise with the head.

It will thus be seen that the invention constructed and operated as disclosed above, provides sucker rod rotating mechanism which is easily applied to and removed from a sucker rod string for use in rapidly connecting or disconnecting sections of the rod and also by which a pre-

determined torque may be applied to the rod to assure a uniform connecting together of the sections of the string.

It will, of course, be understood that the wrench mechanism of the invention may be constructed for use with sucker rods of round or other shape in cross-section by suitably shaping the latch member and holding plate for gripping engagement with such rods to hold the same against rotation relative to the rotary head.

The invention is disclosed herein in connection with a certain specific embodiment of the same, but it will be understood that this is intended by way of example only and that various changes may be made in the construction and arrangement of the parts within the spirit of the invention and the scope of the appended claims.

Having thus clearly shown and described the invention, what is claimed as new and desired to secure by Letters Patent is—

1. Power wrench mechanism for connecting and disconnecting elongated threaded members disposed in end to end arrangement on a common axis and each having elongated, flat, external faces disposed in angular relation about said axis comprising a housing having a radially disposed opening, a rotary head rotatably mounted in the housing and having a radially disposed slot positioned to form with said opening a throat into and out of which one of said members may be moved when the opening and slot are in radial alignment, holding means including a holding element having a recess of angular shape and which is rotatably mounted on the head for swinging movement to a position in engagement with adjacent ones of said faces of said one member in said slot to hold said one member against rotation relative to the head and to another position out of engagement with said one member, and means on said element and head positioned for coaction to move said element to said holding position upon rotation of the head in one direction and to move the element out of said holding position upon rotation of the head in the other direction.

2. Power wrench mechanism for connecting and disconnecting elongated threaded members disposed in end to end arrangement on a common axis and each having elongated, flat, external faces disposed in angular relation about said axis comprising a housing having a radially disposed opening, a rotary head rotatably mounted in the housing and having a radially disposed slot positioned to form with said opening a throat into and out of which one of said members may be moved when the opening and slot are in radial alignment, holding means including a holding element rotatably mounted on the head for swinging movement to a position in engagement with said one member in said slot and having internal angularly disposed faces positioned for engagement with adjacent one of said external faces of said one member to hold said one member against rotation relative to the head and to another position out of engagement with said one member, means on said element and housing positioned for coaction to move said element to said holding position upon rotation of said head in one direction and out of said holding position upon rotation of the head in the other direction and means for holding the other of said members against rotation.

3. Power wrench mechanism for connecting and disconnecting elongated threaded members disposed in end to end arrangement on a common axis comprising a housing having a radially disposed opening, a rotary head rotatably mounted in the housing and having a radially disposed slot positioned to form with the opening a throat into and out of which one of said members may be moved when the opening and slot are aligned, stop means carried by the head, movable means mounted on the housing for movement toward and away from the head and means removably connected to said movable means for movement to one position thereon for coaction with said stop means upon movement of the movable means toward the head to arrest rotation of the head with said opening in

alignment with said slot and to another position thereon for coaction with said stop means upon movement of said movable means toward the head to arrest rotation of the head in the other direction with said opening in alignment with said slot.

4. Power wrench mechanism for connecting and disconnecting elongated threaded members disposed in end to end arrangement on a common axis comprising a housing having a radially disposed opening, a rotary head rotatably mounted in the housing and having a radially disposed slot positioned to form with the opening a throat into and out of which one of said members may be moved when the opening and slot are aligned, abutment means on the head movable therewith in a circular path upon rotation of the head, movable means on the housing movable toward and away from the head, a stop element, and means for releasably connecting the element to the movable means at one location for movement with the movable means to a position for engagement with said abutment means to arrest rotation of the head in one direction and to another location for movement with the movable means to a position for engagement with the abut-

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ment means to arrest rotation of the head in the other direction.

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