

Jan. 10, 1956

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2,729,997

HYDRAULICALLY CONTROLLED REVERSIBLE RATCHET WRENCH

Filed July 6, 1954

3 Sheets-Sheet 1

Fig. 1

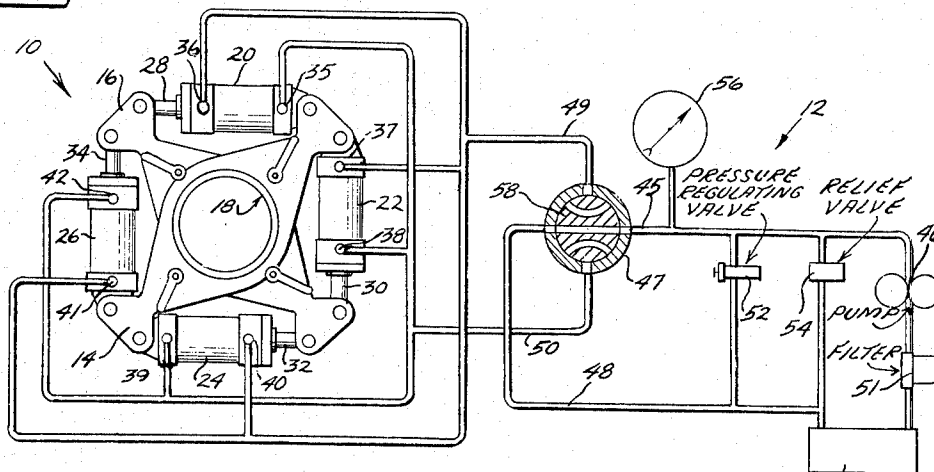


Fig. 2

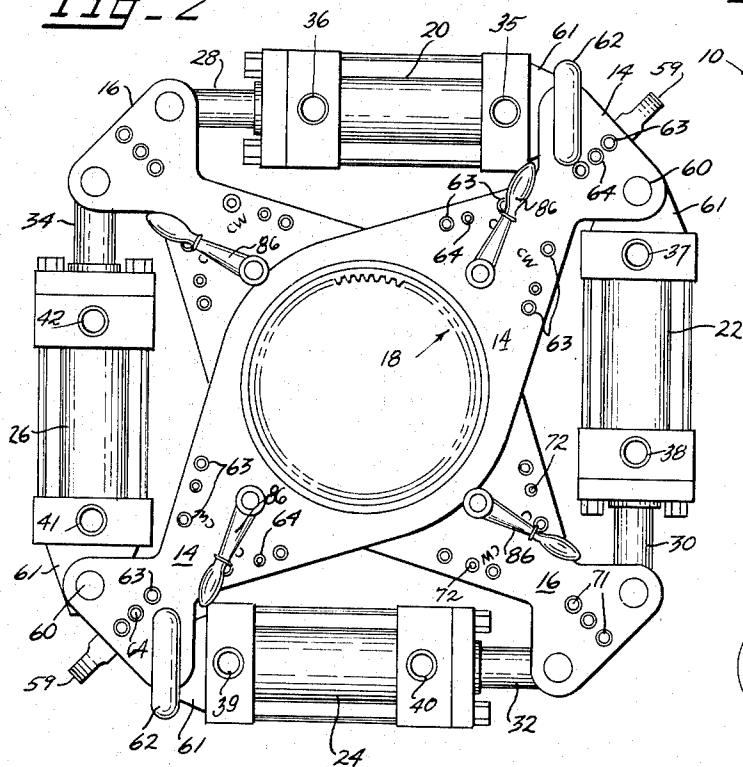
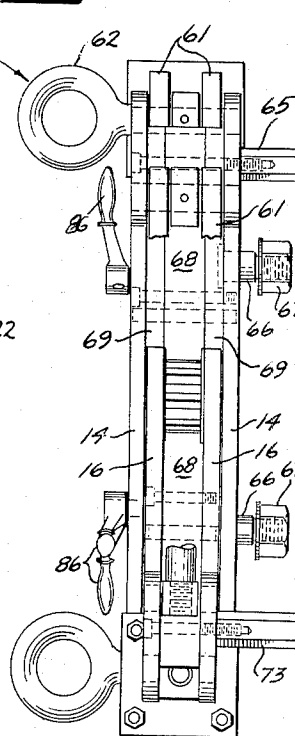


Fig. 3



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3 Sheets-Sheet 2

Fig. 4

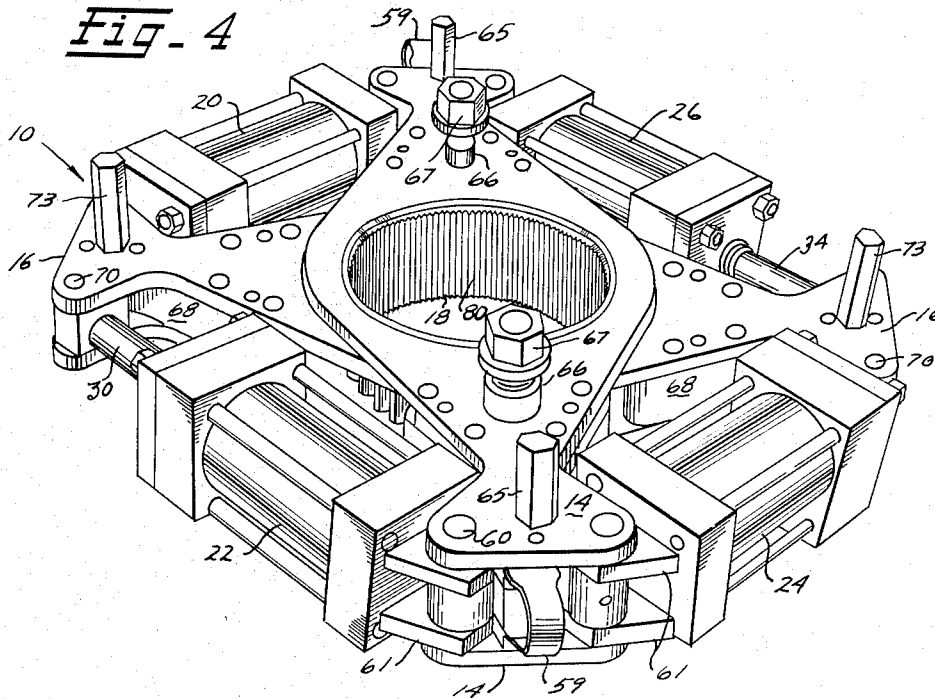
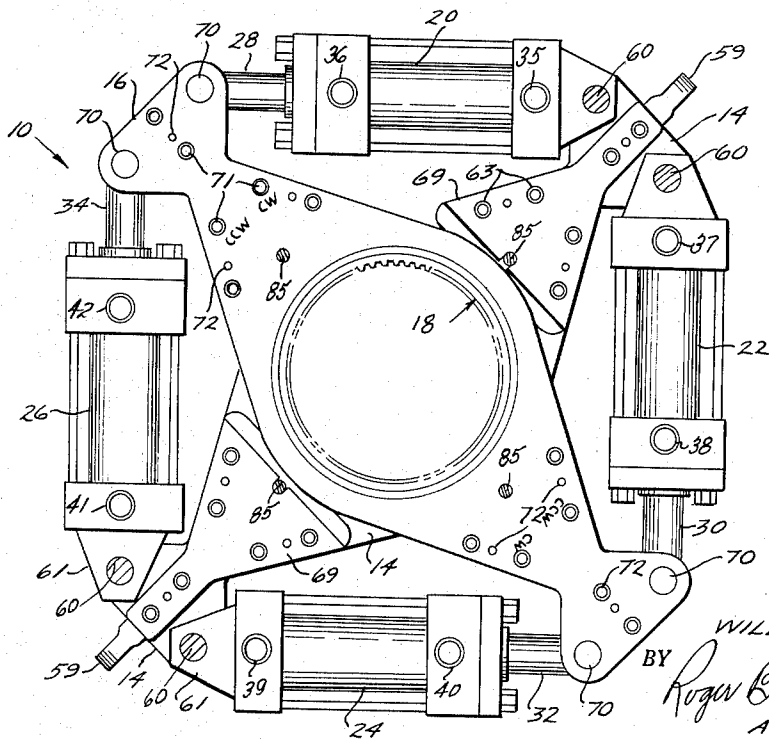


Fig. 5



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3 Sheets-Sheet 3

Fig. 6

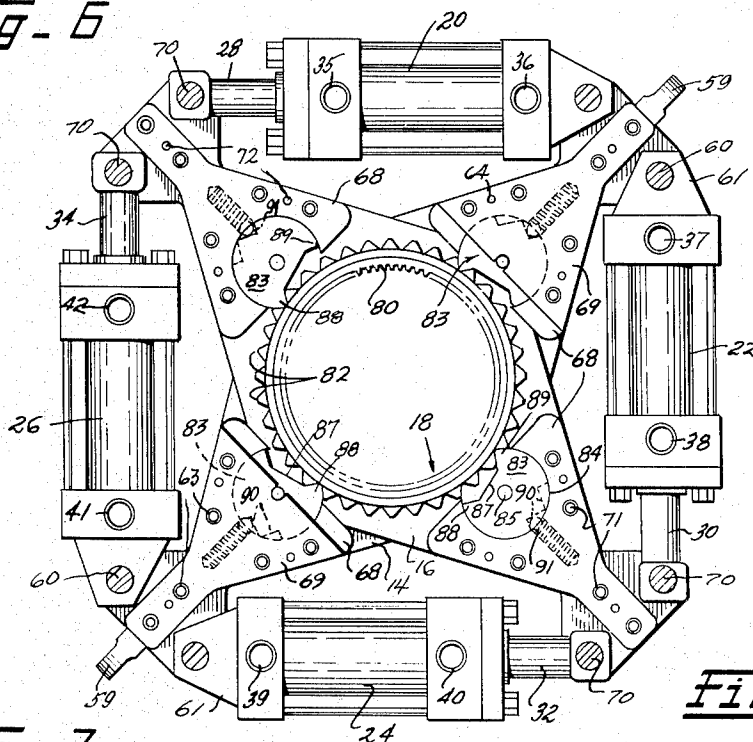


Fig. 7

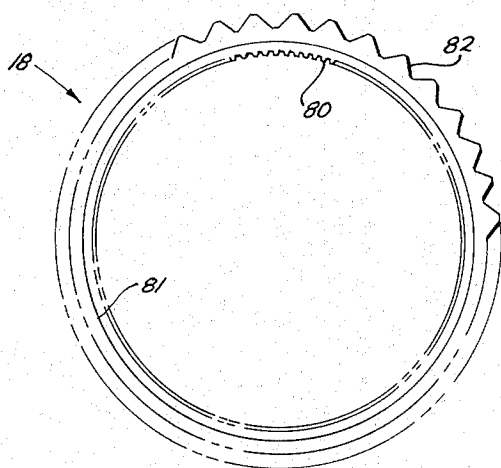
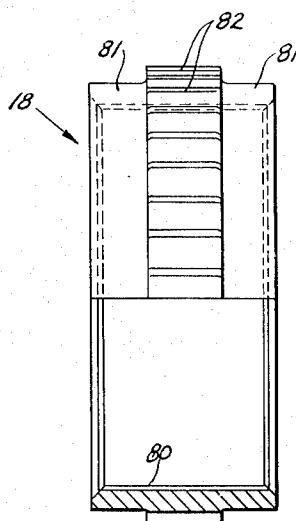


Fig. 8



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1

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HYDRAULICALLY CONTROLLED REVERSIBLE RATCHET WRENCH

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Application July 6, 1954, Serial No. 441,365

8 Claims. (Cl. 81—60)

This invention relates to a wrench and, more particularly, to a heavy duty, hydraulically operated torque wrench.

An object of the invention is to provide a tool for applying a selected torque to a rotatable device by means which include a ratchet wheel and hydraulically actuated pawls engageable with the ratchet wheel and wherein the forces applied to the ratchet and transferred to the rotatable device are substantially constant throughout the stroke of the pawls.

Another object of the invention is to provide a torque wrench of the aforementioned type which can apply its forces either clockwise or counterclockwise without requiring that the wrench be reversed in its engagement with the rotatable device.

It is a further object of the invention to provide an hydraulic torque wrench which can be simply operated and which is particularly adapted to apply great force to a rotatable device and which can be provided in relatively large sizes without becoming unwieldy.

Additional objects as well as advantages of the invention will become apparent to those skilled in the art from the following description of the annexed drawings which, by way of preferred example only, illustrate one specific embodiment of the invention and in which,

Fig. 1 is a schematic plan view of the hydraulic wrench and the control system therefor;

Fig. 2 is a plan view of the front face of the hydraulic wrench;

Fig. 3 is a right-hand side view of the wrench;

Fig. 4 is a perspective view of the wrench taken from the rear thereof;

Fig. 5 is a view similar to Fig. 2 but with the front anchor plate removed;

Fig. 6 is a view similar to Figs. 2 and 5 showing the wrench with the front anchor plate and the front drive plate removed;

Fig. 7 is a plan view of the ratchet wheel; and

Fig. 8 is a side view of the ratchet wheel.

While a wrench constructed in accordance with the present invention may find a wide variety of applications, it can be used to particular advantage in applying torque of great magnitude to relatively large rotatable objects or devices. For example, it has been found that the wrench of this invention, in a suitable size, will apply the torque necessary to tighten and loosen the relatively large nuts which are used to secure the principal shaft of a turbo-jet engine. As an example of the forces involved, the specifications of a typical engine may require that the shaft nut be tightened or set with an applied torque on the order of 300,000 in. lbs. and it may be necessary to apply a torque of the order of 500,000 in. lbs. in loosening such a nut. It can be assumed that in the following specification there is described a wrench which is suited to tighten and loosen such a shaft nut and to apply torque in excess of the amount mentioned.

The wrench 10 can be described in general terms with reference to Fig. 1 wherein the wrench is designated gen-

2

erally by the reference numeral 10 and the hydraulic control system therefor by the numeral 12.

Included in the wrench 10 are a pair of anchor plates 14, 14 and a pair of substantially identical drive plates 16, 16. The said anchor plates and drive plates 14 and 16 are elongated and each is provided with an enlarged central portion defining a large circular opening for rotatably receiving an internally splined ratchet wheel or ring 18. The anchor plates 14, 14 are respectively located on axially opposite sides of the ratchet wheel or at the front and rear of the wrench and the drive plates 16, 16 are respectively located adjacent the inner surfaces of the front and rear anchor plates. As will be described in detail hereinafter, the ratchet ring 18 has a row of teeth extending around the central portion of its periphery which row is located between the drive plates 16, 16 and the ratchet ring also has peripheral end portions or hubs which are rotatably received within the openings in the anchor plate and drive plate at the front and at the rear of the wrench.

While the anchor plates 14, 14 are spaced apart, they are arranged in concentric aligned relationship to each other as are the drive plates 16, 16. The anchor plates and drive plates cross each other at a substantial angle, which, in the various views of the drawings, is shown to be approximately 90°.

Both pairs of the extending ends of the anchor plates 14, 14 are pivotally connected to the head ends of two hydraulic actuating cylinders. Accordingly, there are four such cylinders which are designated in clockwise order by the reference numerals 20, 22, 24 and 26 starting from the top in Fig. 1. The actuating cylinder 20 located at the top contains a reciprocable piston having a piston rod 28 extending through its left-hand end, or in a counterclockwise direction with respect to the ratchet ring 18, and is pivotally connected to the adjacent ends of the drive plates 16, 16. The actuating cylinder 22 contains a reciprocable piston having a piston rod 30 extending downwardly, or in a clockwise direction with respect to the ratchet ring 18, and connected to the opposite ends of the drive plates 16, 16. The lowermost actuating cylinder 24 contains a reciprocable piston having a piston rod 32 extending through its right-hand end, or in a counterclockwise direction with respect to the ratchet ring 18, and engaging said opposite ends of the drive plates 16, 16. The actuating cylinder 26 also contains a reciprocable piston having a piston rod 34 which extends upwardly, or clockwise with respect to the ratchet ring 18, and which is pivotally connected to the said adjacent ends of the drive plates 16, 16.

The cylinder 20 has a port 35 at its head end and a port 36 at its other end. When fluid flow to the cylinder 20 is through the port 35, the piston rod 28 will be moved outwardly or counterclockwise. When fluid flow to the cylinder 20 is through the port 36, the piston rod 28 will be moved inwardly or clockwise.

The cylinder 22 has a port 37 at its head end and a port 38 at its other end. When fluid flow to the cylinder 22 is through the port 37, the piston rod 30 will be moved outwardly or clockwise. When fluid flow to the cylinder 22 is through the port 38, the piston rod 30 will be moved inwardly or counterclockwise.

The cylinder 24 has a port 39 at its head end and a port 40 at its other end. When fluid flow to the cylinder 24 is through the port 39, the piston rod 32 will be moved outwardly or counterclockwise. When fluid flow to the cylinder 24 is through the port 40, the piston rod 32 will be moved inwardly or clockwise.

The cylinder 26 has a port 41 at its head end and a port 42 at its other end. When fluid flow to the cylinder 26 is through the port 41, the piston rod 34 will be moved outwardly or clockwise. When fluid flow to the cylinder

3

26 is through the port 42, the piston rod 34 will be moved inwardly or counterclockwise.

It will be readily understood that if the diametrically opposite actuating cylinders 20 and 24 receive hydraulic fluid through their head ports 35 and 39, respectively, their respective piston rods 28 and 32 will be moved counterclockwise and will rotate the drive plates 16, 16 counterclockwise as viewed in Fig. 1. It will also be seen that if at the same time the diametrically opposite actuating cylinders 22 and 26 receive hydraulic fluid through their ports 38 and 42, respectively, their respective piston rods 30 and 34 will be retracted in a counterclockwise direction and will assist in counterclockwise rotation of the drive plates 16, 16. It will also be apparent that if the diametrically opposite actuating cylinders 20 and 24 receive hydraulic fluid through their ports 36 and 40, respectively, their piston rods 28 and 32 will be retracted causing clockwise rotation of the drive plates 16, 16. If the diametrically opposite actuating cylinders 22 and 26 at the same time receive hydraulic fluid through their head ports 37 and 41, their piston rods 30 and 34 will be extended and assist in clockwise rotation of the drive plates 16, 16.

The hydraulic system 12 for controlling the wrench 10 is particularly adapted to selectively control fluid flow to and from the aforementioned hydraulic actuating cylinders. More specifically, the system includes a reservoir 44 containing the hydraulic fluid at atmospheric pressure. The fluid is withdrawn from the reservoir 44 by means of a pump 46 and is directed under pressure to a selectively operable flow control valve 47 through a conduit 45. In addition to the pressure conduit 45, the flow control valve 47 is connected to a drain line 48 leading to the reservoir or sump 44 and is also connected to two conduits 49 and 50 extending to the wrench 10. It is desirable to include a filter 51 in the line between the reservoir 44 and the pump 46 and it is necessary to include a pressure regulating valve 52 connected between the pressure line 45 and the drain line 48 and to also include a relief valve 54 connected between the lines or conduits 45 and 48 to set an upper limit on regulated pressure. There is also included a pressure indicating gage 56 in the line 45 adjacent the flow control valve 47.

The flow control valve 47 includes a movable valve member 58 which is preferably biased to the position shown. The valve member 58 has a plurality of passages for selectively interconnecting the pressure conduit 45 to the feed line 49, the feed line 50, or to the drain line 48. In the biased position of the valve member 58 the pressure line is connected to the drain line so that there will be no hydraulic flow to or from the actuating cylinders in the wrench 10. In a second position of the movable valve member 58, its passages are arranged to connect the pressure line 45 to the feed line 49 extending to the wrench while at the same time connecting the feed line 50 to the drain line 48. In a third position of the movable valve member 58, its passages are arranged to connect the pressure line 45 to the feed line 50 while connecting the feed line 49 to the drain line 48.

It is important to observe that the feed line 49 is connected to the ports 36, 37, 40 and 41 in the actuating cylinders 20-26, respectively, which, as previously mentioned, upon receiving flow through the said ports will cause movement of their respective piston rods in a clockwise direction with respect to the ratchet wheel 18 and thereby cause clockwise rotation of the drive plates 16, 16. It is also important to observe that the feed line 50 is connected to the ports 35, 38, 39 and 42 of the actuating cylinders 20-26, respectively, which, as previously described, upon receiving flow through the said ports will cause movement of their respective piston rods in a counterclockwise direction with respect to the ratchet wheel 18 and thereby cause counterclockwise rotation of the drive plates 16, 16.

Accordingly, when the feed line 49 is connected to the

4

pressure line 45, the actuating cylinders 20-26 operate to cause clockwise rotation of the drive plates 16, 16. At the same time the feed line 50 is connected to the drain line 48 so that the actuating cylinders will drain through the ports 35, 38, 39 and 42 so that clockwise movement of the drive plates 16, 16 will be unopposed. When the feed line 50 is connected to the pressure line 45, the actuating cylinders 20-26 will cause counterclockwise rotation of the drive plates 16, 16 and the ports 36, 37, 40 and 41 of the said actuating cylinders will accommodate drain flow to the feed line 49 so that such counterclockwise rotation of the drive plates will be unopposed.

In operation of the control system 12, the movable valve member 58 in the flow control valve 47 is moved to the said second position to interconnect the pressure line 45 and the feed line 49 to effect clockwise rotation of the drive plates 16, 16. When the movable member 58 is released, it is biased into the neutral position wherein pressure is maintained in the actuating cylinders to prevent undesirable counterclockwise rotation of the drive plates 16, 16. When it is desired to effect counterclockwise rotation of the said plates, it is necessary to shift the movable valve member 58 to the said third position. Then, when the movable valve member 58 is released, hydraulic pressure is maintained within the actuating cylinders to prevent undesirable clockwise rotation of the drive plates 16, 16.

As will be more fully described hereinafter, the drive plates 16, 16 support a pair of pawls arranged to engage the ratchet wheel 18 in diametrically opposite locations. The said pawls are adapted so that they can selectively be positioned to engage and drive the ratchet wheel during clockwise rotation of the drive plates and to escape the ratchet wheel during counterclockwise rotation of the drive plates or they can selectively be positioned to engage and drive the ratchet wheel during counterclockwise plate rotation and to escape the ratchet wheel during clockwise plate rotation.

Accordingly, the ratchet wheel 18 can be driven clockwise or counterclockwise by reciprocation of the drive plates 16, 16. The drive plates 16, 16 are reciprocated by switching the direction of fluid flow to and from the actuating cylinders 20-26 as controlled by the valve 47 in the manner previously described.

The anchor plates 14, 14 also support a pair of pawls which are substantially identical in structure and selective operation to the drive plate pawls and which also engage the ratchet wheel. However, the anchor plate pawls do not act as drive pawls, but act as holding devices. That is, as the drive plates rotate the ratchet clockwise, the anchor pawls escape the ratchet but prevent inadvertent counterclockwise movement of the ratchet on the return or counterclockwise stroke of the drive plates. As the drive plates rotate the ratchet counterclockwise, the anchor pawls escape the ratchet but prevent inadvertent clockwise rotation of the ratchet on the return or clockwise stroke of the drive plates.

Turning now to a more detailed consideration of the wrench structure and with reference to Figs. 2-6, it will be noted that at each of their ends the aligned anchor plates 14, 14 are provided with two suitable openings receiving pins 60, 60 extending through brackets 61, 61 projecting from the head ends of the respective actuating cylinders. Two such pins on opposite ends of the anchor plates comprise the shanks of eye bolts 62, 62 extending from the front anchor plate 14 and which eye bolts are provided for securing cables or chains in a hoist mechanism which may be utilized to locate the wrench 10 in a substantially horizontal operating position. A plurality of dowel pins 63, 63 extend between the anchor plates 14, 14 to locate the plates in concentric aligned relationship and the outermost of the said dowel pins secure a generally U-shaped strap 59 extending from each of the ends of the said plates. The straps 59, 59 may be engaged by cables or chains in a hoist mechanism to lo-

cate the wrench 10 in a substantially vertical operating position.

The anchor plates 14, 14 are connected in their spaced apart aligned and concentric relationship by a plurality of bolts 64, 64 extending from the front anchor plate and threaded into the rear anchor plate. The outermost bolt on each end of the anchor plates has threaded extensions which are received within legs 65, 65 provided to support the wrench 10 in a horizontal position. A pair of bolts 66, 66 are provided to project from the front face of the rear anchor plate rearwardly thereof. The bolts 66, 66 are used to fixedly secure the wrench 10 to an adapter (not shown) by use of the nuts 67, 67. The adapter to which the anchor plates 14, 14 are secured may take various forms and is supplied in the form best suited to a particular operating condition. It is preferred that relatively movable means be provided in the adapter structure to indirectly connect the ratchet wheel 18 and the nut or other rotatable device to which torque is to be applied. In any event, the adapter should be sufficiently sturdy to fixedly mount the anchor plates 14, 14, because the said anchor plates provide a support structure upon which the drive plates 16, 16 and ratchet 18 are rotatably mounted.

As previously mentioned, the anchor plates 14, 14 support a pair of pawls engageable with the ratchet wheel 18. The means for mounting and retaining the pawls (which will be described hereinafter) comprise a pair of generally Y-shaped support blocks 68, 68, one such block being located by the dowel pins 63, 63 adjacent each end of the plates 16, 16 and between the said plates with the stem portion of the Y-shaped block directed outwardly. Each of the said pawl support blocks 68, 68 is located in superimposed relationship between a pair of generally Y-shaped spacer plates 69, 69 engaging the front and rear anchor plates 14, 14, respectively. The spacer plates 69, 69 are of substantially the same thickness as the drive plates 16, 16 which, as previously mentioned, are located between and in engagement with the anchor plates 14, 14 but which cross the anchor plates at a substantial angle.

As clearly shown in Fig. 5, the drive plates 16, 16 are substantially identical to the anchor plates 14, 14. The aligned ends of the drive plates are provided with suitable openings for pivot pins 70, 70 connected to the ends of the piston rods extending from the actuating cylinders 20-26. The drive plates 16, 16 also have suitable openings for dowel pins 71, 71 which locate the said drive plates in aligned concentric relationship. A plurality of bolts 72, 72 extend from the front to the rear drive plate to connect them together. The outermost bolts have threaded extensions received in legs 73, 73 generally similar to but longer than the legs 65, 65 and which cooperate with the said legs 65, 65 to support the wrench 10 in a horizontal position when the wrench is placed on a table or stand or the like.

A pair of pawl support blocks 68, 68 are respectively located between the end portions of the drive plates 16, 16 in the same plane as the pawl support blocks 68, 68 associated with the anchor plates 14, 14. The pawl blocks associated with the anchor plates are diametrically opposite each other and the pawl blocks associated with the drive plates are diametrically opposite each other. Accordingly, the four pawl blocks are arranged in substantially equal circumferentially spaced relationship around the ratchet wheel 18. However, when the drive plates 16, 16 are rotated clockwise or counterclockwise their pawl support blocks 68, 68 are also rotated around the ratchet wheel.

As shown in Figs. 7 and 8, the ratchet wheel or ring 18 is internally splined at 80 to either directly engage a nut or other object for the application of torque or to apply torque through intermediate connecting means as is preferred. On its outer periphery, the ratchet wheel has a centrally located row of teeth 82, 82 which are of substantially the same width as the pawl blocks 68, 68 and

located in substantially the same plane. On each side of the row of teeth the ratchet has axially extending bearing surfaces or hubs 81, 81 which are respectively engaged between the front anchor and drive plates and the rear anchor and drive plates.

As shown in Fig. 6, the ratchet wheel 18 is rotatably mounted in the anchor plates 14, 14 and drive plates 16, 16 so that its teeth 82, 82 are engageable by four pawls 83, 83 respectively located in the pawl support blocks 68, 68. Each pawl 83 is substantially cylindrical and is located in a circular opening 84 in its support block 68. A shaft 85 is keyed to each pawl 83 and extends forwardly thereof in spaced relationship through an opening in the anchor plate or drive plate with which the pawl is associated. The forwardly extending portion of each shaft 85 is connected to a handle 86 which is utilized to rotate or pivot its respective pawl to effect selective engagement between the said pawl and the teeth on the ratchet wheel. As previously mentioned, the pawls are selectively engageable with the ratchet wheel 18 to effect either clockwise or counterclockwise rotation thereof on reciprocation of the drive plates 16, 16. As a guide to selective engagement, the front surfaces of the anchor and drive plates are provided with the inscribed letters C. W. and C. C. W. in spaced apart relationship adjacent each of the pawl-shifting handles 86.

The means on each pawl 83 selectively engageable with the ratchet wheel 18 comprises a pair of teeth 88 and 89 defined in spaced apart relationship on the periphery of each pawl by a peripheral notch 87 cut therefrom. The arrangement is such that when an operating handle 86 is positioned for clockwise driving movement of the ratchet wheel, the tooth 88 on its respective pawl will engage between adjacent teeth 82 of the ratchet wheel. When the said handle is positioned for counter-clockwise driving movement, the tooth 89 on the said pawl will engage between adjacent teeth 82 on the ratchet wheel and the pawl tooth 88 will be disengaged therefrom. If the said handle is located in a neutral position, that is, between the letters C. W. and the letters C. C. W., both teeth 88 and 89 will be out of engagement with the ratchet wheel teeth.

Since only the pawls 83, 83 carried by the drive plates 16, 16 effect rotation of the ratchet wheel, the anchor plates 14, 14 being stationary, it will be apparent that the pawl teeth on the pawls carried by the anchor plates must escape the ratchet wheel during rotation thereof. More specifically, when the pawls are selectively positioned for clockwise rotation of the ratchet wheel, all of the pawl teeth 88, 88 will engage the ratchet wheel, but the pawl tooth arrangement is such as to permit the teeth 88, 88 on the anchor pawls to escape the ratchet wheel while it is rotated clockwise by the teeth 88, 88 on the drive pawls. When the pawls are selectively positioned for counterclockwise rotation of the ratchet wheel, all of the pawl teeth 89, 89 will engage the ratchet wheel, but the pawl tooth arrangement is such as to permit the teeth 89, 89 on the anchor pawls to escape the ratchet wheel while it is rotated counterclockwise by the teeth 89, 89 on the drive pawls.

Rotation of the ratchet wheel 18 clockwise or, selectively, counterclockwise occurs only during one half a cycle of oscillation of the drive plates. Therefore, upon the return or non-driving stroke of the drive plates for clockwise rotation, the teeth 88, 88 on the drive pawls escape the ratchet wheel while the teeth 88, 88 on the anchor pawls retain the ratchet wheel from undesirable counterclockwise rotation. Upon the return or non-driving stroke of the drive plates for counterclockwise rotation, the teeth 89, 89 on the drive pawls escape the ratchet wheel while the teeth 89, 89 on the anchor pawls retain the ratchet wheel from undesirable clockwise rotation.

To assure that engagement between the pawl tooth 88 or pawl tooth 89 and the ratchet 82 is maintained after

the pawl has been selectively positioned, a pair of oppositely facing peripheral notches 90, 90 are provided in each pawl 83. A spring biased ball 91 is arranged to be engaged within one or the other of the notches 90, 90 depending upon the selected position of the pawl. The spring which engages the ball 91 within one or the other of the notches 90, 90 forces either the tooth 88 or the tooth 89 back into driving engagement between successive ratchet teeth after the drive plates have been moved counterclockwise or clockwise, respectively.

The operation of the pawls 83, 83 will be more fully understood if it is considered that each of the pawls 83, 83 is positioned for counterclockwise driving engagement with the ratchet wheel, as shown in the various figures of the drawings, and after the overall operation of the wrench is briefly described.

Having placed all of the pawl-shifting handles 86, 86 in the "C. C. W." positions, the valve 47 in the control system 12 can be placed in the said third position for flow of hydraulic fluid into the feed line 50 which, as previously described, will effect counterclockwise rotation of the drive plates 16, 16. The valve 47 is held in such position until the piston rods in the actuating cylinders 20-26 have moved to their full extent. In such counterclockwise movement of the drive plates 16, 16, the pawl teeth 89, 89 of the pawls 83, 83 carried by the drive plates will engage between successive teeth on the ratchet wheel in diametrically opposite locations thereon and move the ratchet wheel counterclockwise. The pawl teeth 89, 89 on the pawls 83, 83 supported by the anchor plates 14, 14 will escape the pawl teeth during such counterclockwise movement of the ratchet wheel.

When the piston rods have moved to their full extent, the valve 47 is shifted to the said second position to effect hydraulic flow into the actuating cylinders through the feed line 49 which, as previously mentioned, effects clockwise rotation of the drive plates 16, 16. During such clockwise rotation of the drive plates 16, 16, the pawl teeth 89, 89 of the pawls 83, 83 carried by the said drive plates escape the ratchet teeth. The pawl teeth 89, 89 on the pawls 83, 83 supported by the anchor plates 14, 14 engage between successive ratchet teeth 82, 82 in diametrically opposite locations on the ratchet wheel to hold the said ratchet wheel against clockwise rotation with the drive plates.

The aforescribed cycle of operation is repeated until the ratchet wheel has applied or set the desired torque on the rotatable object. The desired torque can be recognized by the pressure reading in the indicating gage 56.

It will be understood that in clockwise rotation of the drive plates 16, 16 the oppositely located actuating cylinders 22 and 26 will be applying their forces on a line of action from the center of the wrench 10 or from the center of the ratchet wheel 18 which decreases in length as the piston rods of the said cylinders are extended. This means that the torque applied by the actuating cylinders 22 and 26 decreases during the clockwise stroke. However, during such clockwise stroke, the oppositely located actuating cylinders 20 and 24 apply their forces on a line of action from the center of the wrench which increases in length during the stroke by reason of the fact that the piston rods of the said actuating cylinders are retracted. This means that the torque applied by the cylinders 20 and 24 is increasing during the clockwise stroke. It is an important feature of this invention that the increase in torque by the forces of the actuating cylinders 20 and 24 substantially counterbalances the decrease in torque applied by the actuating cylinders 22 and 26 and, as a result, the applied torque is substantially constant throughout the clockwise stroke.

The same is also true in the counterclockwise stroke wherein the torque applied by the cylinders 20 and 24 decreases while the applied torque of the cylinders 22 and 26 increases.

It is another important feature of this invention that

relatively great hydraulic forces may be applied without undue stress to the wrench. More specifically, when the force is applied to the ratchet wheel 18 by the pawls 83, 83, it might be expected that stress would be set up in the pawl shafts 85, 85. However, the said shafts extend in spaced relationship through the openings in their respective anchor and drive plates so that no shearing stress is applied to any of the pawl shafts. Instead, the force or thrust at the pawls is absorbed on the relatively large bearing surface afforded at the periphery of the pawls 83 in their sockets provided by the circular openings 84, 84 in the pawl support blocks 68, 68.

It will be noted by observation that a wrench constructed in accordance with this invention is particularly adapted to withstand hard use wherein forces of great magnitude are applied and it is believed that such a wrench will have a long and efficient life.

While the invention has been described with respect to one specific embodiment as shown by the drawings, it should be understood that it is not the intent to limit the scope of the invention to the said specific embodiment otherwise than indicated by the claims which follow.

The invention claimed is:

1. The combination in an hydraulic torque wrench comprising, an aligned pair of elongated anchor plates having concentric central openings, a rotatable ratchet wheel having hub portions received in said openings, an aligned pair of elongated drive plates having concentric central openings, rotatably embracing said hub portions with the drive plates crossing the anchor plates at a substantial angle, pawl means on said drive plates selectively engageable with the ratchet wheel to drive the same during reciprocation of the drive plates, means for reciprocating said drive plates including a pair of hydraulic actuating cylinders connected at each end of the anchor plates and having piston rods connected in pairs to the ends of the drive plates whereby the said cylinders are arranged in pairs with a cylinder in each pair substantially diametrically opposite the other cylinder in the pair, and flow control means for introducing fluid to the actuating cylinders so as to extend the piston rods of one diametrically opposite pair of cylinders while retracting the piston rods on the other diametrically opposite pair of cylinders whereby the torque applied by said actuating cylinders is substantially constant throughout the length of stroke of their respective piston rods.

2. In a wrench, the combination comprising a ratchet wheel adapted for driving connection with a rotatable device, a drive plate engaging and rotatable around said ratchet wheel, an anchor plate engaging and rotatable around said ratchet wheel, a first pawl carried by said drive plate and engageable with said ratchet wheel to rotate the same with the drive plate when the drive plate is rotated in one direction relative to said anchor plate, and a second pawl carried by said anchor plate and engageable with said ratchet wheel to retain the same relative to the anchor plate when the drive plate is rotated in the opposite direction relative to the anchor plate.

3. In a wrench, the combination comprising a ratchet wheel adapted for driving connection with a rotatable device, an elongated drive plate having a central opening for rotatably engaging the ratchet wheel, an elongated anchor plate having a central opening for rotatably engaging the ratchet wheel, a first pair of pawls carried by said drive plate for engagement with the ratchet wheel on diametrically opposite sides thereof, the said first pair of pawls being adapted for selective engagement with the ratchet wheel to rotate the ratchet wheel in one direction, or selectively in the other direction, relative to the anchor plate when the drive plate is oscillated with respect to the anchor plate, and a second pair of pawls carried by said anchor plate for engagement with the ratchet wheel on diametrically opposite sides thereof, the said second pair of pawls being adapted for selective engagement with the ratchet wheel to retain the ratchet

wheel from rotation in said other direction, or selectively from rotation in said one direction, relative to the anchor plate when the drive plate is oscillated with respect to the anchor plate with the said first pair of pawls selectively engaging the ratchet wheel in the manner set forth above.

4. In a wrench, the combination comprising a ratchet wheel adapted for driving connection with a rotatable device, an elongated drive plate having a central opening for rotatably engaging the ratchet wheel, an elongated anchor plate having a central opening for rotatably engaging the ratchet wheel, the said drive plate and the said anchor plate being rotatably engaged with the ratchet wheel and being disposed at a substantial angle to each other, pawl means carried by the drive plate and engageable with the ratchet wheel to rotate the same in one direction relative to the anchor plate when the drive plate is oscillated with respect to the anchor plate, and means for oscillating the drive plate including a pair of hydraulic cylinders connected with each end of the anchor plate and having piston rods connected in pairs with the ends of the drive plate whereby the said cylinders are arranged in pairs with a cylinder in each pair substantially diametrically opposite the other cylinder in the pair, the piston rods associated with one diametrically opposed pair of cylinders being simultaneously extensible while the piston rods associated with the other pair of diametrically opposed cylinders are simultaneously retracted whereby the torque applied by the said hydraulic cylinders to the drive plate is substantially constant throughout the length of stroke of the piston rods.

5. In a wrench, the combination comprising a ratchet wheel adapted for driving connection with a rotatable device, an elongated drive plate having a central opening for rotatably engaging the ratchet wheel, an elongated anchor plate having a central opening for rotatably engaging the ratchet wheel, the said drive plate and the said anchor plate being rotatably engaged with the ratchet wheel and being disposed at a substantial angle to each other, pawl means carried by the drive plate for selective engagement with the ratchet wheel to rotate the ratchet wheel in one direction, or selectively in the other direction, relative to the anchor plate when the drive plate is oscillated with respect to the anchor plate, second pawl means carried by the anchor plate for selective engagement with the ratchet wheel to retain the ratchet wheel from rotation in said other direction, or selectively from rotation in said one direction, relative to the anchor plate when the drive plate is oscillated with respect to the anchor plate and with the said first pawl means selectively engaging the ratchet wheel in the manner set forth, and means for oscillating the drive plate including a pair of hydraulic cylinders connected with each end of the anchor plate and having piston rods connected in pairs with the ends of the drive plate whereby the said cylinders are arranged in pairs with a cylinder in each pair substantially diametrically opposite the other cylinder in the pair, the piston rods associated with one diametrically opposed pair of cylinders being simultaneously extensible while the piston rods associated with the other pair of diametrically opposed cylinders are simultaneously retracted whereby the torque applied by the said hydraulic cylinders to the drive plate is substantially constant throughout the length of stroke of the piston rods.

6. In a wrench, the combination comprising a ratchet wheel adapted for driving connection with a rotatable device, an elongated drive plate having a central opening for rotatably engaging the ratchet wheel, an elongated anchor plate having a central opening for rotatably engaging the ratchet wheel, the said drive plate and the said anchor plate being rotatably engaged with the ratchet wheel and being disposed at a substantial angle to each other, a first pair of pawls carried by said drive plate for engagement with the ratchet wheel on diametrically opposite sides thereof, the said first pair of pawls being

adapted for selective engagement with the ratchet wheel to rotate the ratchet wheel in one direction, or selectively in the other direction, relative to the anchor plate when the drive plate is oscillated with respect to the anchor plate, a second pair of pawls carried by said anchor plate for engagement with the ratchet wheel on diametrically opposite sides thereof, the said second pair of pawls being adapted for selective engagement with the ratchet wheel to retain the ratchet wheel from rotation in said other direction, or selectively from rotation in said one direction, relative to the anchor plate when the drive plate is oscillated with respect to the anchor plate with the said first pair of pawls selectively engaging the ratchet wheel in the manner set forth, and means for oscillating the drive plate including a pair of hydraulic cylinders connected with each end of the anchor plate and having piston rods connected in pairs with the ends of the drive plate whereby the said cylinders are arranged in pairs with a cylinder in each pair substantially diametrically opposite the other cylinder in the pair, the piston rods associated with one diametrically opposed pair of cylinders being simultaneously extensible while the piston rods associated with the other pair of diametrically opposed cylinders are simultaneously retracted whereby the torque applied by the said hydraulic cylinders to the drive plate is substantially constant throughout the length of stroke of the piston rods.

7. In a wrench, the combination comprising a ratchet wheel adapted for driving connection with a rotatable device, an elongated drive plate having a central opening for rotatably engaging the ratchet wheel, an elongated anchor plate having a central opening for rotatably engaging the ratchet wheel, the said drive plate and the said anchor plate being rotatably engaged with the ratchet wheel and being disposed at a substantial angle to each other, a first pawl carried by said drive plate and engageable with the said ratchet wheel to rotate the same in one direction relative to the anchor plate when the drive plate is oscillated with respect to the anchor plate, a second pawl carried by said anchor plate for engagement with the ratchet wheel to retain the ratchet wheel from rotation in the other direction when the drive plate is oscillated with respect to the anchor plate, means for oscillating said drive plate including a pair of hydraulic cylinders connected with each end of the anchor plate and having piston rods connected in pairs with the ends of the drive plate whereby the said cylinders are arranged in pairs with a cylinder in each pair substantially diametrically opposite the other cylinder in the pair, and flow control means for introducing fluid to the hydraulic cylinders so as to extend the piston rods of one diametrically opposed pair of cylinders while retracting the piston rods of the other diametrically opposed pair of cylinders whereby the torque applied by the said cylinders to the drive plate is substantially constant throughout the length of stroke of the respective piston rods.

8. In an hydraulic torque wrench, the combination comprising a ratchet wheel adapted for driving connection with a rotatable device, an aligned pair of elongated drive plates having central openings for rotatably engaging the ratchet wheel on axially opposite sides thereof, an aligned pair of elongated anchor plates having central openings for rotatably engaging the ratchet wheel on axially opposite sides thereof, the said pair of drive plates and the said pair of anchor plates being rotatably engaged with the ratchet wheel and being disposed at a substantial angle to each other, a first pair of pawls carried by said pair of drive plates for engagement with the ratchet wheel on diametrically opposite sides thereof, the said first pair of pawls being adapted for selective engagement with the ratchet wheel to rotate the ratchet wheel in one direction, or selectively in the other direction, relative to the pair of anchor plates when the pair of drive plates is oscillated with respect to the anchor plates, a second pair of pawls carried by said pair of anchor plates for engage-

11

ment with the ratchet wheel on the diametrically opposite sides thereof, the said second pair of pawls being adapted for selective engagement with the ratchet wheel to retain the ratchet wheel from rotation in said other direction, or selectively from rotation in said one direction, relative to the pair of anchor plates when the pair of drive plates is oscillated with respect to the anchor plates with the said first pair of pawls selectively engaging the ratchet wheel in the manner set forth, means for oscillating the pair of drive plates including a pair of hydraulic cylinders 10 connected with each end of the pair of anchor plates and having piston rods connected in pairs to the ends of the pair of drive plates whereby the said cylinders are arranged in pairs with one cylinder in each pair substantially diametrically opposite the other cylinder in the 15

12

pair, and flow control means for introducing fluid to the cylinders so as to extend the piston rods of one diametrically opposed pair of cylinders while retracting the piston rods of the other diametrically opposed pair of cylinders whereby the torque applied by said cylinders is substantially constant throughout the length of stroke of the piston rods.

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