

June 16, 1959

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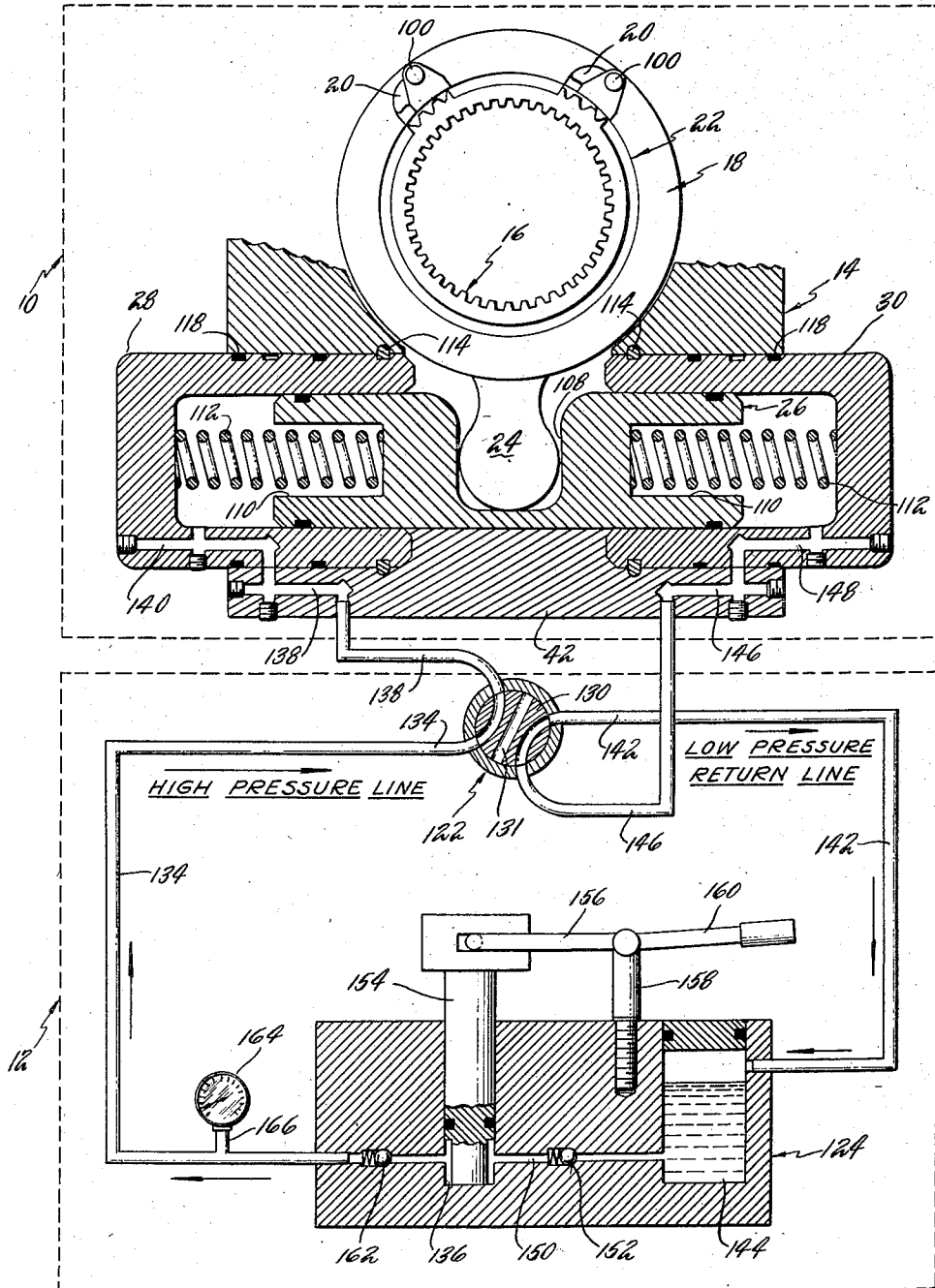
2,890,612

HYDRAULIC RATCHET WRENCH

Filed June 15, 1956

5 Sheets-Sheet 1

FIG. 1



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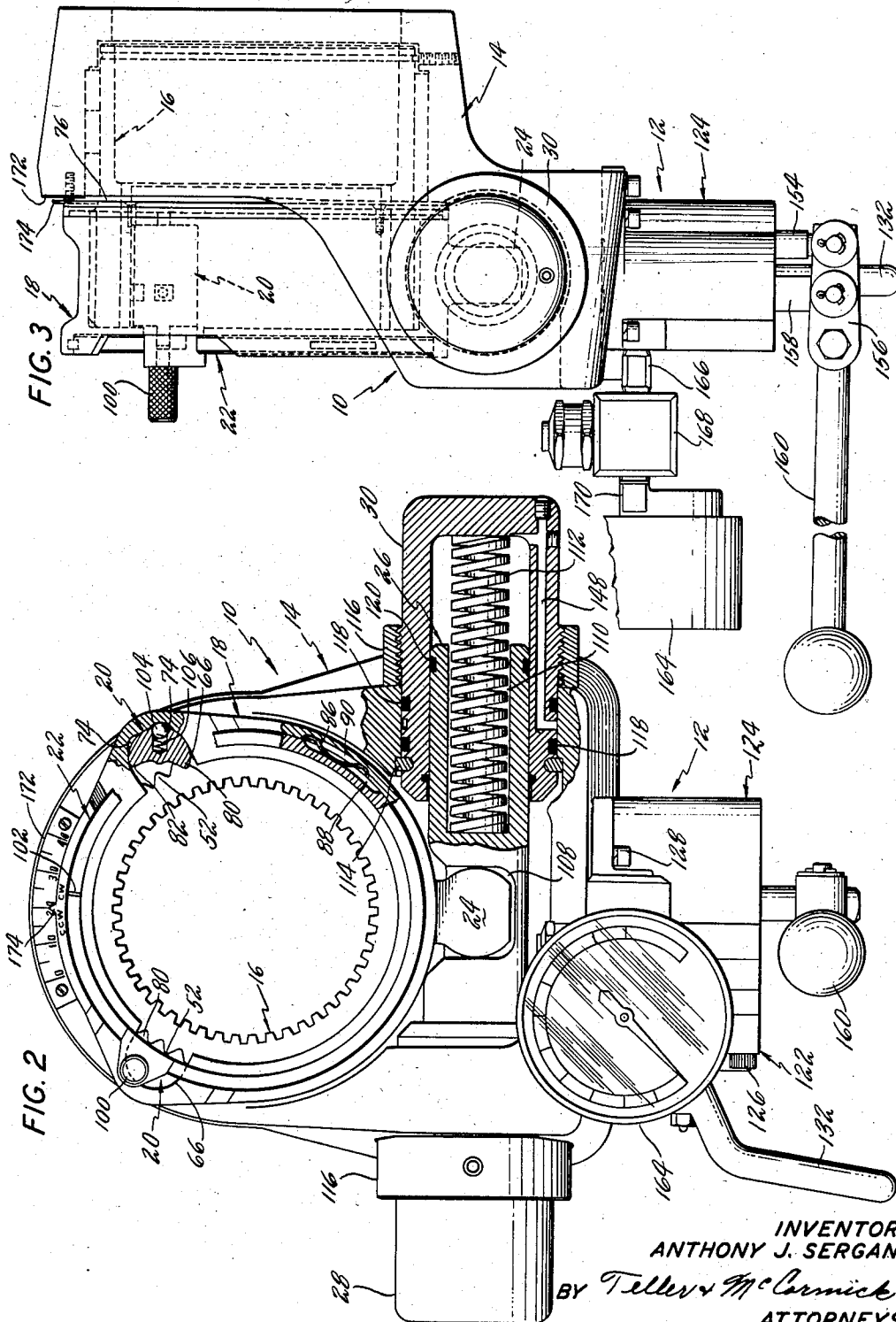
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FIG. 6

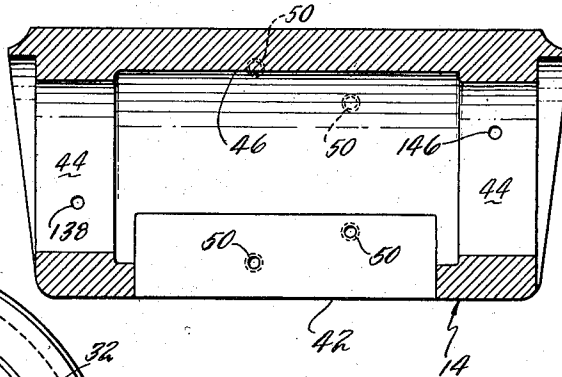


FIG. 4

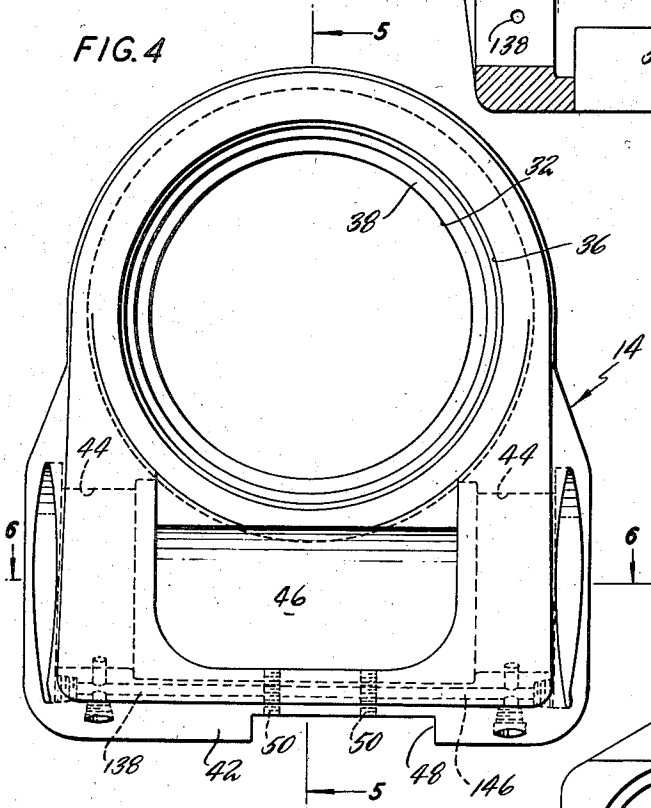


FIG. 5

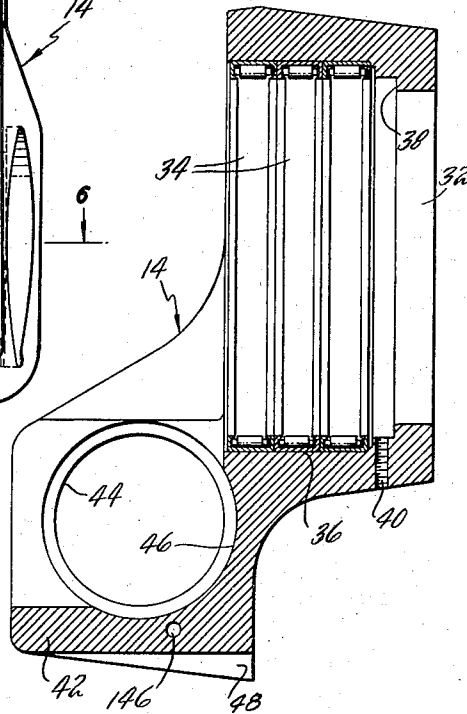
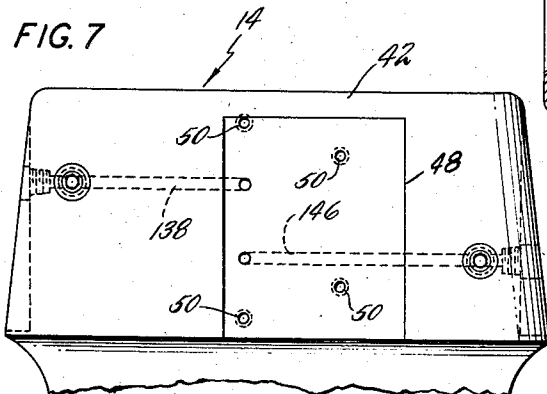


FIG. 7



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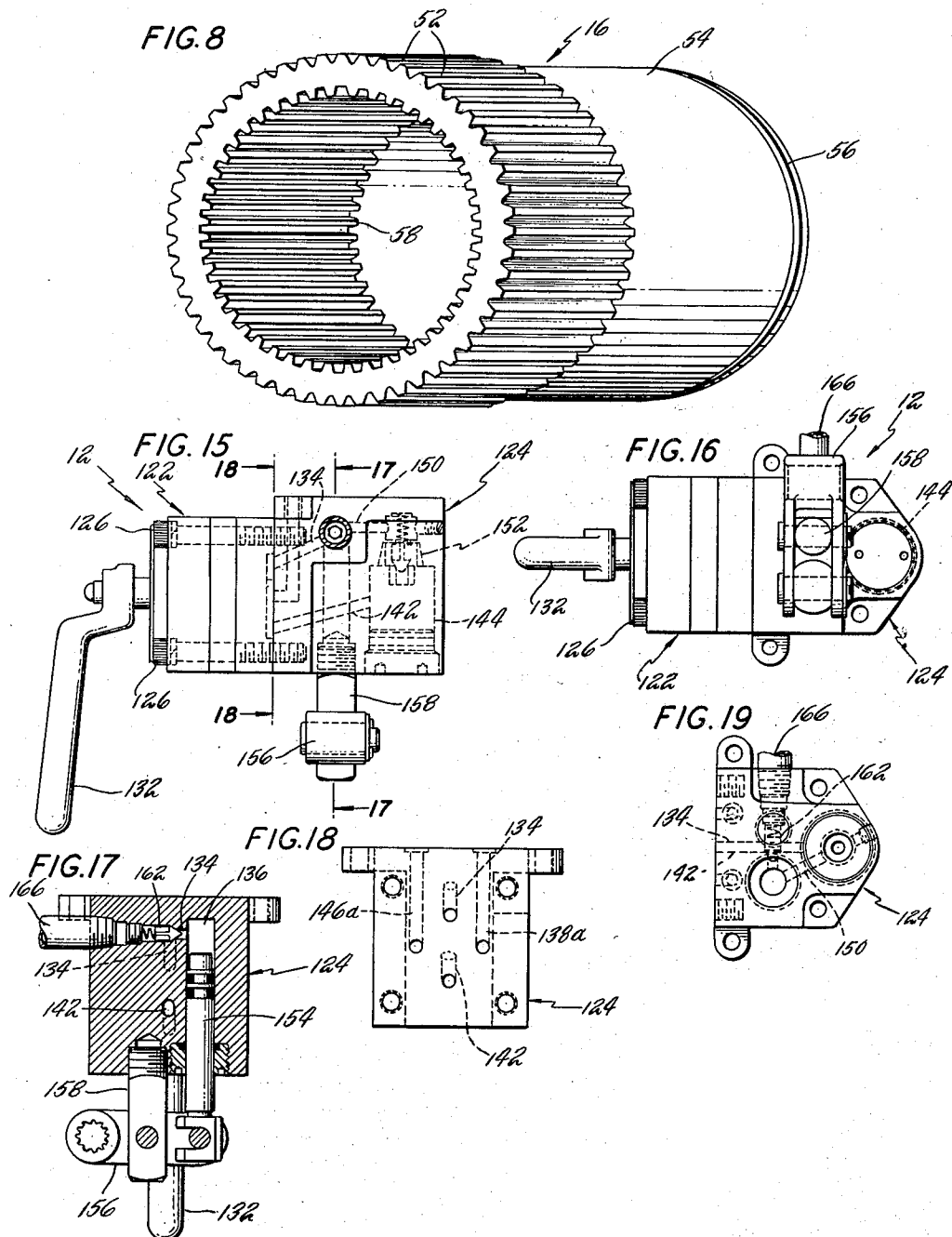
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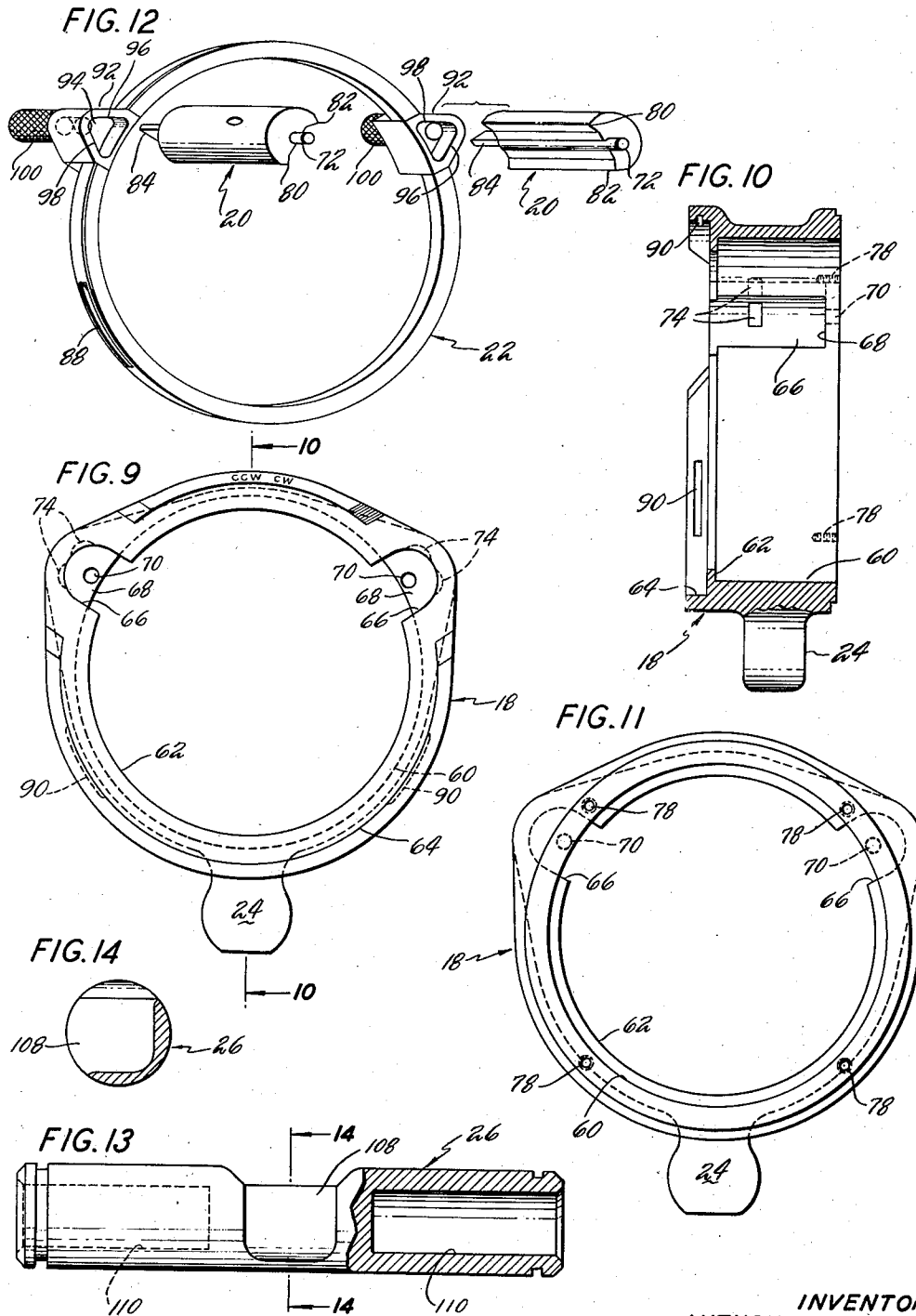
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2,890,612

HYDRAULIC RATCHET WRENCH

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Application June 15, 1956, Serial No. 591,682

5 Claims. (Cl. 81-60)

This invention relates to a fluid pressure operated heavy duty wrench and, more specifically, to an improved hydraulically operated ratchet wrench. A wrench of the general type under consideration here is shown in the Davis Patent No. 2,729,997.

It is the general object of the invention to provide an hydraulic ratchet wrench capable of high torque, heavy duty performance in many different uses but which is compact and lightweight so that it can be conveniently carried and operated.

The more specific objects and advantages of the invention will become apparent to those skilled in the art from the description of the preferred embodiment shown in the drawings of which there are five sheets. However, the invention is not limited to the one embodiment shown, other forms being encompassed within the scope of the invention as indicated by the claims forming a part of this specification.

In the drawings,

Fig. 1 is a schematic view of the wrench including the ratchet assembly and the hydraulic assembly;

Fig. 2 is a front elevational view of the wrench, parts thereof being shown in vertical cross-section to illustrate details of construction;

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

Fig. 4 is a front elevational view of the ratchet housing;

Fig. 5 is a vertical sectional view of the said housing taken as indicated by the line 5-5 of Fig. 4;

Fig. 6 is a horizontal sectional view of the ratchet housing taken as indicated by the line 6-6 of Fig. 4;

Fig. 7 is a fragmentary bottom view of the ratchet housing;

Fig. 8 is an oblique projection of the ratchet which in assembly is disposed within the aforesaid housing;

Fig. 9 is a front elevational view of the driving ring forming a part of the ratchet assembly;

Fig. 10 is a vertical cross-sectional view of the driving ring taken as indicated by the line 10-10 of Fig. 9;

Fig. 11 is a rear elevational view of the said driving ring;

Fig. 12 is an oblique projection of the pawl-setting ring (as viewed from the rear thereof) and showing the pawls in exploded relationship to the said ring;

Fig. 13 is a front view of the reciprocable driving piston, a part thereof being in vertical section to show a spring chamber;

Fig. 14 is a transverse sectional view of the driving piston taken as indicated by the line 14-14 of Fig. 13;

Fig. 15 is a front elevational view of the hydraulic assembly which includes a selector valve and a pump;

Fig. 16 is a bottom view of the hydraulic assembly;

Fig. 17 is a vertical sectional view through the pump taken as indicated by the line 17-17 of Fig. 15;

Fig. 18 is a left-hand end view of the pump housing and taken as indicated by the line 18-18 of Fig. 15;

and

Fig. 19 is a bottom view of the pump housing.

A preferred embodiment of an hydraulic ratchet wrench constructed in accordance with the present invention comprises two assemblies connected together as a compact unit. One assembly 10 can be considered as the ratchet assembly and includes the elements which engage and apply torque to the work, and the other assembly 12 can be considered as the hydraulic assembly and includes the pump and flow selector valve. As shown in Figs. 2 and 3, the ratchet assembly 10 is directly connected above the hydraulic assembly 12. In Fig. 1, the ratchet and hydraulic assemblies are shown separated, but it should be understood that Fig. 1 is merely a schematic view intended for general reference.

Turning now to a more detailed consideration of the ratchet assembly 10, it will be observed in Figs. 2 and 3 that this assembly includes a housing 14 which rotatably supports a ratchet wheel 16. It will also be observed that a ring 18 surrounds the ratchet or ratchet wheel 16 and that a plurality of pawls 20, 20 (two shown) are supported in the said ring for selective driving engagement with the teeth on the ratchet, whereby rotation of the ring 18 will drive the ratchet 16. A pawl-setting ring 22 is mounted upon the drive ring 18 for limited relative rotation thereon, whereby selectively to set the pawls 20, 20 in engagement with the ratchet teeth for rotation of the ratchet clockwise or counterclockwise. Having set the pawls, the ratchet can be driven in the selected direction in step-by-step fashion by oscillation of the driving ring 18, this being effected by means of an appendage or arm 24 on the drive ring which appendage is oscillated by reciprocation of a double-end piston 26 in a base portion of the housing 14. The ends of the piston 26 are movable within left and right cylinders 28 and 30, respectively, which are supported by the housing 14 in its said base portion. All of the aforementioned elements will be described in considerable detail, starting with the ratchet housing.

The ratchet housing 14 as best shown in Figs. 4-7 has a large forwardly and rearwardly extending bore 32 which receives the rear end portion of the ratchet 16. Preferably, a plurality of anti-friction bearing units 34, 34 are located in an enlarged diameter section 36 of the bore 32 to surround and rotatably support the rear end portion of the ratchet wheel. When placed in the housing 14, the rear end of the ratchet wheel 16 is disposed in closely spaced relationship to a shoulder 38 formed in the bore 32, the said wheel being retained in fore and aft position by the ends of screws projecting radially into the said bore through a plurality of circumferentially spaced tapped openings 40, 40 in the said housing adjacent the internal shoulder 38.

The lower portion of the ratchet housing 14 projects forwardly of that portion thereof wherein the ratchet-receiving bore 32 is defined, the said forwardly projecting lower portion of the housing defining a base 42. At the left and right ends of the base 42 and thereabove, cylindrical openings 44, 44 are defined in the housing 14 to receive the left and right cylinders 28 and 30, respectively. The base 42 is open at the front but has a cylindrical surface 46 accommodating reciprocating axial movement of the piston 26 which moves within the cylinders 28 and 30 after they have been secured in the end openings 44, 44. The bottom surface of the base 42 has a forwardly and rearwardly extending slot 48 and the hydraulic assembly 12 is secured to the base 42 within the slot 48, a plurality of screw holes 50, 50 being provided in the base to receive fastening screws from the said assembly. A plurality of fluid passages are defined in the base of the housing as will be described hereinafter.

The ratchet or ratchet wheel 16 as best shown in Fig. 8 is generally cylindrical and is provided with external longitudinal ratchet teeth 52, 52 around its entire periphery, but only at the front end portion thereof. The rear end portion 54 of the wheel has no external teeth and is of less diameter than the portion having the external teeth 52. The smooth rear portion 54 of the ratchet 16 may be considered as the hub of the ratchet and is received in the forwardly and rearwardly extending bore 32 of the housing 14, said hub portion 54 being supported on the anti-friction bearing units 34, 34. An external peripheral groove 56 is defined in the ratchet 16 adjacent its rear end, said groove being provided to receive the ends of screws extending through the tapped holes 40, 40 in the main housing whereby the ratchet 16 is secured against movement forwardly or rearwardly.

The interior of the ratchet 16 is splined as indicated at 58 to provide the means for driving engagement between the ratchet 16 and the work. The internal splines can be provided to extend the entire length of the ratchet 16 or they can be provided in any portion thereof, as for example, adjacent the forward end as shown. It should be understood that the aforescribed splines are illustrative of means that can be used for engaging the work or an adapter connected with the work, but it is believed that a wide variety of work-engaging means will be found suitable.

As previously mentioned, the ratchet 16 is rotated by means of the drive ring 18. The drive ring 18 is best shown in Figs. 9, 10 and 11 and has a main bore 60 of sufficient size to rotatably receive the row of teeth 52 on the front end of the ratchet 16. The front end of the ratchet engages against a shoulder 62 defined in the bore 60 and an enlarged diameter opening or bore 64 is provided forwardly of the shoulder 62 to receive the pawl-setting ring 22. Driving connection between the ring 18 and the ratchet teeth 52 is effected by the pawls 20, 20 which are respectively located in substantially semi-cylindrical recesses 66, 66 provided in the ring 18 and opening into the bore 60. While any practical number of pawl recesses 66, 66 can be provided for the same number of pawls, two are shown, these being preferably equally circumaxially spaced from each other and from the driving appendage or arm 24 on the drive ring 18. It will be observed that the pawl-receiving recesses 66, 66 do not extend completely through the ring 18 but that the ring defines a rear wall 68 in each recess. A centrally located circular opening 70 is provided in the rear wall 68 of each recess to receive and journal a rearwardly extending pin 72 on each of the pawls 20, 20. It will also be observed that a pair of ball-receiving openings are provided in radially spaced relationship in the peripheral wall of each pawl-receiving recess 66. The ball-receiving openings 74, 74 accommodate a spring biased ball detent for each pawl as will be described.

The drive ring 18 is secured in position around the ratchet teeth by means of a retaining annulus 76 (Fig. 3) which is secured to the rear end of the ring 18 as by a plurality of screws extending into circumferentially spaced tapped openings 78, 78 provided in the ring 18. The retaining annulus 76 surrounds the hub portion 54 of the ratchet 16 so that the ratchet teeth 52 cannot be withdrawn rearwardly from within the ring 18 and so that the ring 18 cannot be withdrawn forwardly from around the ratchet teeth 52.

The pawls 20, 20 which fit within the pawl recesses 66, 66 are shaped similarly to the recesses, i.e., they are substantially semi-cylindrical. The pawls 20, 20 are inserted within the recesses 66, 66 from the front face of the ring 18, the pins 72, 72 being received in the journal openings 70, 70 in the rear walls 68, 68 of the recesses. Each pawl 20 has a pair of longitudinally extending teeth 80, 82 engageable with the ratchet teeth 52, each pair comprising a tooth 80 engageable with the ratchet teeth 52 to effect clockwise rotation of the ratchet and

a tooth 82 engageable with the ratchet teeth 52 to effect counterclockwise rotation of the ratchet. In addition, each pawl 20 has a forwardly extending generally rectangular projection 84 which is engaged by the pawl-setting ring 22 to effect rotation of the pawls 20, 20 on their pins 72, 72, whereby selectively to engage the teeth 80, 80 or the teeth 82, 82 with the ratchet teeth 52.

The said pawl-setting ring 22 is received in the forwardly opening bore or face 64 of the drive ring 18 for limited relative rotation thereon. More specifically, the pawl-setting ring 22 fits within the bore 64 in sliding engagement and is retained within said bore by a plurality of circumaxially spaced springs 86, 86 (Fig. 2). Each spring 86 is formed of flat stock and is arched as shown in Fig. 2 to have an arcuate central portion engaged within a peripherally extending groove or slot 88 in the pawl-setting ring 22 and to have arcuate end portions received in the ends of a groove or slot 90 provided in the drive ring 18 and opening into the bore 64. It will be quite apparent from Fig. 2 that the spring engagement or connection between the drive ring 18 and the pawl-setting ring 22 permits relative rotation therebetween, which relative rotation is limited by the length of the slots 88, 88, provided in the pawl-setting ring 22. However, only limited rotation of the pawl-setting ring 22 on the drive ring 18 is necessary to effect selective engagement of the pawls 20, 20 with the ratchet 16.

That is, during limited rotation of the pawl-setting ring 22 relative to the drive ring 18, the pawls 20, 20 are pivoted on their respective journal or pivot pins 72, 72. The pawl-setting ring accomplishes such pivoting movement of the pawls 20, 20 by means of a pair of bosses 92, 92 provided in the ring 22 and having generally triangular wells 94, 94 which receive the forwardly extending generally rectangular projections 84 on the respective pawls 20, 20. The bosses 92, 92 and the wells 94, 94 are so arranged that during rotation of the pawl-setting ring 22 in one direction, the pawl projections 84, 84 will engage against one wall 96 in each well 94 and during rotation of the pawl-setting ring 22 in the opposite direction, the projections 84, 84 will engage against the opposite walls 98, 98 of the wells 94. When the projection 84 of a pawl engages the wall 96 within a well 94, the pawl will have been pivoted on its longitudinal axis extending through the pin 72 to engage its tooth 80 with the ratchet teeth 52 for clockwise rotation of the ratchet. When the projection 84 of a pawl engages the wall 98 of a well 94, the said pawl will have been pivoted so that its tooth 82 will engage the ratchet teeth 52 for counterclockwise rotation of the ratchet.

The pawl-setting ring 22 is rotated manually, a pair of studs 100, 100 being secured to the bosses 92, 92 and projecting forwardly therefrom for an operator to grasp. An operator can be guided in selecting the direction of rotation of the pawl-setting ring 22 to effect clockwise or counterclockwise driving engagement with the ratchet by means of indicia CW and CCW placed on the front face of the drive ring 18. An indicating slot 102 will register with the legend CW when the pawls are engaged for clockwise rotation of the ratchet 16 and the slot or groove 102 will register with the legend CCW when the pawls are engaged with the ratchet 16 for counterclockwise rotation thereof. After setting the pawls, the setting ring 22 rotates with the drive ring 18.

In Fig. 2, the pawl-setting ring 22 and the pawls 20, 20 are shown positioned to effect driving engagement between the drive ring and the ratchet wheel in the clockwise direction. In such position of the pawls, the tooth 80 on each pawl is engaged between successive teeth 52, 52 on the ratchet 16 and the tooth 82 on each pawl is spaced from the ratchet teeth. It will be observed that a ball detent 104 is biased by a spring 106 disposed within a suitable cavity in each pawl 20 to engage the said ball detent within the clockwise detent cavity 74 in the associated pawl-receiving recess 66. With the spring

biased ball detents 104, 104 disposed as described, the pawls 20, 20 cannot be inadvertently shifted from their described positions. In such position of the pawls and detents, clockwise rotation of the drive ring 18 will cause the ratchet 16 to be moved clockwise by reason of the engaged teeth. However, the clockwise driving teeth 80, 80 of the pawls can escape or over-ride the ratchet teeth 52, 52 during counterclockwise rotation of the drive ring 18 relative to the ratchet teeth.

When the pawl-setting ring 22 and the pawls 20, 20 are positioned for counterclockwise drive of the ratchet 16, the pawl teeth 82, 82 are engaged with the ratchet teeth 52, 52 and the pawl teeth 80, 80 are spaced therefrom. In this last described position of the pawls, the ball detents 104, 104 will be positioned in the counterclockwise detent cavities 74, 74 in the pawl recesses. When so positioned, the pawl teeth 82, 82 will escape or over-ride the ratchet teeth during clockwise rotation of the drive ring 18 relative to the ratchet 16.

As previously mentioned, the ratchet 16 is driven by oscillation of the drive ring 18, such oscillation being effected by reciprocation of the double-end piston 26 which is connected between its ends with the arm 24 on the drive ring and which reciprocates substantially tangentially of the ring. More specifically, the outwardly extending arm or appendage 24 on the drive ring 18 is received in a pocket 108 defined between the ends of the said piston (Figs. 13 and 14). Each end of the piston has a central recess 110 receiving a spring 112, the springs 112, 112 being seated in the ends of the left and right-hand cylinders as shown in Fig. 2. Therefore, when no fluid pressure is provided in the respective cylinders, or when the fluid pressure is the same in both cylinders, the piston 26 is centered by the springs 112, 112. When the piston 26 is centered as shown in Fig. 2, the ratchet 16 is not displaced to transmit torque to the work. The piston is displaced and thus the ratchet is displaced to transmit torque only when the fluid under pressure is introduced to either the cylinder 28 or the cylinder 30.

The said cylinders 28 and 30 are received in the bores 44, 44 in the ratchet housing 14. Each cylinder is secured in position by means of a ring segment 114 surrounding the inner end portion of the cylinder and received within a groove in the housing. Each cylinder is additionally secured by means of a nut 116 which engages a threaded portion on the cylinder and which is advanced into engagement with the housing 14. Conventional annular seals 118, 118 embrace the respective cylinder to prevent leakage between the cylinders and the housing and a seal 120 is disposed in a suitable groove around each end of the piston 26 to prevent leakage between the said piston and the associated cylinder.

While a wrench constructed in accordance with this invention can be operated by a variety of fluid pressure systems capable of alternately pressurizing and draining the cylinders, a manually operable hydraulic system is preferred. The preferred hydraulic assembly 12 is desirably compact and includes a valve housing 122 and a pump housing 124. The valve housing 122 is secured against one end face of the pump housing 124 as by bolts 126, 126 and the pump housing is secured in the slot 48 in the base of the ratchet housing 14 as by bolts 128, 128 extending into the tapped holes 50, 50 in the said base.

The selector valve 130 (Fig. 1) disposed within the valve housing 122 is of conventional construction and need not be described in detail herein. The said valve is rotatable by a handle 132 between three positions, these positions being:

(1) A position wherein a passage 134 in the pump housing 124 and in communication with a pump chamber 136 therein is connected with a passage 138 in the base of the wrench housing 14 (Fig. 7) and which is connected with a passage 140 in the cylinder 28 (Fig. 75

1) and opening thereinto, and wherein a passage 142 in the pump housing 124 and in communication with a reservoir 144 therein is connected with a passage 146 in the base of the wrench housing 14 and which is connected with a passage 148 in the cylinder 30 and opening thereinto.

(2) A position wherein the passage 134 is connected with the passage 146, and wherein the passage 142 is connected with the passage 138.

(3) A "neutral" position wherein the passages 138 and 146 are interconnected at the valve 130 by a valve passage 131 and wherein the passages 138 and 142 are closed at the valve.

It will be observed with reference to Figs. 15 and 18 that the pump and reservoir passages 134 and 142 in the pump housing 124 extend to the left-hand end face of the pump housing where the valve 130 is mounted in its housing 122. It will also be observed that the valve 130 is not directly connected with the passages 138 and 146 in the wrench housing 14 but is connected therewith through the passages 138a and 146a, respectively, in the pump housing 124.

In the No. 1 position of the valve 130 wherein the pump passage 134 is connected with the passages to the left-hand cylinder 28 and wherein the reservoir passage 142 is connected with the passages to the cylinder 30, hydraulic fluid under pressure can be introduced to the cylinder 28 while the cylinder 30 is drained. Therefore, the piston 26 may be driven toward the right in Figs. 1 and 2 to rotate the drive ring 18 counterclockwise. In the No. 2 position of the valve 130, the pump passage 134 is connected with the passages to the cylinder 30 and the reservoir passage 142 is connected with passages to the cylinder 28, whereby hydraulic fluid may be introduced under pressure to the cylinder 30 while the cylinder 28 is drained. Therefore, the piston 26 can be driven toward the left as shown in Figs. 1 and 2 whereby to rotate the drive ring 18 clockwise. In the No. 3 position, fluid under pressure can drain from one cylinder into the other to equalize the pressures, whereupon the springs 112, 112 will bring the piston to the center position shown in Figs. 1 and 2. In the operation of the ratchet wrench as will be described, the valve 130 is moved by the handle 132 between the No. 1 and No. 2 positions to reciprocate the piston 26 whereby to oscillate the drive ring 18 and thus to drive the ratchet 16 in the desired direction. During such operation of the valve, hydraulic fluid is pumped from the pump housing 124 through the valve 130 and into the cylinders 28 and 30, respectively, as will now be described.

The pump housing 124 defines a passage 150 between the reservoir 144 and the pump chamber 136. A check valve indicated generally at 152 is disposed in the passage 150 to permit flow from the reservoir 144 to the pump chamber 136 but to prevent flow from the pump chamber to the reservoir. Flow from the reservoir to the pump chamber is brought about by creating a vacuum in the pump chamber and in the passage 150, the vacuum being created by movement of a pump piston 154 within the pump chamber. More specifically, the piston is movable upwardly and downwardly in the chamber 136 with its lower end extending from the pump housing and connected to a pump arm 156. The pump arm 156 is pivotally connected to a post 158 which is secured in the bottom end of the pump housing 124. The pump piston 154 is reciprocated in the chamber 136 by oscillating the pump arm 156, this being accomplished manually by movement of a handle 160 (Figs. 2 and 3) which is detachably connected to the pump arm 156 on the end thereof of opposite the piston 154. It will be readily understood that in downward movement of the pump piston 154 in the chamber 136, a partial vacuum is created in said chamber and in the passage 150 to draw hydraulic fluid from the reservoir through the check valve 152. It will also be understood that high pressure is created in the

pump chamber 136 and in the passage 150 to close the check valve 152 when the pump piston 154 is moved upwardly in the said chamber.

During such upward or high pressure movement of the pump piston 154, hydraulic fluid is forced from the pump chamber 136 into the passage 134 extending to the valve 130. A check valve 162 is disposed in the passage 134 to prevent flow from the selector valve 130 to the pump chamber 136 but to permit flow from the pump chamber to the said selector valve. Thus, during movement of the pump piston 154 in one direction (downwardly), the pump chamber 136 is filled with hydraulic fluid from the reservoir 144 thus creating a partial vacuum within the reservoir and drawing hydraulic fluid thereinto through the passage 142, and during movement of the pump piston 154 in the other direction (upwardly), hydraulic fluid under pressure is forced from the chamber 136 through the passage 134 to the selector valve 130.

The actual pressure of the hydraulic fluid pumped through the passage 134 to the wrench assembly is indicated at a pressure gage 164 which communicates with the passage 134. More specifically, a pipe nipple 166 communicating with the passage 134 on the downstream side of the check valve 162 receives hydraulic fluid at the pressure in the passage 134. The nipple 166 communicates with a gage protector 168 which is connected by a conduit 170 to the gage 164. In the event that the hydraulic pressure in the passage 134 is greater than anticipated and is so great that it might cause damage to the gage 164, the gage protector 168 will block the flow of hydraulic fluid at excessive pressure to the gage, thus protecting the same.

It will be readily understood that the driving force on the reciprocable piston 26 and on the drive ring 18 will be directly related to the pressure created in the passage 134. The driving force in which the operator is interested is the inch pounds or foot pounds of torque applied by the ratchet 16. Therefore, it is convenient to calibrate the gage 164 in inch pounds or foot pounds of torque rather than to calibrate the same in the equivalent hydraulic pressure.

The assembly and operation of the hydraulically operated ratchet wrench will for the most part be apparent from the foregoing description of the elements included therein. However, a general summary of the assembly and operation is deemed to be desirable.

The first step in assembly of the wrench is to place the drive ring 18 around the teeth 52 on the ratchet 16 and to secure the ring in place by attaching the retaining annulus 76. Then, the pawls 20, 20 are thrust into the pawl recesses 66, 66 in the drive ring 18 and retained therein by placing the pawl-setting ring 22 into the front face of the drive ring, securing the same by means of the circumaxially spaced arched springs 86, 86. Then, the cylinder 28 or the cylinder 30 is inserted into its respective bore 44 in the wrench housing 14 and secured therein by the associated ring segment 114 and by its associated nut 116. Then, a spring 112 is placed in the attached cylinder and the reciprocable piston 26 is located in the said cylinder to receive the associated spring 112. Then, the other spring 112 is placed into the recess in the free end of the piston 26 and the other cylinder placed thereover and attached in like manner to the wrench housing 14. The final step in connecting the elements of the ratchet assembly 10 is to insert the hub portion of the ratchet 16 into the wrench housing 14 where it is received on the anti-friction bearing units 34, 34. The ratchet 16 is rotatably secured within the wrench housing 14 by advancing the circumaxially spaced screws through the housing 14 into the groove 56 adjacent the rear end of the ratchet. With the ratchet thus positioned, the driving arm or appendage 24 on the drive ring 18 will be disposed in the pocket 108 of the reciprocable piston 26.

The hydraulic assembly is completed by connecting the

selector-valve housing 122 to the pump housing 124 by means of the screws 126, 126 and then the assembly is connected with the ratchet assembly by the attaching bolts 128, 128 which are advanced into the threaded holes 50, 50 in the slotted portion of the wrench housing base 42. Hydraulic fluid can be introduced to the reservoir 144 either before or after the hydraulic assembly 12 is attached to the ratchet assembly 10. It will be observed that a detachable plug closes one end of the reservoir 144 for adding oil thereto.

Assuming that it is desired to use the assembled wrench to apply torque in a clockwise direction, the first step in operation is to rotate the pawl-setting ring 22 to the position shown in Fig. 2 wherein the indicating groove on the said pawl-setting ring is disposed opposite the legend CW in which position of the said ring the pawls 20, 20 will be positioned so that their respective teeth 80, 80 will engage the ratchet teeth 52. Then, the handle 132 on the selector valve 130 is moved to position the said valve in its No. 2 position and the pump handle 160 is oscillated to pump hydraulic fluid into the cylinder 30. The introduction of hydraulic fluid under pressure in the cylinder 30 drives the piston 26 toward the left thereby to rotate the drive ring and the ratchet clockwise. The resistance to piston movement is the torque load imposed upon the work as may be measured in inch pounds on the gage 164. If one stroke of the piston 26 toward the left as viewed in Fig. 2 is insufficient to apply the desired torque to the work, the piston is returned and a new load stroke or arming stroke is made. That is, after the initial movement of the piston toward the left, the selector valve 130 can be placed in its No. 1 position by the valve handle 132 and the piston 26 will be forced from the cylinder 28 toward the right into the cylinder 30 by spring force and by the force of hydraulic fluid introduced to the cylinder 28 in the No. 1 position of the valve 130. Then, the selector valve 130 is repositioned in its No. 2 position and hydraulic fluid is pumped into the cylinder 30 to force the piston toward the left. When the piston moves toward the right into the cylinder 30, the pawl teeth 80, 80 override the ratchet teeth in the accompanying counterclockwise rotation of the drive ring 18. However, as in the first arming stroke, the pawl teeth 80, 80 engage the ratchet teeth 52 and move the ratchet 16 clockwise with clockwise rotation of the drive ring.

Reciprocation of the drive piston and oscillation of the drive ring can be continued until the desired torque is applied to the work. Obviously, the piston 26 will have to be reciprocated several times and the drive ring 18 will have to be oscillated several times to complete one revolution of the ratchet wheel 16 in step-by-step fashion. That is, the drive ring 18 can only be rotated through approximately 40° in one step during each complete cycle of reciprocation and oscillation. The entire "step" or advance is made during only the drive stroke portion of the cycle as may occur, for example, in movement of the piston 26 from the cylinder 30 toward the cylinder 28. The amount of rotation of the drive ring in one drive stroke of the piston 26 is indicated on a scale 172 which is attached to the wrench housing 14, an indicating pointer 174 being secured to the drive ring 18 to pass over the scale 172 as the said drive ring is rotated relative to the ratchet housing. An operator observing the passage of the pointer 174 over the scale 172 will reposition the selector valve 130 when the pointer 174 approaches the "40°" indicia on the scale 172 with the knowledge that the drive piston 26 has completed a full driving stroke.

It will be obvious that the same method of operation obtains in applying torque in a counterclockwise direction to the work. It is only necessary to re-position the pawls 20, 20 so that their counterclockwise driving teeth 82, 82 engage the ratchet teeth 52, 52 to advance the ratchet wheel counterclockwise in step-by-step fashion.

It will also be obvious to those skilled in the art that many modifications and alternative forms of construction can be provided in accordance with the invention and within the scope of the following claims.

The invention claimed is:

1. In a fluid pressure operated ratchet wrench for applying torque to work, the combination comprising a ratchet housing, a ratchet wheel having means connectible with the work and having external teeth and rotatably supported in the housing for connection with the work, a drive ring surrounding the ratchet teeth and rotatable therearound, said drive ring having an outwardly extending arm, a plurality of pawls rotatably supported in said ring for selective engagement with the ratchet teeth to effect clockwise or counterclockwise driving engagement between the ring and the wheel, means for selectively engaging said pawls comprising a ring supported on said driving ring for limited relative rotation thereon and connected with said pawls to rotate the same in the drive ring, a double-end piston reciprocable in said housing relative to the ratchet wheel and connected between its ends with said arm, a pair of cylinders supported on said housing and respectively surrounding the ends of the piston, and fluid control means for alternately introducing fluid under pressure to the cylinders and for alternately draining the same, whereby to reciprocate the piston and oscillate the drive ring to advance the ratchet wheel in the selected direction of rotation in step-by-step fashion, there being one step of advance during each cycle of reciprocation and oscillation.

2. An hydraulic ratchet wrench for applying torque to work and comprising, a ratchet housing, a ratchet wheel having means connectible with the work and having external teeth and rotatably supported in the housing for connection with the work, a drive ring surrounding the ratchet teeth and rotatable therearound, said drive ring having an outwardly extending arm, a plurality of pawls rotatably supported in said ring for selective engagement with the ratchet teeth to effect clockwise or counterclockwise driving engagement between the ring and the wheel, means for selectively engaging said pawls comprising a ring supported on said driving ring for limited relative rotation thereon and connected with said pawls to simultaneously rotate the same in the drive ring, a double-end piston reciprocable in said housing relative to the ratchet wheel and connected between its ends with said arm, a pair of cylinders supported on said housing and respectively surrounding the ends of the piston, and hydraulic control means including a reservoir for receiving hydraulic fluid drained from the cylinders and manually operable pump for withdrawing hydraulic fluid from the reservoir and for pressurizing the same, and also including a selector valve for selectively introducing fluid under pressure alternately to the cylinders and for alternately draining the same, whereby to reciprocate the piston and oscillate the drive ring to advance the ratchet wheel in the selected direction of rotation in step-by-step fashion, there being one step of advance during each cycle of reciprocation and oscillation.

3. In a fluid pressure operated ratchet wrench for applying torque to work, the combination of a ratchet housing having a base, a ratchet wheel having means connectible with the work and having ratchet teeth and being rotatably supported in the housing, a drive ring rotatable relative to the ratchet wheel and having an outwardly extending arm, pawl means movably supported in said drive ring for selective engagement with the ratchet teeth to effect clockwise or counterclockwise driving engagement between the drive ring and the ratchet wheel, a double-end piston reciprocable in the base of the housing substantially tangentially with respect to the drive ring and having means defined between its ends receiving the arm on the drive ring, whereby reciprocation of the piston effects oscillation of the drive ring, a pair

of cylinders supported on said housing base and respectively surrounding the ends of the piston, and fluid pressure operating means attached to said housing base comprising a source of fluid under pressure and a control valve for alternately introducing fluid under pressure to the cylinders and for alternately draining the same, whereby to advance the ratchet wheel in a preselected direction of rotation in step-by-step fashion by reciprocation of the piston, there being one step of advance during each cycle of reciprocation.

4. In a fluid pressure operated ratchet wrench for applying torque to work, the combination of a ratchet housing having a base, a ratchet wheel having means connectible with the work and having ratchet teeth and being rotatably supported in the housing, a drive ring rotatable relative to the ratchet wheel and having an outwardly extending arm, pawl means movably supported in said ring for selective engagement with the ratchet teeth to effect clockwise or counterclockwise driving engagement between the ring and the wheel, a double-end piston reciprocable in the base of the housing substantially tangentially with respect to the drive ring and having a pocket defined between its ends receiving the arm on the drive ring, whereby reciprocation of the piston effects oscillation of the drive ring, a pair of cylinders supported on said housing base and respectively surrounding the ends of the piston, and fluid pressure operated means attached to said housing base comprising a fluid reservoir, means for pumping fluid from the reservoir under pressure, and a control valve for alternately introducing fluid under pressure to the cylinders and for alternately draining the same to the reservoir, whereby to advance the ratchet wheel in a selected direction of rotation in step-by-step fashion by reciprocation of the piston, there being one step of advance during each cycle of reciprocation.

5. In a fluid pressure operated ratchet wheel for applying torque to work, the combination of a ratchet housing having a base, a ratchet wheel having means connectible with the work and having ratchet teeth and being rotatably supported in the housing, a drive ring rotatable relative to the ratchet wheel and having an outwardly extending arm, pawl means movably supported in said ring for selective engagement with the ratchet teeth to effect clockwise or counterclockwise driving engagement between the ring and the wheel, a double-end piston reciprocable in the base of the housing substantially tangentially with respect to the drive ring and having a pocket defined between its ends receiving the arm on the drive ring, a pair of cylinders supported on said housing base and respectively surrounding the ends of the piston, a spring located in each cylinder for biasing said piston, whereby the piston normally is located in a central position relative to said cylinders, and fluid pressure operated means attached to said housing base comprising a source of fluid under pressure and a control valve for alternately introducing fluid under pressure to the cylinders and for alternately draining the same, whereby to advance the ratchet wheel in a selected direction of rotation in step-by-step fashion caused by reciprocation of the piston and accompanying oscillation of the drive ring, there being one step of advance during each cycle of reciprocation and oscillation.

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