Feb. 22, 1955 R. E. WALLACE, SR 2,702,489

PORTABLE HYDRAULIC MOTOR-OPERATED RATCHET WRENCH

Filed July 18, 1952 2 Sheets-Sheet 1

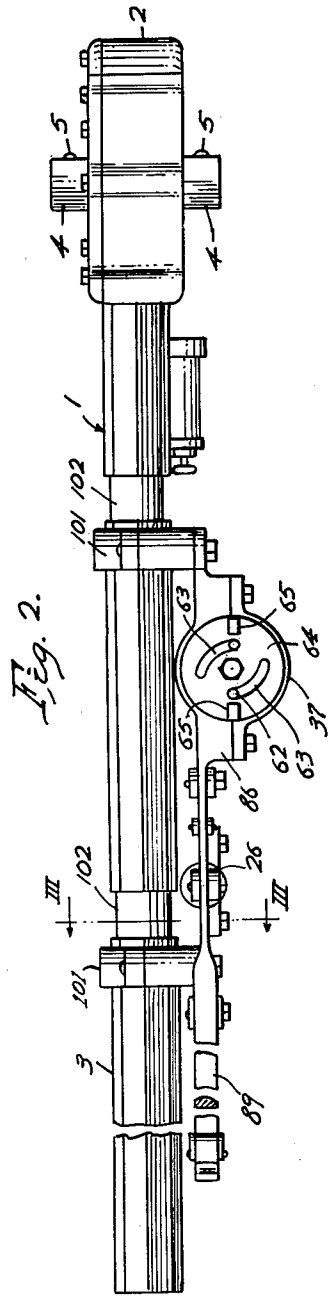


Fig. 2.

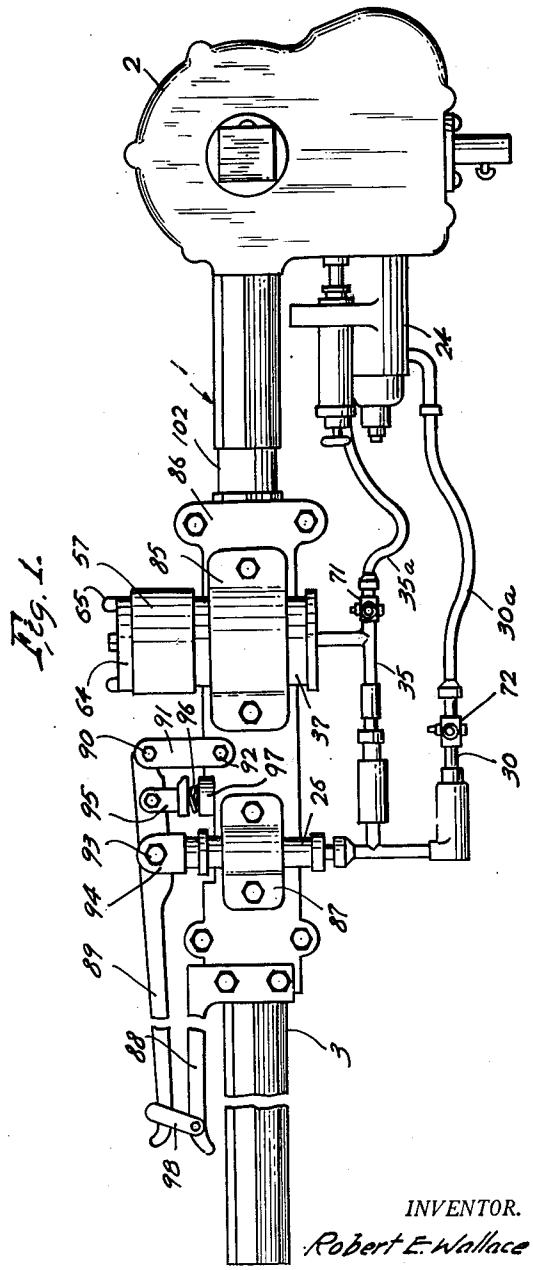


Fig. 1.

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PORTABLE HYDRAULIC MOTOR-OPERATED RATCHET WRENCH

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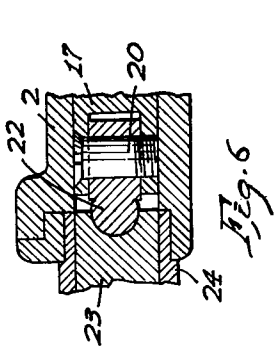


Fig. 6

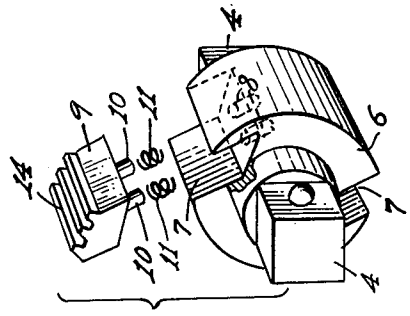


Fig. 4.

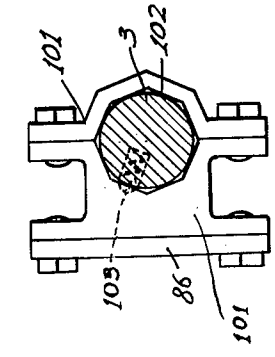


Fig. 3.

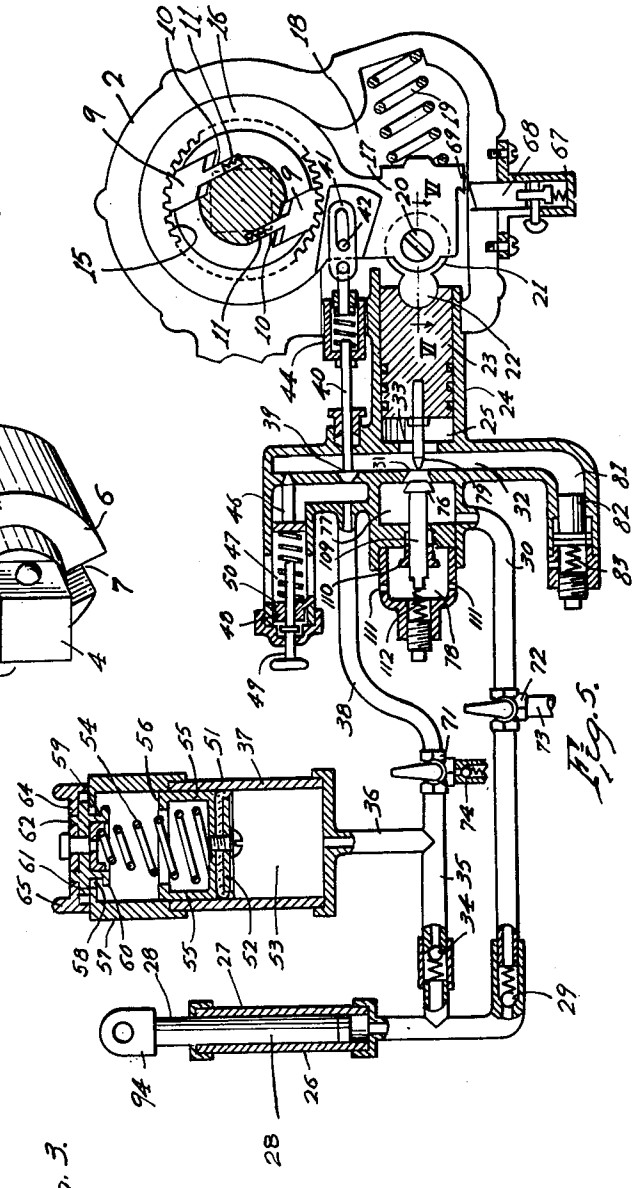


Fig. 5.

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2,702,489

PORTABLE HYDRAULIC MOTOR-OPERATED RATCHET WRENCH

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Application July 18, 1952, Serial No. 299,552

11 Claims. (Cl. 81—58.1)

This invention relates as indicated, to a portable hydraulic ratchet wrench, and, more particularly, to an improved arrangement of ratchet wrench mechanism having a self-contained and manually operable hydraulic system which may be selectively operated through its hydraulic operating mechanism or in the mechanical fashion of a conventional ratchet wrench.

In many instances, nuts become locked or frozen on their bolts so that it is difficult to begin rotation of the nut to effect its removal. This difficulty is particularly common in the case of nuts of large size such as those used on locomotive main and side rods, large electric generators and motors, rolling mill housings, etc. Such nuts are frequently located in a position in which it is impossible to use a wrench having a handle sufficiently long to obtain the leverage necessary to start the desired loosening motion. This large leverage is required only during initial loosening movement since a considerably smaller leverage is effective to continue rotation of the nut once such rotation has been initiated.

One of the objects of this invention is to provide a wrench in which an extremely large mechanical advantage may be obtained for effecting initial or final nut rotation without the necessity of providing an unduly long wrench handle. To this end, the invention contemplates the provision of a ratchet wrench having relatively rotatable operating parts. One of such parts is arranged for actuation by a piston having an hydraulic operating system. The hydraulic system is self-contained and mounted as a unit on the wrench and includes a manually operable pump which is so designed that it must be actuated many times to move the actuating piston a distance sufficient to rotate the wrench actuating part connected thereto through an angle equivalent to one or two of the ratchet cogs. In this manner, a very high mechanical advantage is obtained for initiating or concluding rotational movement of the nut.

A further object of the invention is to provide an hydraulic system of the character described in which the ratchet operating piston is automatically returned to a starting position after movement through a work stroke of predetermined length so that it will be reciprocated continuously and thereby effect a continuous rotation of the wrench operating parts in response to continuous manual operation of the hand pump.

Other objects and advantages of the invention will become apparent from the following description.

In the drawings there is shown a preferred embodiment of the invention. In this showing:

Fig. 1 is a plan view of a ratchet wrench, a portion of the handle thereof being shown broken away, and having applied thereto an hydraulic operating system constructed in accordance with the principles of this invention;

Fig. 2 is an elevational view of the wrench shown in Fig. 1;

Fig. 3 is a sectional view taken substantially along the line III—III of Fig. 2;

Fig. 4 is a fragmentary perspective view of the nut socket actuating spindle and of an actuating pawl therefor;

Fig. 5 is a fragmentary and diagrammatic showing, parts thereof being illustrated in section, of the hydraulic system shown in Figs. 1 and 2; and

Fig. 6 is a sectional view taken substantially along the line VI—VI of Fig. 5.

Referring first to Figs. 1 and 2, the numeral 1 designates as a whole a ratchet wrench comprising a housing 2 in

which there is mounted a ratchet mechanism of a character to be described and having an operating handle 3 connected thereto. Actuating studs 4 project from opposite sides of the housing 2 for engagement with nut sockets in a conventional fashion. The actuating studs 4 are each provided with spring biased pawls or detents 5 for holding sockets in position thereon in a conventional manner.

As best shown in Figs. 4 and 5, the square studs 4 are formed on the axial ends of a rotatable operating member 6 which is rotatably mounted centrally of the housing 2. The operating member 6 is provided with a pair of slots 7 respectively extending inwardly from the periphery thereof and having a pair of pin-receiving openings 8 at their inner ends. Detents or pawls 9 are mounted for sliding rectilinear movement in the slots 7, and have a pair of pins 10 at their inner ends which are receivable in the openings 8. Springs 11 are receivable in the openings 8 and when compressed by the ends of the pins 10 provide a bias for moving the pawls outwardly in the slots 7. The outer ends of the pawls 9 have locking teeth 14 thereon for meshing engagement with similar ratchet teeth 15 on the inner surface of an annular actuating member 16 (see Fig. 5) which is rotatably mounted in the housing 2. As will be apparent from the showing of Fig. 5, the teeth 14 and 15 do not extend radially of the rotating operating parts 6 and 16 but are inclined with respect to the radii thereof in such manner that rotation of the annular operating member 16 in a clockwise direction as viewed in Fig. 5 will cam the pawls 9 inwardly and move the ratchet teeth 14 and 15 out of meshing engagement. This camming movement of the pawls 9 is inwardly against the action of their biasing springs 11. Upon movement of the rotatable actuating member 16 in a counterclockwise direction, the slope of the engaging surfaces on the teeth 14 and 15 produces a reactive force which holds such teeth in meshing engagement, and thus locks the pawls 9 to the annular operating part 16 for rotation therewith to thereby impart rotation to the spindle 6 and the socket actuating studs 4 connected thereto. The annular operating part 16 has an actuating lug 17 projecting laterally therefrom into an opening 18 in the housing 2 in which it has an oscillating movement. A spring 19 has engagement between the housing 2 and lug 17 for resiliently biasing the oscillating movement of the annular operating part 16 in a clockwise direction.

The actuating lug 17 is provided with a pivot pin receiving opening parallel to the axis of the rotatable operating parts 6 and 16 and in which a pivot pin 20 (see Fig. 6) is mounted. A motion transmitting member 21 is journaled on the pin 20 and has a universal connection 22 with a piston 23 which is slidable in a cylinder 24 so that reciprocating movement of the piston 23 will be effective to impart an arcuate movement to the actuating lug 17. Admission of hydraulic fluid under pressure to the space 25 within cylinder 24 moves the piston 23 to rock the lug 17 against the action of its biasing spring 19. The spring 19 through the lug 17 and piston 23 is effective to force fluid out of the space 25 in a manner to be described.

Fluid pressure for actuating the piston 23 is supplied by a pump 26. The pump 26 comprises a cylinder 27 having a piston 28 reciprocable therein. On the down stroke of the piston 28 as viewed in Fig. 5, a ball check valve 29 is unseated and fluid under pressure is delivered to the conduit 30, and through valve port 31, passage-way 32, and opening 33 to the cylinder chamber 25. On the up stroke of the piston 28, the ball check valve 29 seats to disconnect the cylinder 27 from the high pressure conduit 30, and the ball check valve 34 is unseated to connect the cylinder 27 with the low pressure conduit 35. The low pressure conduit 35 has a connection 36 to a reservoir 37 of hydraulic fluid. The up stroke of the piston 28 is thus operative to draw a charge of hydraulic fluid into the cylinder 27.

The low pressure conduit 35 has a branch 38 by which it is connectable to the conduit 32 through a port in the wall of the passage-way 32 which is opened and closed by a valve 39. Opening and closing of the valve 39 is effected by an operating stem 40 having a slotted actuating link 41 at an opposite end thereof. An actuating pin

42 secured to the lug 17 projects through the slot in the link 41. Upon arcuate movement of the actuating lug 17 to the right as viewed in Fig. 5, the pin 42 will move to the end of the slot in the link 41, and drag the valve actuating stem 40 to the right to open the valve 39 and thereby connect low pressure conduits 36 and 38 to the passageway 32. In this manner, the pressure of the fluid in the passageway 32 is released, and fluid is exhausted from the cylinder chamber 25 to the reservoir 37 by operation of the spring 19 in moving the lug 17 to the left as viewed in Fig. 5. In a manner to be described, the fluid in the reservoir 37 is maintained under a minimum pressure and exhaust of fluid through conduit 38 is against this minimum pressure. This minimum exhaust pressure reacts against the valve 39 and is effective to hold the valve 39 in its open position until such time as it is seated by operation of the actuating pin 42. This seating action takes place when the pin 42 moves to the left end of the slot in the link 41 in the position illustrated in Fig. 5. The stem 40 is provided with a resilient connection 44 intermediate its ends to allow for over travel movement thereof by its actuating link 41 and the pin 42.

A safety valve 46 is provided for limiting the torque which can be applied by the hydraulic system to the operating member 16. The valve 46 is shown in its closed position and is provided with a spring 47 biasing it to such position. The biasing spring 47 has one end bearing against the valve 46 and its other end bearing against an adjustable collar 48. The collar 48 is threaded on the shank of a stem which can be manually rotated to adjust the axial position of the collar 48 thereon and thereby the force of the spring holding the valve 46 in closed position. An arm 50 on the collar 48 may be utilized to indicate the position of the collar 48 with respect to the stem 49, and indicia calibrated in pounds torque or pressure may be provided to indicate the pressure which will be required to unseat and open the valve 46. When this pressure is exceeded, the valve 46 will open and connect the passage-way 32 to the exhaust conduit 38 and thereby relieve the pressure in the cylinder 25.

The reservoir 37 comprises a cylinder 51 having a piston 52 mounted in the upper end of the fluid chamber therein. The piston 52 has a spring 54 biasing it downwardly to maintain a minimum pressure on the fluid in the chamber 53. To facilitate assembly of the piston 52 in the cylinder 51, a cylinder 55 having an inturned lip 56 at the upper end thereof is connected to the piston 52. An extension 57 has a detachable threaded connection at its lower end to the cylinder 51, and its upper end has a closure in which is formed a pair of slots 58 through which a pair of actuating members 59 project. The lower ends of the members 59 have outwardly projecting lugs 60 for a purpose to be described. The parts 59 and 60 are connected with slides 61 having sliding engagement on the upper closed end of the cylinder 57. Pins 62 project upwardly from the slides 61 and engage in arcuate slots 63 formed on a cap 64 as best shown in Fig. 2. The cap 64 has a pair of manually engageable lugs 65 by which it may be rotated on the cylinder 57. Prior to assembling of the cylinder 57 on the cylinder 51, the cap 64 is rotated to move the lugs 60 to their innermost positions. In this position of the lugs 60, the piston 52 may be moved upwardly with respect to the cylinder 57, the lip 56 clearing the lugs 60. When the lip 56 is moved to its uppermost position against the upper end of the cylinder 57, the cap 64 is rotated to move the members 59 radially outwardly in the slots 58 so that the lugs 60 will engage under the lip 56 and prevent downward movement of the cylinder 55 by the spring 54 with respect to the cylinder 57. The cylinder 57 may then be threaded into position on the cylinder 51 after which the cap 64 is turned to move the lugs 60 inwardly to a position in which they clear the lip 56 and release the piston 52 for a downward movement by its biasing spring 54. The piston 52 will then move downwardly until it engages with the upper surface of the hydraulic fluid in the chamber 53 in which position its spring 54 will be effective to maintain the fluid in the chamber 53 under pressure.

In the event that the hydraulic system is not to be employed, a latch 67 is provided for locking the lug 17 against return movement by its biasing spring 19. The latch 67 comprises a detent 68 having a spring for moving it upwardly with respect to the housing 2 as viewed in Fig. 5 to a position in which it will lie in the path of movement of a locking member 69 carried by the lug.

With the detent 68 in its upper position, the locking member 69 will prevent operation of the wrench by its hydraulic system. The detent 68 is provided with an operating handle which projects outwardly through an inverted L-shaped slot (not illustrated) by which the detent operating handle and the detent 68 may be held in their upper locking position.

In order to effect an hydraulic operation of the wrench, the latch 68 is placed in its lower position as illustrated in Fig. 5, and for such operation, the conduit 30 may be considered as being directly connected to the passageway 32 through the port 31. Upon manual operation of the piston 28, fluid pressure will be pumped through the conduit 30 to the pressure chamber 25 to effect a movement of the piston 23 to the right as viewed in Fig. 5. Movement of the piston to the right will actuate the operating lug 17 through the motion transmitting member 21. This movement will continue until the pin 42 moves to the end of the slot in the link 41 to unseat the exhaust valve 39. When the exhaust valve 39 is unseated, fluid in the chamber 25 will be exhausted through the conduits 38 and 36 to the reservoir 37, and the spring 19 will be effective to return lug 17 to its initial position as shown in Fig. 5. As lug 17 moves to this position, the pin 42 will move to the left end of the slot in the link 41 and seat the valve 39 to thereby disconnect the chamber 25 with respect to the exhaust conduit 38. The hydraulic system will then be again in a position to effect another actuation of the lug 17 through another small angular movement.

It is, of course, to be understood that when the lug 17 is actuated by the piston 23, the annular member 16, through the locking detents 9 will rotate the spindle 6 and thus apply torque to the nut socket which may be mounted on the studs 4. Upon return movement of the lug 17 by the spring 19, the slope of the meshing teeth 14 and 15 is such that the pawls 9 will be cammed inwardly to allow rotational movement of annular member 16 without a similar movement being imparted to the spindle 6.

Attention is directed to the fact that a single reciprocating movement of the piston 23 is effective only to move the operating member 16 through a relatively small angle, and that the volume of fluid displaced by the pump piston 28 during one working stroke thereof is relatively small as compared to the volume of fluid required to effect a working stroke of the piston 23. For this reason, a large number of strokes will be required of the piston 28 to effect a single stroke of the piston 23 and a resultant movement of the wrench operating member 16 through a small angular distance. In this manner, a large mechanical advantage is obtained, and a large operating torque may be applied to a nut through the application of relatively small increments of force to the manually operated piston 28.

The hydraulic system described above is adapted for operation from a source of fluid pressure supply in which the fluid pressure is created by a motor-driven pump rather than a manual system as described above. For this purpose, a pair of two-way valves 71 and 72 are respectively mounted in the conduits 30 and 35 for disconnecting the reservoir 37 with respect to the exhaust conduit 38 and for disconnecting the conduit 30 with respect to the manual pump 26. Upon disconnecting operation of the valves 71 and 72 in this manner, the conduit 30 will be connected to a fluid pressure supply conduit 73 and the exhaust conduit 38 will be connected to an exhaust conduit 74, the conduit 73 being connected with a fluid pressure supply source (not shown). It will be noted that the exhaust conduit 74 is provided with a spring-biased ball-check valve which maintains a minimum exhaust pressure for holding the valve 39 in its open position as described above in connection with the pressure of the reservoir 37. The ball-check valve in exhaust passage 74 performs the same function as spring 54 in the reservoir.

To control the connection of cylinder space 25 to the pressure supply conduit 73, a valve 76 controlling the opening and closing of the port 31 is provided. The valve 76 is operated by a stem 109 having its inner end connected with the valve 76 and positioned in a pressure chamber 77 which is connected with the high pressure conduit 30. The outer end of the stem 109 has a rectilinear sliding movement through a stuffing box 110 and projects into a chamber 78 which is at atmospheric pres-

sure, it being ported to the atmosphere as at **111**. A spring **112** provides a bias against the outer end of the stem **109** for moving the valve **76** to its closed position. The spring **112** has a force which is just sufficient to close the valve **76** against the force of the minimum exhaust pressure in the passage **32** as controlled by either the ball-check valve **74** or the spring **54**. Any time this pressure is exceeded, as will happen when valve **39** closes and pressure fluid is admitted to passage **32**, the valve **76** will move to the left, as viewed in Fig. 5, against the action of the spring **112** and open the port **31** to connect the cylinder **25** with the fluid supply conduit **30**.

To provide for initial opening of the port **31** for supplying pressure to the passage **32** which will be effective to open valve **76**, an operating pin **79** is secured to the piston **23**. The pin **79** has a length such that it engages with and unseats the valve **76** when the piston **23** is moved to its fully retracted position by the spring **19** as illustrated in Fig. 5. In operation, when the piston **23** moves to its retracted position, the pin **42** closes the exhaust valve **39**, and the pin **79** strikes the valve **76** and unseats it, allowing fluid pressure to enter passage **32**. This pressure acting on the right end of valve **76**, as viewed in Fig. 5, forces it to the left, thereby completing its movement to a fully open position connecting the cylinder pressure chamber **25** to the fluid pressure supply conduit **73**. The fluid pressure admitted to the chamber **25** will move the piston **23** to the right to supply torque through the ratchet mechanism to the wrench. As the piston **23** moves to the right, the pressure of the fluid in the chamber **77** and passage **32** will be effective to maintain valve **76** in its open position. When the piston **23** moves to the end of its working stroke, the pin **42** will open the valve **39** and thereby connect the chamber **25** to the exhaust conduit **74**. Opening of valve **39** releases the pressure in passage **32**, and the spring **112**, together with the fluid pressure exerted on the exposed area on the left end of valve **76**, as viewed in Fig. 5, move valve **76** to closed position. Also, spring **19** starts return movement of piston **23** and fluid will be exhausted from cylinder chamber **25**. At near the end of the return movement, pin **42** operates to move valve **39** to its closed position to disconnect chamber **25** from exhaust. Closure of exhaust valve **39** takes place just at, or just prior to, the time initial contact of pin **79** with valve **76** takes place.

In order that the final movement of the piston **23** to the left as viewed in Fig. 5 may take place for the purpose of unseating the valve **76**, an expansible chamber **81** is provided. The chamber **81** is cylindrical in shape and has a piston **82** having a spring **83** biasing it to the right as viewed in Fig. 5, the chamber in which the piston **82** is mounted being ported at the left of the piston, as viewed in Fig. 5, to the atmosphere. The spring **83** exerts a force sufficient to move the piston **82** to the right as viewed in Fig. 5 only when the pressure in the passage **32** is at the exhaust pressure determined by the check valve in **74** or the spring **54** in reservoir **37**. At all higher pressures, the piston **82** moves to the left to the position illustrated. Final movement of the piston **23** to the left by the spring **19** for opening the valve **76** increases the pressure in the passage **32**. This increased pressure reacts against the piston **82** which will move outwardly against the action of its biasing spring **83** to allow additional fluid to escape from the chamber **25** after closure of the exhaust valve **39**, and thereby enable final movement of the piston **23** to the left as viewed in Fig. 5 to open the valve **76** so that another operating cycle of the piston **23** may be started. Except for the action of the piston **82** in accommodating movement of fluid during final movement of the piston **23** after closure of exhaust valve **39**, the fluid in passage **32** would lock the piston against movement to its fully retracted position. In this manner, the piston **23** will be reciprocated continuously to effect continuous operation of the wrench ratchet mechanism as long as the fluid conduits **73** and **74** are connected with the chamber **25** through the valves **71** and **72**.

Referring again to Fig. 1, it will be noted that the reservoir **37** is mounted by a bracket **85** on a supporting bracket **86**. In a similar manner, the pump **26** is connected by a bracket **87** to the supporting bracket **86**. The operating mechanism for the pump **26** includes a stationary hand grip **88** secured to the bracket **86** and an overlying hand grip **89** having a pivotal connection **90** at one end thereof to the upper end of a toggle link **91**, the lower end of which is pivoted at **92** to the supporting bracket **86**. Spaced from pivot **90**, a second pivot **93** connects the lever **89** to the upper end **94** of the piston **28**. Intermediate the pivotal connections **90** and **93** the manually operative lever **89** has a pivotal connection to a cap **95** which bears against the upper end of a biasing spring **96**, the lower end of the spring **96** bearing against a stationary member **97** on the supporting bracket **86**. A locking link **98** is provided for tying the outer ends of the levers **88** and **89** together and to prevent upward movement of the lever **89** by its spring **96**. When the link **98** is rotated to release the lever **89**, its spring **96** moves it upwardly to effect a suction stroke of the piston **28**. Thereafter, the levers **88** and **89** may be squeezed together by one hand of an operator to effect a pressure stroke of the piston **28**.

As best shown in Figs. 2 and 3, the bracket **86** is mounted on the handle **3** by supporting brackets **101** which have a polygonal shape similar to that of the handle **3**. Adjacent the brackets **101** the handle **3** is provided with a pair of spaced circular portions **102** of reduced area. In the event that it is desired to change the angular position of the fluid system relative to the handle **3** it is only necessary to move the bracket **86** lengthwise on the handle until it is opposite the circular positions **102**. The bracket **86** may then be rotated to the desired angular position and then moved endwise relative to handle portions **102** so that the polygonal contour of the outer surfaces of the handle **3** and the similar contour of the inner surfaces of the brackets **101** will be effective to prevent turning movement of the supporting bracket **86** on the handle **3**. A ball detent **103** is provided in the handle **3** for releasable holding engagement with one of the supporting brackets **101** when the brackets **101** are moved to a position over the polygonal surface of the handle **3**. The detent **103** is for the purpose of releasably holding the bracket **86** against axial shifting movement on the handle **3**. In order that this relative rotational movement of the bracket **86** and the handle **3** can be effected without interference, the fluid supply conduits **30** and **35** are provided with flexible portions **35***a* and **30***a* respectively.

While the apparatus described above and shown in the drawings represents a preferred embodiment of the invention, it will be understood that this is merely by way of illustration, and that various changes may be made therein within the contemplation of this invention and under the scope of the following claims.

I claim:

1. The combination with a ratchet wrench having a nut socket receiving spindle, a handle, and ratchet mechanism including a rotatable ratchet member interconnecting said handle and spindle, of a fluid pressure motor having a reciprocable piston, means connected with said piston and member for oscillating said member in one rotational direction in response to the power stroke of said piston, a spring biasing said member and thereby said piston for movement in an opposite direction in response to the exhaust stroke of said piston, and valve means responsive to movement of said piston to the end of its power stroke for connecting said motor to an exhaust for the exhaust stroke of said piston.

2. The combination with a ratchet wrench having a nut socket receiving spindle, a handle, and ratchet mechanism including a rotatable ratchet member interconnecting said handle and spindle, of a fluid pressure motor having a reciprocable piston, means connected with said piston and member for oscillating said member in response to reciprocation of said piston, a self-contained hydraulic system including a manually operable pump for supplying fluid pressure to said motor, and bracket means mounting said pump on said handle.

3. The combination with a ratchet wrench having a nut socket receiving spindle, a handle, and ratchet mechanism including a rotatable ratchet member interconnecting said handle and spindle, of a fluid pressure motor having a reciprocable piston, means connected with said piston and member for oscillating said member in response to reciprocation of said piston, a self-contained hydraulic system including a manually operable pump for supplying fluid pressure to said motor, and a reservoir having valve means operable to connect it alternately to said pump and to said motor, and

bracket means mounting said pump and reservoir on said handle.

4. The combination with a ratchet wrench having a nut socket receiving spindle, a handle, and ratchet mechanism including a rotatable ratchet member interconnecting said handle and spindle, of a fluid pressure motor having a reciprocable piston, means connected with said piston and member for oscillating said member in one rotational direction in response to the power stroke of said piston, a spring biasing said member and thereby said piston for movement in an opposite direction in response to the exhaust stroke of said piston, valve means responsive to movement of said piston to the end of its power stroke for connecting said motor to an exhaust for the exhaust stroke of said piston, and a manually operable pump for supplying fluid pressure to said motor.

5. The combination with a ratchet wrench having a nut socket receiving spindle, a handle, and ratchet mechanism including a rotatable ratchet member interconnecting said handle and spindle, of a fluid pressure motor having a reciprocable piston, means connected with said piston and member for oscillating said member in one rotational direction in response to the power stroke of said piston, a spring biasing said member and thereby said piston for movement in an opposite direction in response to the exhaust stroke of said piston, an exhaust valve for said motor, and means interconnecting said valve and rotatable ratchet member for closing said exhaust valve at one end of oscillating movement of said member and for opening said exhaust valve at the other end of oscillating movement of said member.

6. The combination with a ratchet wrench having a nut socket receiving spindle, a handle, and ratchet mechanism including a rotatable ratchet member interconnecting said handle and spindle, of a fluid pressure motor having a reciprocable piston, means connected with said piston and member for oscillating said member in one rotational direction in response to the power stroke of said piston, a spring biasing said member and thereby said piston for movement in an opposite direction in response to the exhaust stroke of said piston, an exhaust valve for said motor, means interconnecting said valve and rotatable ratchet member for closing said exhaust valve at one end of oscillating movement of said member and for opening said exhaust valve at the other end of oscillating movement of said member, a fluid pressure supply conduit, a control valve controlling the connection of said conduit with said motor, and means responsive to opening of said exhaust valve for closing said control valve.

7. The invention defined in claim 6 characterized by said last named means including a pressure chamber, an operating stem for said control valve having a portion thereof positioned in said chamber, a stuffing box through which the outer end of said stem extends and is slidable, the outer end of said stem being subjected to atmospheric pressure, and a spring acting on the outer end of said stem and biasing said control valve to its closed position.

8. The combination with a ratchet wrench having a nut socket receiving spindle, a handle, and ratchet

mechanism including a rotatable ratchet member interconnecting said handle and spindle, of a fluid pressure motor having a reciprocable piston, means connected with said piston and member for oscillating said member in one rotational direction in response to the power stroke of said piston, a spring biasing said member and thereby said piston for movement in an opposite direction in response to the exhaust stroke of said piston, an exhaust valve for said motor, means interconnecting said valve and rotatable ratchet member for closing said exhaust valve at one end of oscillating movement of said member and for opening said exhaust valve at the other end of oscillating movement of said member, a fluid pressure supply conduit, a control valve controlling the connection of said conduit with said motor, means responsive to opening of said exhaust valve for closing said control valve, and means connected to one of the operating parts of said system for opening said control valve subsequent to closure of said exhaust valve.

9. The invention defined in claim 8 characterized by said last named means comprising an actuating pin connected to said piston.

10. The combination with a ratchet wrench having a nut socket receiving spindle, a handle, and ratchet mechanism including a rotatable ratchet member interconnecting said handle and spindle, of a fluid pressure motor having a reciprocable piston, means connected with said piston and member for oscillating said member in one rotational direction in response to the power stroke of said piston, a spring biasing said member and thereby said piston for movement in an opposite direction in response to the exhaust stroke of said piston, an exhaust valve for said motor, an operating stem having a connection at one end to said valve and a slot at its other end, and an operating pin connected to said member for oscillation therewith and projecting through said slot for actuating said stem to close said valve at one limit of oscillation thereof and to open said valve at the other limit of oscillation thereof.

11. The combination with a ratchet wrench having a nut socket receiving spindle, a handle, and ratchet mechanism including a rotatable ratchet member interconnecting said handle and spindle, of a fluid pressure motor having a reciprocable piston, means connected with said piston and member for oscillating said member in one rotational direction in response to the power stroke of said piston, a spring biasing said member and thereby said piston for movement in an opposite direction in response to the exhaust stroke of said piston, valve means responsive to movement of said piston to the end of its power stroke for connecting said motor to an exhaust for the exhaust stroke of said piston, and a spring-biased valve for limiting the pressure within said motor acting against said piston.

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