This invention relates to improvements in hydraulic power devices of the rotary type adapted for drills, although not limited to such use.

Among the objects of my invention is to provide an improved construction, including a detachable motor and valve mechanism on the main casing, to facilitate assembly and disassembly of the parts.

A further object is to provide a new and improved power device of the portable type having an improved form of hand-grip and trigger device for controlling the operation or reversal of the motor by the thumb and fingers of one hand.

A still further object of the invention is to provide an improved form of connection between the motor and the rotary tool-holding member.

Other objects of my invention will appear from time to time as the following specification proceeds and, with reference to the accompanying drawings, wherein:

Figure 1 is a fragmentary longitudinal section of a drilling apparatus constructed in accordance with my invention, taken substantially along the axis of the drill chuck, and showing the fluid control valve and its operating lever, showing the valve in an open position for rotating the drill motor in one direction;

Figure 2 is a fragmentary section taken substantially along line 2—2 of Figure 1;

Figure 3 is a fragmentary detailed section of the fluid control valve and its operating lever, showing the valve in an open position for rotating the drill motor in one direction;

Figure 4 is a view similar to Figure 3, but showing the valve in position for rotating the drill motor in the opposite direction from that shown in Figure 3;

Figure 5 is a fragmentary end view of the drill, with parts of the motor shown in section generally along the axis of the drill chuck;

Figure 6 is a detailed section taken on line 6—6 of Figure 2; and

Figure 7 is a detailed section taken on line 7—7 of Figure 2.

Referring now to details of the embodiment of my invention illustrated in the drawings, a drilling apparatus includes a main casing 10 having a drill chuck 11 rotatably mounted in a bore 12, opening to the front face of said casing. Said chuck includes a socket member 12a fixed on a squared end 13 of a shaft 14 to receive the rear squared end of a drill 15, which may be a well-known form of spiral drill using a drill bit (not shown) on its forward end. The shaft 14 has a reduced intermediate portion 16 journalled in an antifriction bearing 17 and a splined rear end portion 18 engaged within a hub 19 of an enlarged cup-shaped internal gear 20 journalled in an antifriction bearing 21. The internal gear 20 is recessed in an enlarged counterbore 22 opening to the rear face of the main casing 10, as shown in Figure 1.

The main casing 10 is provided with two lateral projections 25 and 26 integral therewith and forming connections for opposed handle members 27 and 28, respectively. One of the lateral projections 25 is longer than the other and has an elongated recess 29 opening to the rear face of the housing for reception of a control valve block 30, which will be hereinafter more fully described.

The handle member 27 is connected to the shorter projection 25 may be of any suitable form for holding by one hand. As shown herein, said handle member consists of a tubular pipe 32 fixed in a base 33 suitably connected to the projection 25 by cap screws 34.

The handle member 28 has a hand grip 35 at its outer end, herein consisting of a rectangular frame formed of a relatively large rear member 36, generally convex in cross-section, for engagement in the palm of the hand, and smaller end and front frame members 37 and 38, all integral with a hollow base 39. The base 29 has a pair of opposed flanges 40, 41 detachably connected to the adjacent end of the projection 26 of main casing 10 as by cap screws 42, 43.

A fluid motor of the gear type, indicated generally at 50, is wholly supported on a rear plate 51 which encloses the recess 22 housing the internal gear 20. The drill motor 50 has a drive rotor 52 with its teeth meshing with the teeth of an idler rotor 53. The drive rotor 52 has an integral shaft 54 journalled in the rear plate 51 on suitable roller bearings 55 and 56. The rotor shaft 54 has a pinion 57 fixed on its forward end for engagement with the teeth of the internal gear 20. The idler rotor 53 has a shaft 58 journalled in the rear plate 51 on roller bearings 59 and 61.

In the preferred form shown herein, the motor 50 includes a pair of thin bearing plates 65 and 66 in engagement respectively with the front and rear faces of the drive rotor 52 and the idler rotor 53. An intermediate spacer 57 surrounds said rotors, between said bearing plates, and a cover plate 60 is engaged with the outer face of the bearing plate 56. The outer ends of the rotor bearing shafts are journalled in said cover plate. The bearing plates 65, 66, the spacer 57 and the cover plate 60 are all detachably secured to the main portion of the rear plate 51 as by cap screws 62, 63.

The rear plate 51 includes a laterally elon-
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gated portion 76 formed integrally therewith and extending the full length of the lateral projection 26 of the main casing 10 so as to enclose the recess 29 in the latter. The rear plate 51 is detachably secured to the casing as by a plurality of cap screws 11, 11.

The control valve block 83 is detachably connected to the inner face of the rear plate portion 76 as by a plurality of cap screws 72, 72. When assembled in position, the control valve block is fully enclosed in the recess 29 of casing 10, but is wholly supported on the rear plate portion 76.

The valve block has a longitudinal bore 73, therein, in which is slidably mounted a piston valve member 74 of the spool type for controlling the supply of liquid to the motor 59 through ducts 75 and 77 formed in the rear plate 51 and communicating between said motor and valve ports 80 and 81 in the valve block 83. The valve ports 80 and 81 are formed by drilled passageways 80a and 81a, opening respectively into the side of annular grooves 82 and 84, spaced along the longitudinal bore 73 of the valve block, as seen in Figures 2, 5, and 7. The lowermost valve port 81 is connected to the motor 59 in common with port 81, 28 second port 89 connected to the motor 59, as previously described. The valve spool 77 is connected through a thimble suitably fixed at the outer end of the valve to rotate in the valve port 89. The valve spool 77 is controlled through a valve stem 110 connected to its outer end and projecting through a thimble 111 suitably fixed at the outer end of the valve block 30. A coil spring 112 surrounds the stem 110 between the outer end of the spool and the end of the thimble 111. Said spring is of such tension as to maintain the spool in its neutral or bypassing position, as shown in Figures 1 and 2, and to return said spool to said neutral position unless the spool is positively moved inwardly or outwardly by the manually controlled trigger means, to be presently described more fully.

Figure 3 shows the valve spool 74 moved to the position for supplying fluid under pressure to the duct 76 for rotating the rotor shaft 54 in counterclockwise direction, as seen in Figure 2. In this position of the valve spool, land 104 shuts off direct communication between inlet port 91 and outlet port 98, and fluid from inlet port 97 passes downwardly along the spool between the two intermediate lands 104 and 103 and thence outwardly through port 89 to the duct 76 leading to one side of the motor 59. The duct 77 returning the fluid from the opposite side of the motor 59 communicates with port 81 which is then connected to the opposite side of the land 104 so that the returning fluid will pass along the spool into groove 85 and thence into the outlet port 98.

Figure 4 shows the valve spool moved to the opposite direction so as to complete circulation through the ducts 71 and 76 in the opposite direction and drive the drill motor in a clockwise direction. In this position, the land 103 is moved to close communication between the inlet port 91 and the port 90 leading to the duct 75, and land 104 is moved to close direct communication from inlet port 97 to outlet port 98. Fluid from the inlet port then passes through the port 81 and duct 71. Fluid returning through the duct 76 passes through port 89 into cross-passages 107, thence through the center bore 105 and thence out of cross-passages 108 in the opposite end of the spool into groove 85 which communicates directly with the outlet port 98.

The duct 78 previously mentioned as connecting the ports 92 in the valve block with bore 90 and recess 22 for permitting fluid to return to the system of any liquid which may escape by leakage from the rotors, also communicates with drilled passageways 115 and 116 extending the full length of the rotor shafts 54 and 59, respectively so as to afford free communication between opposite ends of said rotor shafts and balance any pressures which may develop along said shafts. As will be seen from Figure 1, the inner end of the drive rotor shaft 54 is open to the interior of the internal gear 20 within the recess 22 so as to be in continuous communication with the duct 79 through bore 90. The inner end of the idler rotor shaft 59 is also in continuous communication with the duct 79 through the same bore 90. The port 81 communicates through port 82 into the annular groove 86 leading directly to the outlet port 98. As will be seen from Figures 1, 2, and 3, the port 82 is never closed by the spool valve in any operative position of the latter, so that any excess pressure developed through leakage in the motor will be drained off through duct 79 and returned to the pressure supply line. At the same time, the interior of the recess 22 and other parts adjacent the rotors will be constantly supplied with fluid under a slight pressure, depending upon the...
amount of back pressure effective from the outlet port 98.

A packing gland 117 of any suitable form is provided in the reduced portion of the bore 12 to prevent escape of fluid from the counterbored recess 32 and the front end of the connecting bore 12. In the form shown, said packing gland surrounds the hub 10 of the internal gear 20.

A seal ring 118 may surround the shaft 14 outside the anti-friction bearing 17 for retaining lubricant in the latter.

Referring now to the improved form of hand grip and trigger device for controlling the operation of reversal of the drill by the thumb and fingers of one hand while the device is in use, the outer end of the valve stem 110 is provided with an eye 120 within which a terminal ball 121 on a short lever arm 122 is engaged. The lever arm 122 is pivotally mounted on a pivot pin 123 carried on the hollow base 39 close to the path of longitudinal movement of the valve stem 110. The lever arm 122 has two trigger arms 124 and 125 connected thereto. The first trigger arm 124 is disposed approximately at a right angle to the lever arm 122, while the second trigger arm 125 is disposed at an angle of approximately 180 degrees to the lever arm 122.

The first-named trigger arm 124, herein shown as formed on a slight curve simulating the trigger of a gun, is arranged so that when the valve spool 74 is in its neutral position, as shown in Figures 1 and 2, the free end of said curved trigger projects slightly into the rectangular opening formed by the handle portions 36, 37, 38, and along the inner side of the palm-engaging portion 36. To move the valve spool to one operative position, the curved trigger 124 is depressed by the forefinger of the hand which normally grips the palm-engaging portion 36. The lever mechanism will be rocked bodily on its pivot 126 until the curved trigger 124 is moved into the recessed under face 126 of the palm-engaging grip part 36, as shown in Figure 3. By maintaining pressure on the trigger 124 by the forefinger, the valve will be retained in position to drive the drill in counter-clockwise direction.

The second trigger arm 125, herein shown as substantially straight, projects rearwardly through a slot 127 in the base 39 in position to be engaged by the thumb of the hand holding the grip member 35. When it is desired to set the valve spool in position to cause rotation of the drill in a clockwise direction, the thumb may be used to depress the trigger arm 125 into the position shown in Figure 4.

As previously described, the valve stem 110 is normally controlled by the coil spring 112 and the valve is hydraulically balanced to return the valve to its neutral position, so that the valve is normally neutral seeking when pressure on either trigger arm is released. The trigger arms 124 and 125 can also be manipulated to aid in positioning the valve in its neutral position when desired, or necessary due to failure of the spring 112.

The inlet and outlet pipes 96 and 97 connected to the valve block 30 extend through slots 130 and 131 opening to the rear of the hollow lateral projection 28 (see Figures 2, 6 and 7).

Thus, the rear plate 51, with motor 20 and valve block 30, can be bodily removed from the casing 10 and operated for testing independently of the casing 10 and the parts mounted thereon, without disturbing any of the hydraulic connections therewith or the connections to the supply pipes.

While I have herein shown and described one form in which my invention may be embodied, it will be understood that the construction thereof and the arrangement of the various parts may be altered without departing from the spirit and scope thereof. Furthermore, I do not wish to be construed as limiting my invention to the specific embodiment illustrated, excepting as it may be limited in the appended claim.

I claim as my invention:

In a hydraulic power device, a casing including a central tool supporting body portion and handle supporting projections at opposite sides of said central body portion, one of said projections being provided with an elongated recess opening through one side and the end thereof, a fluid motor supporting plate removably secured to one side of said casing and including an extension overlying said recess at said side of the said one projection, a hydraulic motor supported on said plate with fluid supply passages therefrom extending along said extension, a valve block having ports communicating with said fluid supply passages removably secured to said extension and supported in said recess and having an open ended bore therein opening through the open end of said recess, a handle member removably secured to the end of said one projection and being provided with an aperture aligned with said bore, a reciprocable valve for controlling the direction of fluid flow through said supply passages and valve block disposed within said bore and having a stem projecting through the open end of said recess and said aperture, and finger engageable valve operating means supported by said hand and operatively engaged with said stem.

JOSEPH J. SLOMER.

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